Pregnancy-related Pelvic Girdle Pain in Nulliparous Women in Ireland: a Longitudinal Mixed Methods Study

PhD Thesis

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Francesca Wuytack

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Summary

Background: Pregnancy-related pelvic girdle pain (PPGP) is a common condition and may persist postpartum, but its prevalence, risk and prognostic factors were not known in an Irish setting. Moreover, the impact of persistent PPGP on women's lives had not yet been explored.

Design: A longitudinal mixed methods study.

Aim: To identify the prevalence and factors associated with PPGP antenatally and up to 12 months postpartum in nulliparous women in Ireland, and to explore the experiences and health-seeking behaviours of women with persistent PPGP postpartum.

Setting: One large urban maternity hospital in Ireland. (This is one of the three MAMMI study sites.)

Sample: A preliminary sample of 1478 women (of the final sample of 2600 women) were recruited in early pregnancy, of whom 23 women also took part in an interview.

Methods: Site hospital and university ethical approval were granted. This partially mixed, sequential, equal status design study had an initial quantitative phase (1), followed by a qualitative phase (2). Women aged 18 years or older who were able to read and understand English were recruited to phase 1 of the study, which involved completing a self-administered survey in early pregnancy, and 3, 6, 9 and 12 months postpartum. PPGP was assessed using a pain diagram, and the Pelvic Girdle Questionnaire was included in the final two surveys. The prevalence of PPGP and persistent PPGP were examined at each follow-up point. Risk factors and prognostic factors for PPGP were assessed using multivariable logistic regression. From the sample of phase 1, 23 women who had persistent PPGP for at least three months postpartum took part in an individual semi-structured interview in phase 2 of this study. The interview data were analysed using thematic analysis.

Results: Period prevalence of PPGP was 60.1% in early/mid pregnancy and 69.7% in the last month of pregnancy, with posterior PPGP being most common, followed by combined anterior and posterior PPGP, and anterior PPGP. In the first three months postpartum, 68.8% of women had persistent PPGP. This dropped to 51.2%, 3 to 6 months postpartum, 40.5%, 6 to 9 months postpartum, and 33.3%, 9 to 12 months postpartum.

Women aged 35 or older were less likely to have PPGP in early/mid pregnancy (OR 0.7, 95% CI 0.5-0.9, p=0.02) and in the last month of pregnancy (OR 0.4, 95% CI 0.2-0.8, p=0.04). Women who were obese or very obese were at greater risk of having PPGP (OR 2.1, 95% CI 1.4-3.3, p=0.001). A history of any lumbopelvic pain in the year before becoming pregnant was also strongly associated with PPGP in early/mid pregnancy (OR 5.6, 95% CI 4.3-7.2, p<0.001) and in the last month pregnancy (OR 2.6, 95% CI 2.0-3.4, p<0.001).

Women who were obese or very obese were more likely to have persistent PPGP in the first three months postpartum (OR 2.3, 95% CI 1.2-4.4, p=0.01), 3 to 6 months postpartum (OR 1.9, 95% CI 1.1-3.4, p=0.02), 6 to 9 months postpartum (OR 2.5, 95% 1.4-4.5, p=0.003), and 9 to 12 months postpartum (OR 3.1, 95% CI 1.7-6.0, p<0.001). Women with a history of any lumbopelvic pain before pregnancy were also significantly more likely to have persistent PPGP 0 to 3 months after the birth (OR 2.4, 95% CI 1.7-3.4, p<0.001), and women with any pelvic girdle pain in the year before pregnancy were more likely to have persistent PPGP 3 to 6 months postpartum (OR 2.5, 95% CI 1.7-3.5, p<0.001), 6 to 9 months (OR 3.5, 95% CI 2.4-5.1, p<0.001), and 9 to 12 months postpartum (OR 3.7, 95% CI 2.4-5.8, p<0.001). Compared to women who had anterior PPGP during pregnancy, women with posterior PPGP were more likely to have persistent PPGP 0 to 3 months (OR 2.0, 95% CI 1.0-3.9, p=0.04) and 3 to 6 months postpartum (OR 2.4, 95% CI 1.1-5.1, p=0.02). Women with combined anterior and posterior PPGP during pregnancy were more likely to have persistent PPGP at all four follow-up periods (0-3 months (OR 3.4, 95% CI 1.6-7.3, p=0.001); 3-6 months (OR 4.0, 95% CI 1.8-9.4, p=0.001); 6-9 months (OR 4.2, 95% CI 1.4-12.5, p=0.009); 9-12 months postpartum (OR 4.5, 1.0-21.6, p=0.05)). Women with a history of severe period pain before pregnancy were more likely to have persistent PPGP in the first three months after birth (OR 1.5, 95% CI 1.0-2.1, p=0.04), and not having a university qualification was associated with persistent PPGP 6 to 9 months postpartum (OR 1.6, 95% CI 1.0-2.6, p=0.04). Stress in the first three months postpartum was associated with persistent PPGP 6 to 9 months (OR 2.4, 95% 1.2-4.8, p=0.01) and 9 to 12 months postpartum (OR 3.4, 95% CI 1.6-7.2, p=0.001). On the other hand, women who gave birth by vacuum/kiwi were less likely to have persistent PPGP in the first three months postpartum (OR 0.5, 95% CI 0.3-0.9, p=0.02) and 3 to 6 months postpartum (OR 0.4, 95% CI 0.3-0.8, p=0.004). Women on unpaid maternity leave were also less likely to experience persistent PPGP 9 to 12 months postpartum (OR 0.3, 95% CI 0.09-1.0, p=0.04).

In phase 2, six themes emerged about the experiences of women with persistent PPGP. Women 'put up with the pain' but had to balance activities and were grateful for support from family and friends to face everyday challenges. They described different strategies they used to deal with their symptoms, although many were not sure about what to do or who to see. They 'did not feel back to normal' and described feelings of physical limitations, frustration, and a negative impact on their mood. 'They didn't ask, I didn't tell' was another theme, in which they expressed a perceived lack of follow-up postpartum, and feelings of being ignored by healthcare professionals. The theme 'Seeking advice and support' described women's role of talking to others, and triggers and barriers to getting help. Persistent symptoms were 'unexpected' for women due to a lack of information given about PPGP postpartum. Finally, women were uncertain about how their symptoms would progress, and they expressed worry about having another baby in the theme 'What next?'.

Conclusion: PPGP is a common maternal morbidity affecting more than half of women during pregnancy. Findings call into question the length of postnatal care, since about a third of women with PPGP continued to have persistent symptoms a year after the birth. In Ireland, PPGP is underreported during pregnancy and postpartum. Including questions concerning PPGP in routine antenatal and postnatal care, and adequate information and advice throughout, may identify women at increased risk and address the perceived lack of follow-up.

Summary of contribution of the study to knowledge about PPGP:
This study contributed to knowledge concerning PPGP in several ways: (1) The systematic review that was undertaken in preparation of this study provides a unique rigorous overview of existing literature on risk and prognostic factors for PPGP; (2) This study is the first to provide national data in Ireland about the prevalence of, and risk and prognostic factors for, PPGP; (3) This study gives an in-depth account of the experiences and health-seeking behaviours of women with persistent PPGP.

List of abbreviations

ASLR test: Active Straight Leg Raise test

BMI: Body Mass Index

CI: Confidence Interval

DASS: Depression, Anxiety, Stress Scale

EPDS: Edinburgh Postnatal Depression Scale

FAM: Fear Avoidance Model

GCT: Gate Control Theory

GP: General Practitioner (family doctor)

GRADE: Grading of Recommendations Assessment, Development and Evaluation

MAMMI study: Maternal health And Morbidities in Ireland study

PGS: Pelvic Girdle Syndrome

PHN: Public Health Nurse

PLBP: Pregnancy-related Low Back Pain

PLPP: Pregnancy-related LumboPelvic Pain

PPGP: Pregnancy-related Pelvic Girdle Pain

PROGRESS: PROGnosis RESearch Strategy

QUANT: Quantitative

QUAL: Qualitative

QUIPS: Quality In Prognosis Studies tool

VAS: Visual Analogue Scale

4P test: Posterior Pelvic Pain Provocation test

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Chapter 1 Introduction

1.1 Introduction

In this first chapter, the topic of Pregnancy-related Pelvic Girdle Pain (PPGP) is introduced in terms of its impact in Ireland. The background also gives an overview of the Maternal health And Maternal Morbidities in Ireland (MAMMI) study, of which this PhD study was one strand of. Subsequently, the rationale for this PhD study (Section 1.3) and the research aim and objectives (Section 1.4) are outlined. In section 1.5, issues of terminology concerning PPGP are addressed and the terminology used throughout this thesis is described. A more in-depth account of the literature concerning PPGP is further described in chapter two and chapter three. Finally, in Section 1.6, an overview of all eight chapters of this thesis is presented.

1.2 Background: Maternity care in Ireland and the impact of Pregnancy-related Pelvic Girdle Pain as a maternal morbidity

In Ireland, maternity care is provided jointly by the general practitioner (GP) and maternity hospital. This scheme also includes postnatal care, which typically consists of two visits with the GP at two and six weeks postpartum, and visits from a public health nurse within these six weeks (HSE 2013). This six to eight week length of postnatal care is comparable to many other countries such as the UK and the USA (Southfield (MI): Michigan Quality Improvement Consortium 2012, NICE 2014).

Numerous morbidities related to pregnancy and birth have been reported internationally (MacArthur *et al.* 1991, Schytt *et al.* 2005, Schytt & Waldenstrom 2007, Gartland *et al.* 2010, Shinkawa *et al.* 2012); however, in Ireland the morbidities experienced by women during pregnancy and after birth had not been studied to any great extent. The MAMMI (Maternal health And Maternal Morbidity in Ireland) study was launched in February 2012 to address this deficit by exploring the health and health problems experienced by first-time mothers during pregnancy and the first year postpartum in a cohort of nulliparous women.

Pregnancy-related Pelvic Girdle Pain is a common complaint during pregnancy (Shinkawa *et al.* 2012). In Ireland, the number of women diagnosed with PPGP has been increasing. In 2014, at the Rotunda Hospital (site hospital of this study) alone, 1206 (11.1% of 10814) women were referred to physiotherapy services for PPGP or PLBP (The Rotunda Hospital 2014), compared to 1092 (10.5% of 10314) in 2013 (The Rotunda Hospital 2013). In 2012, around 600 of 10397 (5.8%) women attending the hospital were referred for PPGP (The Rotunda Hospital 2012). This is not unique to this hospital and a similar trend has been reported in other hospitals. The Coombe Women & Infants University Hospital reported that the number of referrals to the physiotherapy department for PPGP continues to rise, reaching 200 per month in 2013 (Coombe Women & Infant University Hospital 2013). The National Maternity Hospital observed a similar increase in referrals, with PPGP accounting for 47% (n=2723) of obstetric referrals to the physiotherapy department, and spinal problems being the second most common reason for referral (19%) (The National Maternity Hospital 2012).

Despite this increasing trend of reporting of PPGP in Ireland, it is still likely to be underreported, and the true prevalence of PPGP and of persistent PPGP postpartum were unknown. National clinical guidelines recommend out-patient physiotherapy for the management of PPGP and persistent PPGP postpartum, with individualised assessment and treatment focussing on stabilising exercises and movement advice, and possibly including multidisciplinary interventions if physical interventions fail (Hogan *et al.* 2012). However, delivering such individual care requires resources that need to be allocated based on knowledge of the impact of PPGP in Ireland. Moreover, PPGP may persist beyond the 6-8 weeks postnatal care with data from other countries suggesting that 8-10% of women continue to have symptoms 18-24 months after the birth (Albert *et al.* 2001, Rost *et al.* 2006). In Ireland, there is no connectivity between maternity hospital records and records of any care that women might receive later on, leaving a knowledge gap concerning any help women with persistent PPGP seek.

This study is the PPGP strand of the MAMMI study (Figure 1-1) and examines PPGP in first-time mothers as a maternal morbidity in the wider context of maternal health in Ireland.

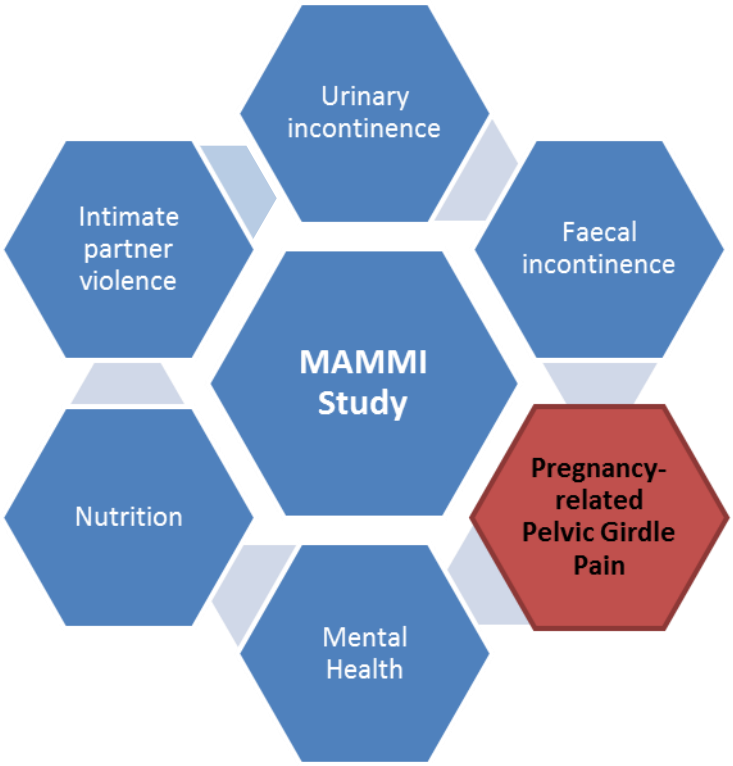

Figure 1-1 Overview of the MAMMI study strands

1.3 Rationale for the study

As a practising chiropractor, I had an existing interest in pelvic girdle pain and understood the need for research in this area.
The rationale for this study was two-fold:

Firstly, in Ireland, research investigating the prevalence and impact of PPGP during pregnancy and postpartum were absent. National differences in maternity care services and socio-economic differences could impact the prevalence, supporting the importance of obtaining national data. National data can provide a basis for assessing interventions and policies. Moreover, the rising PPGP physiotherapy referrals in maternity hospitals across Ireland and the high prevalence of PPGP overseas provide a strong rationale for obtaining national data. In addition, there is no clear consensus on risk and prognostic factors for PPGP in the literature (Chapter 3). The Prognostic

Research Strategy (PROGRESS) emphasises the importance of research on prognostic factors to provide information to inform clinical practice, guide treatment choices, and develop new interventions (Riley *et al.* 2013). The authors of PROGRESS recommend that once potential prognostic factors have been identified, replication in multiple independent studies is key. Prognostic factors can then be brought together in prognostic models to predict the risk of future clinical outcomes in individuals (Steyerberg *et al.* 2013). The term 'prognostic studies' is used to refer to clinical studies of variables predictive of future events as well as studies examining risk factors (Altman 2001). Similarly, this study examined both risk and prognostic factors for PPGP in Ireland.

Secondly, the experiences and health-seeking behaviours of women who have PPGP that persists postpartum had not yet been explored internationally, leaving an important knowledge gap. In-depth information from the women's perspective concerning their experiences and health-seeking behaviours can present useful data to provide a basis for optimising maternity care related to PPGP during pregnancy and postpartum.

1.4 Aim and Research Objectives of the study

This study intended to address the issues described in section 1.3 and examined the impact of PPGP on women in pregnancy and postpartum in Ireland through the following aim and objectives:

The **aim** was to identify the prevalence and factors associated with PPGP antenatally and up to 12 months postpartum in nulliparous women in Ireland, and to explore the experiences and health-seeking behaviours of women with persistent PPGP postpartum.

The research **objectives** were:

(1) To identify the existence and prevalence of self-reported PPGP during pregnancy and 0-3, 3-6, 6-9 and 9-12 months postpartum in 1478[1] nulliparous women in Ireland

(2) To identify pre-pregnancy risk factors for self-reported PPGP in (a) early/mid pregnancy and (b) the last months of pregnancy

(3) To identify pre-pregnancy, pregnancy-related, birth-related and postnatal prognostic factors for self-reported PPGP that persists 0-3, 3-6, 6-9 and 9-12 months postpartum

(4) To explore women's experiences with regard to the impact of self-reported persistent PPGP postpartum on their life, in particular on the care of their infant and parental role

(5) To explore the health-seeking behaviours of women with PPGP that persists postpartum.

Objectives 1 to 3 were predominantly examined in the quantitative phase (1), and objectives 4 and 5 in the qualitative phase (2); however, there was some overlap because this was a mixed methods study.

1.5 Terminology

A great variety of terms have been used to describe somatic pain of the pelvic girdle but, since the publication of the European guidelines on pelvic girdle pain (Vleeming *et al.* 2008) there has been more consistency in the terminology used. A key development in the past decade is the differentiation between low back pain and pelvic girdle pain as two different entities that may or may not co-exist. Although the prevalence of both low back and pelvic girdle pain increase during pregnancy (Kovacs *et al.* 2012), pelvic girdle pain is particularly linked to pregnancy in that it often commences at that time and is more common in women than in men. Low back pain on the other hand tends to drop to its pre-pregnancy prevalence postpartum and its prevalence is similar in males (Vleeming *et al.* 2008). Women with Pregnancy-related Pelvic Girdle Pain (PPGP) also have greater

[1] This consisted of a preliminary sample of 1478 women who gave birth on or before 31st July 2014 of the 1600 women recruited in the site hospital, and of the total of 2600 women to be recruited at the three study sites.

functional impairment and are less responsive to back school treatment than patients with Pregnancy-related Low Back Pain (PLBP), thus supporting the need for distinguishing between the two (Wu *et al.* 2004). Although pelvic girdle pain can occur in males and specific pathologies including pelvic dislocation, pubic symphysis rupture, osteitis pubis, osteitis condensans ili, and infective or inflammatory sacroiilitis can also produce pain of the pelvic girdle (Vleeming *et al.* 2008), both low back and pelvic girdle pain are pain syndromes i.e. they are of a mechanical nature and do not have a clear cause, hence the terms do not unreasonably refer to any pathology. In the past, the term 'non-specific' has sometimes been used to describe low back pain that it is not attributed to a recognisable, known pathology; however, this term does not tend to be used in the pelvic girdle pain literature.

With regards to pain localisation, the following topographical areas correspond to where pain symptoms are most commonly experienced in low back and pelvic girdle pain (Figure 1-2):

Low back pain

In *low back pain*, pain is experienced between the inferior costal margin and the posterior iliac crest (Ostgaard *et al.* 1991a).

Pelvic girdle pain

In *pelvic girdle pain*, pain is experienced between the posterior iliac crest (inferior to L5) and the inferior gluteal folds, particularly in the vicinity of the sacroiliac joints. The pain may radiate in the posterior thigh and can also occur in conjunction with/or separately in the symphysis (Vleeming *et al.* 2008).

Lumbopelvic pain

Lumbopelvic Pain includes pain in the areas of the low back and/or pelvic girdle. In other words, it is a term encompassing both low back pain and pelvic girdle pain (Wu *et al.* 2004).

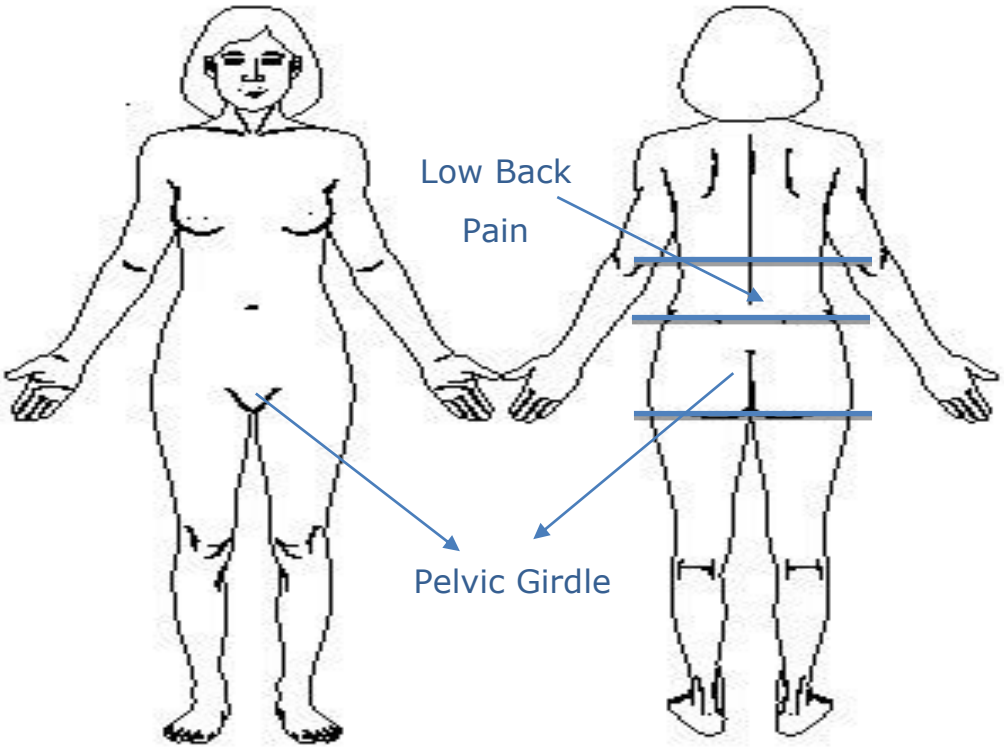

Figure 1-2 Topographical definitions of Low Back Pain and Pelvic Girdle Pain

The prefix '*Pregnancy-related*' then refers to these symptoms being reported during pregnancy.

Mogren & Pohjanen (2005) defined Pregnancy-related Lumbopelvic pain (PLPP) as 'recurrent or continuous pain for more than one week from the lumbar spine or pelvic girdle during pregnancy'; however, this time-frame was chosen arbitrarily and for the present study no required symptom duration was applied and any pain that women experienced during pregnancy in the above described pelvic girdle areas was considered PPGP. Gutke *et al.* (2006) described PPGP as pelvic girdle pain arising during pregnancy or up to three weeks after birth, but one can argue that if pelvic girdle pain starts postpartum, other factors may play a role, including birth-related factors and activities related to the care of the infant. Therefore, it is relevant not to include them under the term 'Pregnancy-related Pelvic Girdle Pain'. If a woman reported PPGP during pregnancy and had persistent symptoms postpartum, this was defined in this study as '*persistent PPGP*'.

In some literature, posterior pelvic girdle pain is considered a subgroup of low back pain, whereby low back pain is described as pain from the inferior costal margin to the inferior gluteal fold with possible referral down the leg (Ostgaard & Andersson 1992, Noren *et al.* 2002, Waddell 2004, van Tulder *et al.* 2006). However, there seems to be a growing consensus more recently to use the terms low back and pelvic girdle pain as two different entities both contained in lumbopelvic pain (Gutke *et al.* 2010), particularly since pelvic girdle pain also includes anterior pelvic girdle pain (pubic symphysis pain), which does not fit under the term low back pain. Hence, the terminology used for this study differentiates pelvic girdle pain from low back pain and focusses on PPGP, defined as pelvic girdle pain during pregnancy (Figure 1-3).

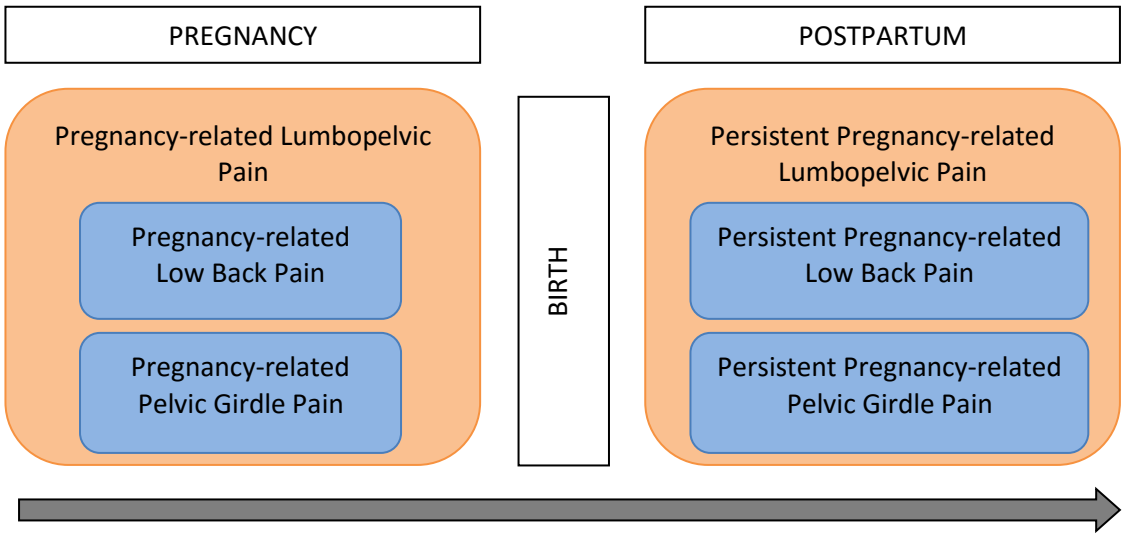

Figure 1-3 Overview of the terminology used in this thesis

Apart from distinguishing between PPGP, PLBP and PLPP (Gutke *et al.* 2010), Albert *et al.* (2002) propose a further classification of PPGP into one of five syndromes according to pain location including Pelvic Girdle Syndrome (PGS), Symphysiolysis, One-sided Sacroiliac syndrome, Two-sided Sacroiliac syndrome and Miscellaneous.

This model of classifying PPGP was adapted for the purpose of this study into three groups of PPGP: (a) women having *Anterior PPGP* defined as pain experienced in the pubic symphysis area, (b) *Posterior PPGP*, which includes pain between the posterior iliac crest and inferior gluteal fold, or (c) *combined anterior and posterior PPGP*.

1.6 Overview of the thesis

This thesis consists of eight chapters. Each chapter has an introduction that sets the chapter in the wider context of the thesis, and a conclusion to summarise to key elements of the chapter.

Chapter one has described the rationale for this study in both the Irish and international context and has specified the aim and objectives. Moreover, it has outlined the broader context of the study as part of the MAMMI study and has explained issues concerning terminology, which are important to be addressed at the start of this thesis to provide clarity throughout.

Chapter two contains a more detailed review of the literature specifically related to PPGP. Background information is provided, including current knowledge regarding the aetiology and prevalence of PPGP, what factors are associated with PPGP, and how women experience PPGP.

Chapter three adds to chapter two and consists of a systematic review and meta-analysis of the literature on risk and prognostic factors for PPGP. The results of this systematic review were used to guide what factors to assess as potential risk and prognostic factors in phase 1 (quantitative) of this study (Chapter 6).

In Chapter four, the broader theoretical framework of this study is outlined, which includes pain theory and early motherhood theory. This framework is used to interpret and discuss the results of this study (Chapters 6-8).

Chapter five consists of a detailed description of this study's paradigm and design, including the rationale for choosing a Mixed Methods approach. The methods used in this study are also outlined in detail.

Chapter six is the first of the two chapters presenting the findings of this study. The findings of the quantitative phase (phase 1) are reported and placed in the context of the existing literature concerning risk and prognostic factors for PPGP that was examined in chapter three.

In Chapter seven, the findings of the qualitative phase (phase 2) are presented and discussed in the context of the theoretical framework and other pertinent literature.

Chapter eight is the final chapter of this thesis. First, the findings of the quantitative and qualitative phases are integrated in the discussion. All five objectives of this study are discussed and meta-inferences are drawn. In addition, based on the findings of this study, recommendations are made for maternity care services and future research in relation to PPGP.

1.7 Conclusion

This chapter outlined the rationale, aim and objectives of this study. Pregnancy-related Pelvic Girdle Pain (PPGP) is a common maternal morbidity, but no knowledge existed in Ireland concerning the prevalence of PPGP during pregnancy and postpartum. In addition, little was known about the experiences and health-seeking behaviours of women with persistent PPGP. The next chapter gives a more detailed account of the literature concerning PPGP.

Chapter 2 Literature Review

2.1 Introduction

The purpose of the literature review in a thesis is 'to understand what has been done before' and sets the context of the study (Boote & Beile 2005) (pp3). In section 2.2, the search strategy that was employed to retrieve relevant information is described. Next, important aspects of PPGP are outlined, including issues concerning diagnosis, prevalence, aetiology, associated factors, and women's experiences (Section 2.3). In line with the rationale of this study (Chapter 1, section 1.3), these topics were chosen based on their relevance to provide key background information for examining the impact of PPGP and persistent PPGP, and for understanding (persistent) PPGP to inform management (Figure 2-1). This literature review contains literature published up until July 2014. Any relevant studies published after this date are incorporated in the discussion (Chapter 8).

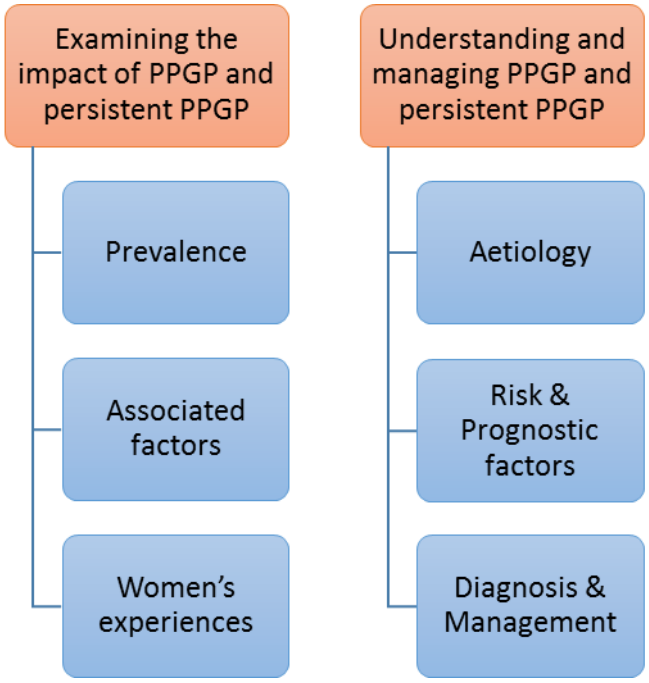

Figure 2-1 Map of the literature review

2.2 Search strategy for Chapter two

Various databases were searched using subject headings/MesH terms and key words to identify relevant literature (Table 2-1). No limits were used in

the database searches. In addition, the following grey literature sources were searched: WHO Reproductive Health Library, HSE Obstetrics and Gynecology Guidelines, website of the Association of Chartered Physiotherapists in Women's Health, conference proceedings of the 13th Low Back and Pelvic Pain International Conference.

Databases
• PubMed • CINAHL • PsycINFO • Maternity and Infant Care • Embase • Cochrane Library
Main search terms (For illustrative purposes; these are not the full search strategies for each individual database; related subject headings/Mesh terms were added for each database)
• Pregnancy OR pregnant OR birth OR childbirth OR postpartum OR postnatal OR antenatal • Pelvis OR pelvic OR low back OR lumbar OR lumbopelvic OR sacroiliac OR pubic symphysis OR symphysis pubis OR symphyseal OR lumbosacral OR sacrococcygeal OR sacrum OR coccyx • Pain OR instability OR dysfunction OR subluxation

Table 2-1 Search strategy for Chapter 2

2.3 Pregnancy-related Pelvic Girdle Pain

2.3.1 Diagnosis & Management

To reach a diagnosis of pelvic girdle pain, the European guidelines recommend that the history and examination should be aimed at determining that the pain is coming from the pelvic girdle and at excluding non-mechanical and lumbar causes. This is achieved by assessing the pain location and carrying out clinical tests to reproduce the pain and assess functional disturbances (Vleeming *et al.* 2008).

Although pain arising from the pelvic girdle is generally experienced in the areas described in section 1.5, the limitation of only using pain location to

distinguish pelvic girdle pain from low back pain, in the absence of a physical examination, relates to the potential of referral of pain distant from its source of origin. In addition, the endurance capacity for standing, walking and sitting in people with pelvic girdle pain is frequently diminished (Vleeming *et al.* 2008); nevertheless, pain is the key symptom in pelvic girdle pain and PPGP.

Gutke *et al.* (2013), presented a proposed set of diagnostic criteria and core outcome set (COS) for pelvic girdle pain at the 2013 World Conference of Low Back & Pelvic Pain (Table 2-2).

Core sets for definition of Pelvic Girdle Pain
Pain location by a pain drawing
Posterior pain provocation by the posterior pelvic pain provocation test (4P test)
Anterior pain provocation by palpation of the symphysis
Severity scored by the Active Straight Leg Raise (ASLR) test

Table 2-2 Core set for definition of Pelvic Girdle Pain (Gutke *et al.* 2013)

This was a significant step in progressing consensus regarding pelvic girdle pain diagnostic criteria and outcomes, but there are some limitations to consider. Firstly, in terms of the Delphi method that was used in developing this set, the study took place within a network of researchers in Norway and Sweden and did not involve international experts until the final (5^{th}) stage, when they were given the opportunity to comment on the findings. Moreover, no patients were involved in the Delphi process and no distinction was made between pelvic girdle pain and PPGP. However, the latter two issues may be more relevant for core outcome set development (Williamson *et al.* 2012) than for agreement concerning a diagnostic set as developing diagnostic criteria requires knowledge of existing clinical tests and PPGP is considered to be pelvic girdle pain related to pregnancy.

Examining the components of this set of criteria for pelvic girdle pain that Gutke *et al.* (2013) proposed, the 4P test is one of the most sensitive (0.81-0.93) and specific (0.80-0.98) tests for posterior PPGP (Ostgaard *et al.* 1994a, Albert *et al.* 2000), but as with all provocation tests for pelvic girdle pain and PPGP, the fact that the aetiology is not known and the lack of a gold standard test, is a clear limitation when investigating the sensitivity and specificity of clinical tests. The ASLR test assesses load transfer through the pelvis and is a measure of one's lumbopelvic stabilisation ability. Although this is important to be evaluated for management purposes and this test has high specificity (0.87) and sensitivity (0.87) for posterior PLPP (Mens *et al.* 2001), it is not diagnostic for isolated pubic symphysis pain and isolated coccygeal pain. More recently, the ASLR test was found to have good specificity (0.88) but only moderate sensitivity (0.54) for all types of PLPP (Mens *et al.* 2012a). The ASLR test is also less diagnostic for isolated low back pain (Mens *et al.* 2012a), which may be useful to distinguish low back and pelvic girdle pain. Mens *et al.* (2001) also found a low correlation (0.27) between the 4P test and ASRL test, and concluded that this may be because the tests measure different aspects. The anterior pain provocation test (palpating the symphysis) on the other hand may not produce pain in women with posterior PPGP, which is the largest group.

Several treatment strategies for PPGP have been examined in existing literature. A Cochrane systematic review on the interventions for preventing and treating low back and pelvic girdle pain during pregnancy (Pennick & Liddle 2013) included 26 randomised controlled trials, of which four examined interventions for PPGP, 11 for PLBP and 11 for PLPP. They found that both acupuncture and exercise, tailored to the stage of pregnancy, were better than usual care in relieving evening pain and improving function in women with PPGP, with acupuncture being superior to exercise. There is also low quality evidence that a rigid belt when added to exercises improves pain but not function. An exercise programme did not reduce women's risk to develop PPGP, but did successfully reduce the risk of women reporting PLPP.

Following the European guidelines on pelvic girdle pain (Vleeming *et al.* 2008), national guidelines were developed in various countries. In Ireland, national guidelines for the management of PPGP during pregnancy and postpartum were produced in 2012 (Hogan *et al.* 2012). In line with the European guidelines, they recommend assessing pain location, aggravating movements/disability, and pertinent questions to rule out other pathologies, in women with suspected PPGP, particularly for the GP and Obstetric Medical team. Treatment and management should then be provided by physiotherapists who also carry out specific clinical tests such as the 4P and ASLR tests.

2.3.2 Prevalence of PPGP and persistent PPGP

Reports on prevalence of PPGP vary greatly from 23%-65%, due to differences in definitions or methods of data collection (Wu *et al.* 2004). The European guidelines on pelvic girdle pain reported a point prevalence for PPGP of about 20%, based on four Scandinavian studies (Vleeming *et al.* 2008). The majority of studies have been conducted in the Nordic countries; however, more recently some studies have been conducted in other European countries and on other continents. Kovacs *et al.* (2012) found a 4-week prevalence of self-reported PPGP of 64.7% in a cohort of 1158 Spanish women between 31-38 weeks pregnant using a questionnaire. In the Netherlands, 60.4% of 182 women had significant PLPP during pregnancy with the majority (92.9%) having PPGP (Mens *et al.* 2012b). Although most prevalence studies were conducted in developed countries, Bjorklund & Bergstrom (2000) found a similar prevalence of PLPP in Tanzania and Zanzibar, compared to Sweden and Finland. Mukkannavar *et al.* (2014) examined the prevalence of pelvic girdle pain in the year after birth in India and found a period prevalence of 43.3% in a cohort of 284 women. In Turkey, 42.3% of 88 women reported having PPGP at the time of birth (Turgut *et al.* 1998).

Although PPGP symptoms often subside after birth, a study in Denmark found that only 63% of women with PPGP were pain free within a month after birth, and daily PPGP persisted in 8.6% of women at two years

postpartum (Albert *et al.* 2002). A more recent study in Sweden found that a third of women still had PLPP three months postpartum; 17% experienced persistent PPGP, 11% had PLBP and 5% had combined pain (Gutke *et al.* 2011). Both these studies included questionnaires and a physical examination to differentiate PPGP from PLBP. Appendix 1 provides an overview of the existing literature on the prevalence of PPGP, PLBP and PLPP during pregnancy and persisting postpartum.

2.3.3 Aetiology

The aetiology of PPGP remains unclear. Several hypotheses are described in the literature, demonstrating the complex and multi-factorial nature of PPGP. These can be generally grouped under two broad categories; biomechanical (section 2.3.3.1) and hormonal aspects (section 2.3.3.2).

2.3.3.1 Biomechanical factors

Topographical & functional anatomy of the pelvis

The pelvic girdle (Figure 2-2) forms a ring-like structure consisting of two innominate bones, joined at the front by the pubic symphysis, and the sacrum, which connects posteriorly to each innominate bone at the sacroiliac joints. The structure of the joints of the pelvis is intimately linked with their biomechanical properties. Historically, the extent and relevance of any movement of the pelvis has been an area of debate. Hippocrates (460-377BC) suggested that the pelvic joints were only mobile during pregnancy, a hypothesis that carried through to the 16th century when also for example Vaesalius thought this to be the case (Bastiaanssen *et al.* 2005), and even in the mid-20th century Solonen (1957) proclaimed that movement in the sacroiliac joints was hardly possible except during pregnancy. However, more recent research has brought the focus onto the importance of pelvic mobility in body kinematics, despite the limited range of movement in the pelvic joints.

The pubic symphysis is a fibrocartilagenous joint comprising of an articular surface on each pubic bone, lined with hyaline cartilage, with a fibrocartilagenous disc in between, and superior, inferior, anterior and

posterior pubic ligaments supporting the joint (Becker *et al.* 2010). During pregnancy the width of this disc may increase to allow for a larger diameter of the birth canal. Garras *et al.* (2008), measuring motion of the pubic symphysis in the frontal plane in a cohort of 45 asymptomatic participants, found that displacement in multiparous women (3.1mm) was greater than in nulliparous women (1.6mm) and men (1.4mm), with a positive association between the number of pregnancies and the total translation at the pubic symphysis during a single-leg stance. However, there does not seem to be a clear association between the width of the pubic symphysis and the severity of symptoms that women experience (Bjorklund *et al.* 1999). Movements at the pubic symphysis are small and the joint is subject to different forces depending on the position/motion. When standing, the superior part of the joint is compressed, while traction occurs at the inferior part. The pubic symphysis is compressed when sitting and during a single-leg stance it is subject to both compression and shear forces (Meissner *et al.* 1996, Becker *et al.* 2010). Walheim *et al.* (1984) examined movement at the pubic symphysis in 15 healthy young adults, which included six nulliparous and three multiparous women (non-pregnant), and found a translation in the transverse and sagittal plane of 1 mm or less, and rotation in the sagittal and frontal plane of less than 1.5 degrees. More movement at the pubic symphysis took place in multiparous compared to nulliparous women, with the greatest symphyseal movement happening when standing on alternating legs, creating vertical shear forces. This may be why for women with anterior PPGP standing on one leg often provokes pain.

The sacroiliac joints have an upper fibrous part, consisting of the deep interosseous ligament, and a lower synovial joint with irregular L-shaped articular surfaces that interlock to resist movement (Drake *et al.* 2005). Anterior sacroiliac ligaments, strong short and long dorsal (posterior) sacroiliac ligaments, and sacrospinous and sacrotuberous ligaments, support the joints. Motion at the sacroiliac joints of approximately two degrees occurs in all major planes, although in many human movements (e.g. single hip flexion when standing) no full range of movement occurs at the sacroiliac joints (Sturesson *et al.* 2000). Nutation/counter-nutation,

whereby the sacrum rotates around the transverse axis at the second sacral segment, is considered the main movement at the sacroiliac joints (Vleeming *et al.* 2012). When vertical loading of the sacrum takes place, which will occur with increasing growth of the pregnancy, the proximal part of the sacrum will tilt forward (nutate), stretching the most dorsal ligaments and increasing the lumbar lordosis. In a comparative study using Doppler Imaging Vibrations, pregnant women with moderate or severe PPGP had similar sacroiliac joint laxity as pregnant women with no or mild pain. However, it seems that asymmetrical laxity of the sacroiliac joints is particularly related to PPGP during pregnancy and an increased likelihood to having moderate to severe persistent PPGP postpartum (Damen *et al.* 2002).

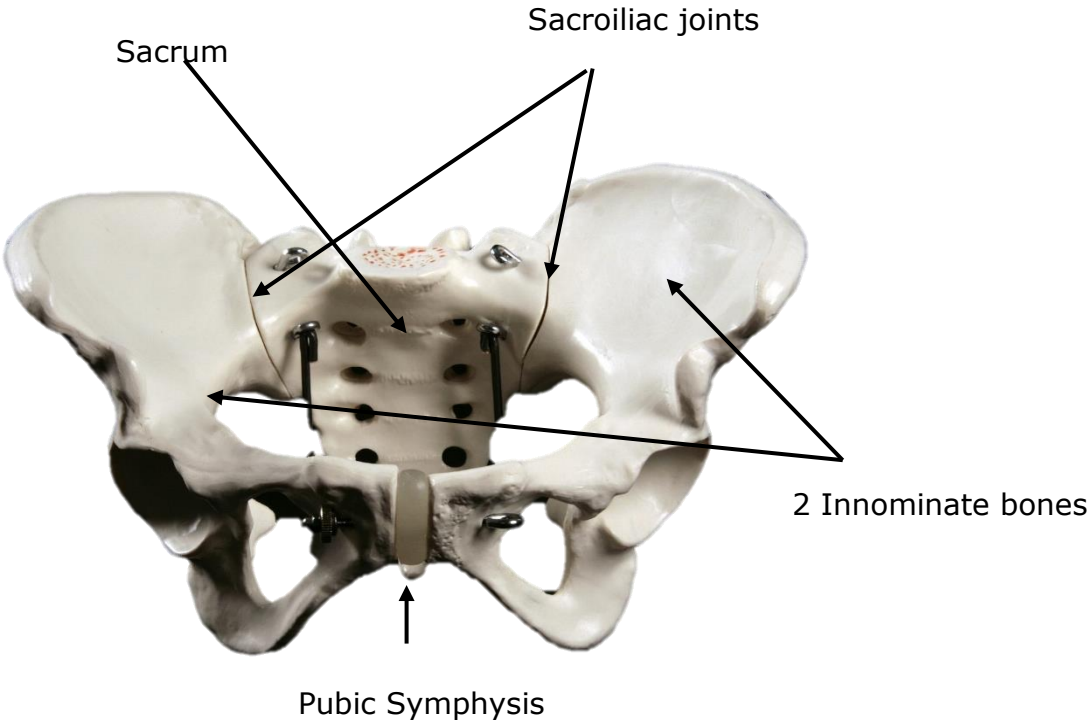

Figure 2-2 Model of pelvic bones (NCSSM photos 2013)

The pelvis has several key functions in the human body. It protects the organs located in the pelvic cavity, facilitates childbirth and is an essential structure for load transmission from the upper body (forces resulting from the body weight and any extrinsic loading of the upper body) to the lower extremities. The latter function is particularly of interest with regards to PPGP, being a musculoskeletal complaint. In this context, looking at the pelvic structures' anatomy topographically does, however, not suffice to

understand its function, because load transfer and movement involves a complex network of muscles, joints, fascia and ligaments that reach far beyond the mere anatomical boundaries of the pelvic girdle (Vleeming *et al.* 2012). Good lumbopelvic stability, sometimes referred to as 'core stability', is essential not only for spinal movement, but also effects upper and lower limb motion. Consequently, dysfunctional neuromuscular control across the pelvis can lead to remote problems anywhere along these kinematic chains. Thus, in understanding pelvic girdle pain and PPGP, the pelvis, spine and surrounding structures should be examined in an integrated, interdependent and dynamic way (Vora *et al.* 2010). Lumbopelvic stability is achieved through form and force closure.

Stability & Mobility of the pelvis: FORM & FORCE closure

Any spinal/upper body load is transferred to the lower extremities through the pelvis in an upright position and creates vertical shear forces to the sacroiliac joints. Ground reaction forces are transmitted upwards, also reaching the pelvis (Pel *et al.* 2008b).

The currently accepted model of how sacroiliac joint stability is achieved and dynamically tailored to the forces it encounters during human movement and loading, combines the concepts of (a) form closure and (b) force closure (Vleeming *et al.* 2012). The European guidelines on pelvic girdle pain define joint stability as "the effective accommodation of the joints to each specific load demand through an adequately tailored joint compression, as a function of gravity, coordinated muscle and ligament forces, to produce effective joint reaction forces under changing conditions" (Vleeming *et al.* 2008) (pp798). A recent systematic review examined the relation between altered kinematic, kinetic, and motor control of the pelvis and PPGP (Aldabe *et al.* 2012a). They included 10 observational studies, six looking at pelvic mobility as a potential contributor to PPGP using various imaging modalities, and four that investigated motor control of the pelvis in women with and without PPGP using surface electromyography and kinematic assessment. They concluded that moderate quality evidence exists that PPGP is related to increased pelvic mobility and altered motor control, with more than 75% of the included studies supporting such conclusions.

(a) FORM closure

Form closure refers to the extent to which joint surfaces fit; closely fitting surfaces leading to increased form closure and joint stability (Arumugam *et al.* 2012). The increased friction resulting from the irregular articular surfaces of the sacroiliac joints, and the wedge-like shape of the sacrum and its position between the ilia contribute to form closure of the pelvis (Vleeming *et al.* 1990, Snijders *et al.* 1993).

(b) FORCE closure

Despite the form closure, additional forces are required for the pelvis to be able to effectively transmit the loads it is exposed to. This force closure is achieved by integrated mechanisms involving active muscular structures and passive connective tissues including ligaments and fascia.

Ligaments

The pelvis has a strong ligamentous supportive system to help resist the large forces it encounters. However, these ligaments are vulnerable to creep under constant trunk loading (McGill & Brown 1992); hence, active muscular support is required to protect against high shear forces. When loading the sacrum vertically (leading to nutation), tension in the posterior ligaments increases, leading to more compression of the joint surfaces and stability (Sturesson *et al.* 1989).

Muscles

Although there are no muscles directly moving the pelvic joints to any great extent, many muscles involved in spinal and hip movement cross or attach to the pelvis. Muscular activation provides an active and dynamic way to adjust pelvic stability, with even minor muscle activity increasing sacroiliac stiffness (van Wingerden *et al.* 2004). This mechanism is sometimes referred to as 'self-bracing' (Vleeming *et al.* 2012). Deep muscles including the transversus abdominus and internal oblique muscles, the multifidi, the pelvic floor muscles, and the diaphragm, are particularly important because they activate just before a movement occurs to provide stability in anticipation of movement (van Dieen *et al.* 2003).

Richardson *et al.* (2002) found that voluntary contraction exercises of the transversus abdominus muscle reduced laxity of the sacroiliac joints. Similarly, Pel *et al.* (2008b), using a simulation model, found that activation of the transverse fibres of the transversus abdominis muscles increased sacroiliac joint compression and reduced vertical shear forces. However, Gnat *et al.* (2013) in their simulation study did not find that it had the same stabilising effect on the pubic symphysis.

Dysfunction of the pelvic floor muscles has also been thought to impair load transfer at the pelvis, thus contributing to PPGP. Pool-Goudzwaard *et al.* (2004) simulated tension of the pelvic floor muscles, which led to increased pelvic stiffness. In a subsequent study, patients with lumbopelvic pain had increased activity but reduced endurance of the pelvic floor muscles (Pool-Goudzwaard *et al.* 2005). Fitzgerald & Mallinson (2012) found an association between PPGP and deep pelvic floor muscle (levator ani and obturator interni) tenderness, but there was no difference in pelvic floor muscle strength (graded using the Modified Oxford scale) between the PPGP and non-PPGP group (Fitzgerald *et al.* 2012). Stuge *et al.* (2012) used vaginal palpation, manometry and 3D ultrasound to assess pelvic floor muscle function and observed that women with PPGP did not have impaired pelvic floor muscle activity compared to controls, but, on the contrary, showed increased pelvic floor muscle activity, which is similar to what Pool-Goudzwaard *et al.* (2005) found. The increased tenderness of deep pelvic floor muscles observed by Fitzgerald & Mallinson (2012) could perhaps be related to increased pelvic floor muscle activity. However, in these studies voluntary pelvic floor muscle function was examined, hence it is difficult to assess the full complexity of pelvic floor muscle activity including involuntary activity. Pelvic floor muscle activity has been shown to be part of the anticipatory contraction of deep muscles for postural and joint stability. It even precedes the contraction of abdominal and diaphragmatic muscles that also increase intra-abdominal pressure, and thus is more than a reflex response as you would expect in the control of continence (Hodges *et al.* 2007). This is relevant, particularly as intra-abdominal pressure plays a role in lumbopelvic control and stability (Hodges *et al.* 2005). O'Sullivan *et al.* (2002) observed (sonographically) an increased pelvic floor descend

and decreased diaphragmatic excursion during an active straight leg raise in a supine position in 13 people with pelvic girdle pain compared to age, gender and body mass index matched controls. This discrepancy was improved through a motor control learning intervention (O'Sullivan & Beales 2007). Although it has been questioned whether intra-abdominal pressure has a function in lumbopelvic stabilisation or is just a result of the contraction of stabilising muscles (Marras & Mirka 1996), Hodges *et al.* (2005) showed that intra-abdominal pressure does increase spinal stiffness regardless of abdominal muscles contraction. However, intra-abdominal pressure also increases the load on the pelvis. This can potentially have a harmful effect and may lead to pain if loads exceed 100N, which is the amount of force that provides relief when wearing a pelvic belt by reducing vertical shear force and increasing sacroiliac joint compression (Mens *et al.* 2006, Pel *et al.* 2008a). Intra-abdominal pressure increases with the size of the abdomen during pregnancy. Nevertheless, Mens *et al.* (2006) found that transversus abdominis and pelvic floor muscle contraction, exercises commonly used in treatment of PPGP, do not significantly increase intra-abdominal pressure and therefore are not contraindicated. Bearing this in mind, the observed descend of the pelvic floor during an active straight leg raise (O'Sullivan & Beales 2007) could be a reaction to relieve the intra-abdominal pressure putting excessive load on the pelvis, rather than a failure of the pelvic floor muscles to contract appropriately.

The same deep muscles (transversus abdominus, internal oblique, pelvic floor muscles, diaphragm) play a role in respiration and regulating intra-abdominal pressure. This is probably why disorders of breathing and incontinence have been found to be associated with back pain (Smith *et al.* 2006). More superficial muscles also impact on pelvic stability; for example, the latissimus dorsi and contralateral gluteus maximus form a cross-brace across the back and pelvis (Mooney *et al.* 2001). Although this relationship (cross-brace) still occurs in patients with pelvic girdle pain, increased activation yet significant weakness of the gluteus maximus muscle has been observed (Massoud Arab *et al.* 2011).

Fascia

Fascia is a type of connective tissue composed of irregularly arranged collagen fibres that can withstand stress in multiple directions (Willard *et al.* 2012). Fascia is present throughout the body, but one key fascial structure in the context of PPGP is the thoracolumbar fascia. The thoracolumbar fascia (Figure 2-3) is a tough, complex, multi-layered fascial structure located in the posterior body wall that surrounds the paraspinal muscles and has various aponeurotic attachments including to the lattisimus dorsi muscle and abdominal and back musculature (Schuenke *et al.* 2012). Biomechanically, the thoracolumbar fascia has movement-dependent viscoelastic properties and transmits forces generated by surrounding muscles to increase lumbosacral force closure (Schleip *et al.* 2012). The force closure mechanism described above, generated by the abdominal muscles (mainly the transversus abdominus) that compresses the anterior sacroiliac joints, requires a force that prevents the posterior aspect of the sacroiliac joint from separating. This is provided by both the posterior sacroiliac joint ligaments and the thoracolumbar fascia that becomes extra thick over the sacrum (Vleeming *et al.* 1995).

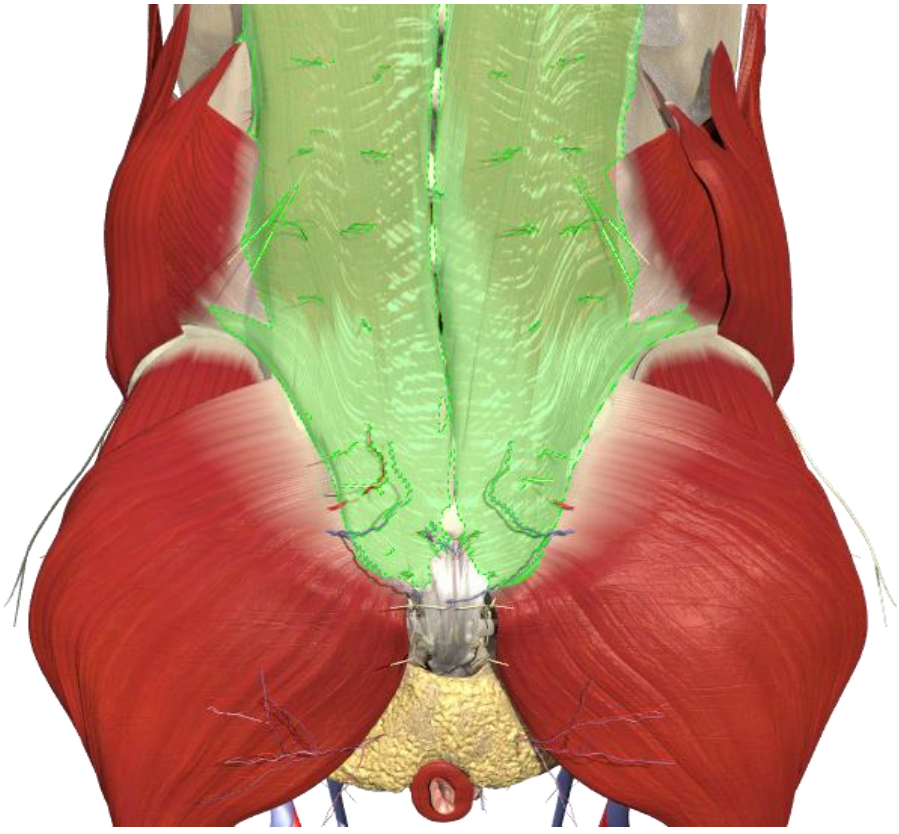

Figure 2-3 Posterior view showing the thoracolumbar fascia (the structure coloured in green) (© Primal Pictures 2014, used with permission)

Force closure is thus provided by the muscles, ligaments and fascia. Dynamic neuromuscular control involves involuntary activation of dynamic restraints in preparation for (feedforward) and/or in response to (feedback) joint motion and loading, to maintain and restore joint stability under functional demand (Riemann & Lephart 2002). It requires an intact sensory, motor system and nervous system for integration and coordination.

This current model of pelvic stability, involving form and force closure with complex neuromuscular control, has been adopted in various clinical applications in the management of patient with pelvic girdle pain. The ASLR test is a commonly used clinical test to assess load transfer across the pelvis, whereby one leg at a time is actively lifted in a supine position, and is highly sensitive and specific for patients with pelvic girdle pain (Mens *et al.* 2001, 2002). de Groot *et al.* (2008) found that 24 women with PLBP/PPGP showed increased muscle activity (measured using surface Electromyography), reduced hip flexion force (measured using a digital force gauge), and a subjectively increased effort to raise their leg when doing an ASLR test. This supports the hypothesis of dysfunctional load transfer across the pelvis in people with PPGP. Moreover, patients with pelvic girdle pain adopted a bilateral bracing motor control pattern compared to a predominantly ipsilateral pattern in pain-free people during the ASLR test (Vleeming *et al.* 2012). Interventions to try and address any dysfunction in force closure and its neuromuscular control have also been based on this model. Stabilisation exercises have been shown to reduce pain intensity and disability linked to PPGP (Pennick & Liddle 2013).

Finally, an important question to ask is why PPGP is the most common form of pelvic girdle pain. This may partially be explained by changes that occur during pregnancy. As the pregnant abdomen grows, the increasing weight anteriorly moves the centre of gravity and brings about anterior pelvic tilting with increased nutation of the sacrum and a more prominent lumbar lordosis (Ritchie 2003). Stretching of the abdominal musculature and an increasing pressure on the pelvic floor also alters the biomechanical forces/effects of these muscles. For example, an advantage of the transversus abdominis muscle as a stabilising muscle is its deep location,

being close to the centre of rotation of the spinal and sacroiliac joints (Adams & Dolan 2007), but this distance naturally becomes larger as the uterus extends during pregnancy. Increased joint laxity during pregnancy is another plausible contributing factor, which may explain why many women develop PPGP as early as the first trimester of pregnancy when there is no significant shift in the centre of gravity. The role of enhanced soft tissue laxity and hormonal changes during pregnancy in the aetiology of PPGP is discussed next (section 2.3.3.2).

2.3.3.2 Hormonal factors

Pregnancy is characterised by significant hormonal changes that drive important physiological changes. Increased joint laxity occurs in preparation for birth, resulting in biomechanical changes that require increased effort of the neuromuscular system to achieve stability during load transfer when executing everyday movements.

In relation to PPGP, the focus in the literature has been on the hormone relaxin, which has been identified as a main contributor to joint laxity (MacLennan 1991, Sherwood 2004). This polypeptide hormone is excreted by the corpus luteum and the decidua, and serum levels rise in the first 12-14 weeks of gestation but then decrease in the second trimester to remain at a similar level in late pregnancy (Petersen *et al.* 1995). Relaxin has been associated with collagen remodelling in connective tissues characterised by an increase in collagenase expression and down-modulation of collagen synthesis and secretion by fibroblasts (Unemori & Amento 1990), which is thought to result in enhanced joint laxity.

Although the relationship between relaxin and joint laxity has been well-established, the association between relaxin and PPGP remains less clear. Aldabe *et al.* (2012b), assessed this relationship in a recent systematic review, and included five case-control and one prospective cohort study of which four were graded as 'high quality' and two as 'low quality'. Four of the six studies, of which three were high quality studies, did not find an association between relaxin levels and PPGP, but the authors concluded that the relation between relaxin and PPGP remains uncertain due to bias

resulting from the assessment method of PPGP and control of risk factors in the included studies. Moreover, current methods of assessing serum relaxin may not capture all relevant fluctuations or other unknown aspects. In addition, there is no direct relationship between increased joint laxity and PPGP. Instead, women with high joint laxity may not develop PPGP because of a superior ability to control this added laxity with force closure. On the other hand, asymmetrical laxity of the sacroiliac joints seems particularly related to PPGP (Damen *et al.* 2002), but this in turn may be due to the biomechanical impact of such asymmetry on certain structures, as it is not plausible that hormonal changes are responsible for increasing laxity in one joint more than another joint.

Postnatally, the level of relaxin drops quickly (Bell *et al.* 1987), but no studies have examined any role of postpartum hormonal changes in persistent PPGP. In the past it has also been postulated that breastfeeding and the associated hormonal changes could be related to persistent PPGP; however, recent literature suggests this is not the case (MacLennan & MacLennan 1997, Bjelland *et al.* 2014), nor has the use of oral contraceptives been shown to be a risk factor for PPGP (Robinson *et al.* 2010c).

2.3.4 Risk Factors & Prognostic Factors

Chapter three reports a systematic review and meta-analysis on risk and prognostic factors for PPGP, PLBP and PLPP.

2.3.5 Associated Factors

Pregnancy-related Pelvic Girdle Pain has been associated with various factors, whereby there is no clear causal direction. The mechanism of these associations seems self-evident for some factors but in many cases is uncertain. Not surprisingly PPGP has been associated with impaired mobility (Ronchetti *et al.* 2008). In a cohort of 642 pregnant women in the Netherlands, women with PPGP were less mobile, and 12.5% of women with PPGP had to use crutches or a wheelchair which was significantly more common (OR 29.2 [5.1-167.1]) than for women without PPGP or for women

with PLBP alone (Van De Pol *et al.* 2007). Robinson *et al.* (2006) found that 7% of 1817 pregnant women in Norway had to use crutches because of their PPGP. Pain intensity and disability related to PPGP have also been positively correlated (Robinson *et al.* 2010a).

Recently, several studies have demonstrated an association between PPGP and incontinence (Fitzgerald *et al.* 2012, Mens *et al.* 2012b). It may be explained by the role of the pelvic floor muscles in both continence and lumbopelvic stability (section 2.3.3.1); however, studies examining any potential link between pelvic floor muscle function and PPGP have mixed findings, which may be due to limitations in terms of measuring automatic pelvic floor muscle function (Stuge *et al.* 2006, Fitzgerald & Mallinson 2012, Stuge *et al.* 2012).

Women with musculoskeletal problems during pregnancy rate their health lower (Schytt *et al.* 2005) and depressive symptoms have been associated with PPGP (Van De Pol *et al.* 2007). The latter endorses the close link between pain and mental health, which will be elaborated on in the theoretical framework of this study (Chapter 4). However, Dorheim *et al.* (2012) found that PPGP was not associated with depression after adjusting for other factors such as insomnia. The same study found a positive association between PPGP and insomnia (Dorheim *et al.* 2012). In a Norwegian cohort of pregnant women, 15% (n=1817) also reported waking up frequently at night due to their PPGP (Robinson *et al.* 2006). The relation between PPGP, depressive symptoms and reduced sleep, and the potential co-existence of these three conditions, may present an escalating process whereby these morbidities enhance one another despite the causal direction remaining unclear.

2.3.6 Women's experiences of PPGP

In-depth explorations of the experiences of women with PPGP are scarce in the literature, and explorations of the experiences of women with persistent PPGP postpartum present a gap in the literature. Stuge & Bergland (2011) looked at women's experiences of a specific treatment programme for

persistent postpartum PPGP using written open-ended questions. Fredriksen *et al.* (2008) employed qualitative text analysis of online discussion fora to examine popular perspectives of women on PPGP in Norway. Discourse on PPGP over a 1-year period was examined and they found that women often entered these internet discussions in search of a diagnosis and understanding of their PPGP symptoms. Women also expressed worry related to the uncertainty of the pain sensations and questioned how much pain to endure, for example in relation to sick leave. Any worries were met with strong messages of precaution and advice on self-care, particularly to promote recovery postpartum. Finally, being given different labels for their condition by different healthcare professionals was also a commonly shared experience.

The views and attitudes of midwives about PPGP were explored in Sweden using qualitative content analysis of four in depth interviews and one focus group with six participants (Mogren *et al.* 2010). Midwives considered PPGP to be a common complaint that tends to worsen in subsequent pregnancies, and all had developed strategies to support women; however, time limits in practice made this challenging. They said some back or pelvic girdle pain was normal during pregnancy and expressed doubts as to whether women with PPGP diagnosed themselves falsely with PPGP or by others. In that context, midwives recognised that women with PPGP often have fear of not being believed.

More recently, three qualitative studies in Sweden (Elden *et al.* 2013a, Persson *et al.* 2013, Elden *et al.* 2014) explored the experiences of women with PPGP during pregnancy. Persson *et al.* (2013), using a Grounded Theory approach, interviewed nine women with PPGP in their third trimester, of which four were pregnant for the first time. A conceptual model of the actions and consequences caused by PPGP was developed based on these data. Women felt unprepared and struggled to understand their condition. They found it difficult to balance support/dependence and to manage any losses resulting from their PPGP. Looking at the consequences of PPGP on these women's lives, their symptoms restricted daily activities, but they did not want to be a burden to others. They described how they

learned, over time, to avoid provocative activities. The well-being of the foetus was most important to them, but they were afraid it would be worse in subsequent pregnancies.

Elden *et al.* (2013a) interviewed 27 women with PPGP who had taken part in a randomised controlled trial (Elden *et al.* 2013b). Five main themes were identified. PPGP affected the ability to cope with everyday life and motherhood (if multiparous). Their condition also put strain on the relationship with their partner due to increasing dependence. Women questioned their identity professionally, not feeling good enough at work. Lastly, women did not look forward to next pregnancies and gave advice for other women saying they should 'listen to their body'.

A different sample of 27 women, six nulliparous and 21 multiparous, with severe PPGP was recruited from the same randomised controlled trial (Elden *et al.* 2014). Severity of PPGP was assessed based on pain provocation tests, subjective pain levels and markings on pain drawings; however, the authors did not describe a clear definition of 'severe' PPGP. Four main themes arose. Women felt unprepared for PPGP, had difficulties describing their condition, and were not used to such pain before pregnancy. Secondly, the pain dominated their lives and they felt frustrated not being able to move about as they wanted. Moreover, acknowledgment by the midwife was considered important and they said they often encountered a lack of knowledge and understanding from healthcare professionals. The fourth theme was 'acceptance of PPGP' in which women said this was important in coping with PPGP.

These three studies exploring women's experiences of PPGP show some common emerging themes, including the feeling of being unprepared, the challenge of coping with daily activities, the perceived lack of knowledge and acknowledgement of healthcare professionals, and the worry about future pregnancies in relation to their PPGP.

2.4 Conclusion

Pregnancy-related Pelvic Girdle Pain is a common complaint during pregnancy and may persist postpartum. The exact cause is unknown, although biomechanical and hormonal changes have been suggested. Three studies have examined women's experiences of PPGP during pregnancy, but no studies explored the experiences of women with persisting symptoms postpartum. Risk and prognostic factors for PPGP will be discussed in Chapter three.

Chapter 3 Systematic Review & Meta-analysis: Risk and prognostic factors for Pregnancy-related Pelvic Girdle Pain, Pregnancy-related Low Back Pain, and Pregnancy-related Lumbopelvic Pain

3.1 Introduction

This chapter reports the methodology and findings of a systematic review of the literature on risk and prognostic factors for PPGP, PLBP and PLPP. Pregnancy-related Pelvic Girdle Pain, PLBP and PLPP were included as outcomes because the scoping search showed that inter-changeable terminology was used to describe these conditions, and excluding one or any of them would result in excluding potentially relevant papers. Moreover, their inclusion allowed for comparisons between these conditions with regards to risk and prognostic factors. The aim and objectives of this systematic review are listed in section 3.3 and the methods used to conduct the review are outlined in section 3.4. The findings for risk factors (Section 3.6-3.8) and prognostic factors (Section 3.9-3.11) are reported separately, and stratified according to outcome ((persistent) PPGP, PLBP and PLPP) and time of follow-up. The findings are discussed in detail in section 3.12 and, in relation to this PhD study's findings, in Chapter 6 (Sections 6.6.2 and 6.17.2).

3.2 Background to this systematic review

3.2.1 Description of the condition

Mechanical pain in the low back and pelvic girdle areas is common during pregnancy and may persist postpartum. For the purpose of this study, PLBP was defined as pain in the lumbar area during pregnancy, PPGP is pain in any of the pelvic girdle areas, and PLPP includes pain in the low back and/or pelvic girdle areas during pregnancy. A description of the terminology used in this study has been presented in chapter 1 (Section 1.5), and the same terminology has been applied to this systematic review (Section 3.4.1.3). The variations in terminology used to describe these conditions in the literature presented a challenge when conducting the systematic review. Subsequently, both PPGP and PLBP were included to assess differences in

risk and prognostic factors, if any, between the two conditions. Pregnancy-related Lumbopelvic Pain (PLPP) was also included because many studies did not differentiate between PLBP and PPGP. Although the focus of this PhD study is PPGP, not PLBP, comparing the risk and prognostic factors associated with each condition may support the importance of differentiating between them (Vleeming *et al.* 2008).

3.2.2 Why it is important to do this review

In order to develop interventions that prevent women from developing these conditions, or aid their speedy recovery, awareness of the risk and prognostic factors is required.

The PROGnosis RESearch Strategy (PROGRESS) series (Hemingway *et al.* 2013) proposed a framework of four inter-related research areas in prognosis research: (1) the course of health-related conditions in the context of the nature and quality of current care (fundamental prognosis research); (2) specific factors that are associated with prognosis (prognostic factor research); (3) the development, validation, and impact of statistical models that predict individual risk of a future outcome (prognostic model research) and (4) the use of prognostic information to help tailor treatment decisions to an individual or group of individuals with similar characteristics (stratified medicine research). This systematic review's focus is on prognostic factor studies, which try to identify factors that are associated with a subsequent clinical outcome in people with a particular disease or health condition (Riley *et al.* 2013). In the second PROGRESS publication, specifically on prognostic factors, Riley *et al.* (2013) emphasise different key uses of prognostic factors, including facilitating clinical decision-making by refining the definition of a health condition, informing treatment recommendations to improve outcomes, and develop prognostic models. In research, assessing prognostic factors can help develop new interventions and intervention studies. The only difference in risk factor research is that an individual does not have the condition of interest at the start point, and the outcome of interest is the condition.

A background literature review identified numerous potential risk factors investigated, including maternal age, number of pregnancies, BMI, smoking, strenuous work, previous pelvic girdle pain or low back pain (Wu *et al.* 2004), previous trauma to the pelvis (Vleeming *et al.* 2008), daily stress levels, work dissatisfaction, parity (Albert *et al.* 2006), gestational age (Al-Sayegh *et al.* 2012), degree of physical activity, work (Kovacs *et al.* 2012), physical activity before pregnancy (Mogren 2005), higher somatisation, posture at work (Stomp-van den Berg *et al.* 2012), history of hypermobility and history of amenorrhoea (Mogren & Pohjanen 2005). Results of studies sometimes disagreed regarding the significance of these factors in terms of developing PPGP/PLBP/PLPP, a point noted in the recently published Irish National Guidelines on the management of pelvic girdle pain in pregnancy and postpartum in which they stated that evidence on risk factors for PPGP is contradictory and inconclusive (Hogan *et al.* 2012). In a review of PPGP, Wu *et al.* (2004) interpreted the evidence on risk factors as 'strong', 'weak', 'conflicting' or 'no' evidence based on the number of studies that examined and pointed significantly to a particular factor. However, the quality and risk of bias of the individual studies were not considered. The European guidelines on pelvic girdle pain (Vleeming *et al.* 2008) also included a narrative section on potential risk factors for PPGP, but new research has emerged since. No systematic review had been conducted investigating potential risk factors for PPGP/PLBP/PLPP. In addition, findings of recent studies did not seem fully congruent with prior studies. For example, Malmqvist *et al.* (2012) found a higher BMI before pregnancy was a significant risk factor for PPGP, whilst Vleeming *et al.* (2008), within the European guidelines, concluded that BMI was a non-risk factor.

Few studies examine prognostic factors for PPGP/PLBP/PLPP, but an exploratory literature search found several potential prognostic factor studies that had investigated pain location, pain severity, disability during pregnancy, back flexors endurance, maternal age and work dissatisfaction (Gutke *et al.* 2008b), physical activity pre-pregnancy (Mogren 2008), belief of improvement (Vollestad & Stuge 2009), birth weight, somatisation, number of days of bed rest (Stomp-van den Berg *et al.* 2012), duration of labour, number of walking deficiencies at primary referral, pre-pregnancy

back pain (Rost *et al.* 2006), and pre-pregnancy BMI (Robinson *et al.* 2010b). Similar to studies examining risk factors, prognostic factor studies had not been reviewed systematically.

The importance of risk and prognostic factors in guiding intervention and management strategies, together with the fact that existing studies have contradictory findings regarding some risk and prognostic factors, and the absence of any systematic review regarding such factors, provided a strong rationale for this systematic review. In the context of this PhD study, this systematic review guided the analysis of quantitative phase (1).

3.3 Aim & Objectives of the systematic review

The aim of this systematic review and meta-analysis was two-fold: i) to determine the risk factors for experiencing Pregnancy-related Pelvic Girdle Pain (PPGP), Pregnancy-Related Low Back Pain (PLBP) and Pregnancy-Related Lumbopelvic Pain (PLPP), and ii) to determine prognostic factors for persistent PPGP, PLBP and PLPP up to 12 months postpartum.

The aim was further stratified in the following objectives of this systematic review:

1. To determine risk factors for PPGP, PLBP and PLPP in:
    a. the 1st trimester of pregnancy
    b. the 2nd trimester of pregnancy
    c. the 3rd trimester of pregnancy
    d. any trimester of pregnancy or the trimester was not stated
2. To determine prognostic factors for PPGP, PLBP and PLPP persisting:
    a. Up to one month postpartum
    b. ≥ 1 month and < 3 months postpartum
    c. ≥ 3 month and < 6 months postpartum
    d. ≥ 6 month and < 9 months postpartum
    e. ≥ 9 month and ≤ 12 months postpartum

In addition, the objectives where examined for the following subgroups of women (Section 3.4.6), where possible, based on:

a. Parity (nulliparous or multiparous)
b. Definition of PPGP (including physical examination or not including physical examination)
c. History of pelvic girdle pain or no history of pelvic girdle pain

The broader aim of this systematic review was to assess potential significant risk and prognostic factors and contribute to the body of knowledge to inform clinical practice, advise and educate pregnant women, and to assist clinical decision-making on possible early management strategies for reducing/preventing PPGP development.

3.4 Methods

3.4.1 Selection of studies & Eligibility criteria

Study selection was done by two reviewers independently by title, abstract, and full text. Reasons for exclusion were recorded at full-text selection level. Figure 3-1 and Figure 3-2 illustrate the Population, Exposure, Outcomes, and Studies (PEOS) of interest in both parts of the systematic review.

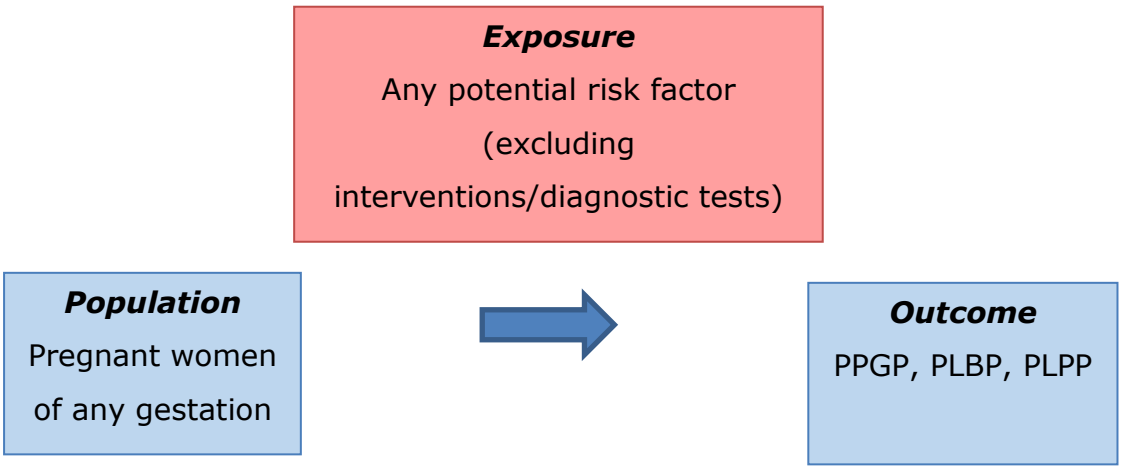

Figure 3-1 Overview of eligibility criteria for studies examining risk factors for PPGP/PLBP/PLPP

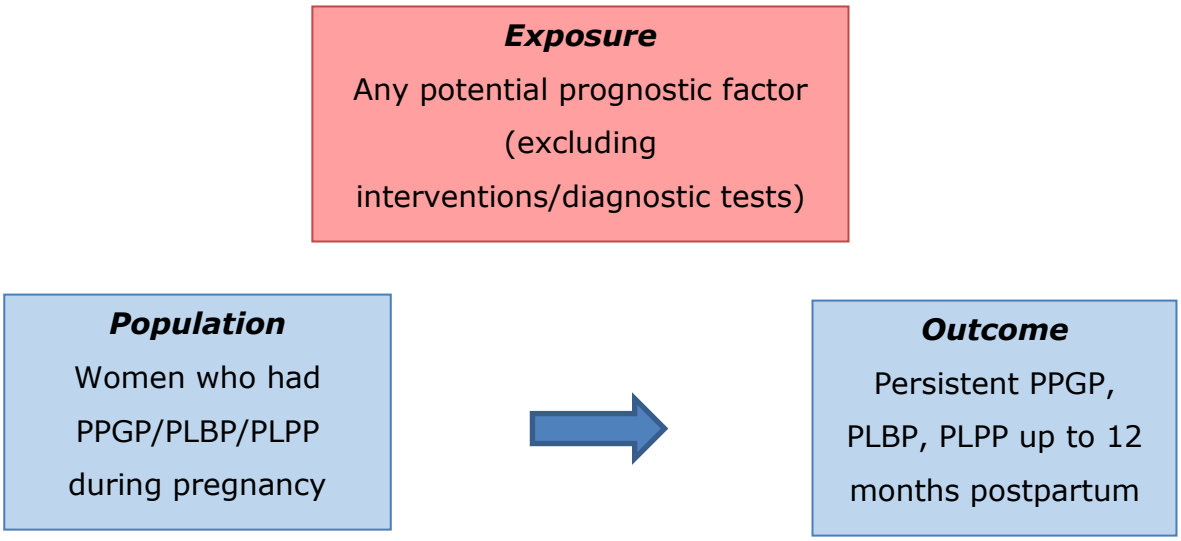

Figure 3-2 Overview of eligibility criteria for studies examining prognostic factors for PPGP/PLBP/PLPP persisting postpartum

3.4.1.1 Population of interest

Participants who (i) were pregnant at any gestation (for objective 1) or (ii) were postpartum (for objective 2). For the purpose of examining prognostic factors for persistent symptoms, 'postpartum' was defined as the time immediately post-birth up to 12 months postpartum.

3.4.1.2 Exposure of interest (Risk & prognostic factors)

Risk factors (objective 1) and prognostic factors (objective 2) were the exposures of interest. These could include:

- Physical factors (e.g. BMI, exercise level, chronic conditions such as diabetes mellitus, past injury, labour/birth)
- Psychosocial factors (e.g. fear avoidance behaviour, depression, anxiety)
- Socio-demographic factors (e.g. age, ethnicity, occupation, age, education level, economic status, parity)

Studies that examined any specific clinical test as the potential risk or prognostic factor e.g. a physical examination test, imaging, laboratory tests etc. were excluded. Studies that investigated the impact of any intervention were also excluded. A Cochrane Review examined interventions for the management and prevention of PPGP and PLBP (Liddle & Pennick 2015).

Definitions of risk and prognostic factors:

(i) A *risk factor* was defined as any modifiable or non-modifiable parameter that increases or decreases the likelihood of a woman experiencing PLBP/PPGP/PLPP and that is non-interventional.

(ii) A *prognostic factor* was defined as any modifiable or non-modifiable parameter that negatively or positively impacts on the clinical course of PLBP/PPGP/PLPP persisting postpartum, reflected by the duration and/or severity of pain.

3.4.1.3 Outcomes

Outcome Definitions for Risk factors studies:

(i) *Pregnancy-related Pelvic Girdle Pain (PPGP):*

Pain reported during pregnancy between the posterior iliac crest and the inferior gluteal folds, particularly in the vicinity of the sacroiliac joints, that may radiate in the posterior thigh and can also occur in conjunction with/or separately in the symphysis.

(ii) *Pregnancy-related Low Back Pain (PLBP):*

Pain reported during pregnancy between the costal margin and the posterior iliac crest.

(iii) *Pregnancy-related LumboPelvic Pain (PLPP):*

PLBP and/or PPGP reported during pregnancy (no differentiation made in the study).

Outcome Definitions for Prognostic factors studies:

(i) *Persistent Pregnancy-related Pelvic Girdle Pain:*

PPGP that was still present to some extent postpartum, from immediately after birth up to 12 months postpartum.

(ii) *Persistent Pregnancy-related Low Back Pain:*

PLBP that was still present to some extent postpartum, from immediately after birth up to 12 months postpartum.

(iii) *Persistent Pregnancy-related LumboPelvic Pain:*

PLPP that was still present to some extent postpartum, from immediately after birth up to 12 months postpartum.

Studies that assessed symptoms consistent with any of the above definitions were included, regardless of the terminology used, provided they met the other selection criteria. Outcomes could be self-reported on a pain diagram or in a questionnaire, or reported to a clinician following a history and physical examination. Guidelines recommend a physical examination should be conducted to diagnose and differentiate between low back and pelvic girdle pain (Vleeming *et al.* 2008). However, the scoping search showed that, in most instances, researchers did not include a physical examination as part of the assessment. Reviewers agreed to include studies and to perform a subgroup analysis comparing studies that did and did not include physical examination findings in their definition of PPGP and/or PLBP. This could not, in fact, be conducted due to a lack of studies that included a physical examination in their assessment (Section 3.4.6).

The outcome of interest was (persistent) PPGP/PLBP/PLPP, reported as being present or absent, or continuously using measures of pain (e.g. severity on VAS) and/or disability (e.g. Rowland Morris disability scale).

3.4.1.4 Study designs

Observational prospective and retrospective cohort studies, and case-control studies were included. Because the assessment of 'risk' or 'prognosis' inherently involves time, cross-sectional studies were included if they reported data on some factors that were present prior to the study (e.g. demographic factors such as professional status). Experimental studies, case studies/reports, reviews, and studies that explored overall prognosis, developed prediction models and stratified medicine research (Riley *et al.* 2013) were excluded. Studies published in a language other than English were also excluded because funds for translation were not available; however, the search was not restricted to the English language, to enable identification of any potential language bias.

3.4.2 Search Strategy

Studies were retrieved using five electronic databases: PubMed, CINAHL, MIDIRS, PsycINFO and Embase, using separate search strategies (Appendix 2). In addition, reference lists of included studies were inspected for additional potentially relevant studies. Although non-English publications were excluded, no language limit was included as a filter because this would permit reviewers to assess publication bias.

3.4.3 Assessment of bias

Risk of bias was assessed by two reviewers independently, with recourse to a third person when disagreement arose, using the modified Quality In Prognosis Studies (QUIPS) tool (Hayden *et al.* 2006, Hayden *et al.* 2013). This tool includes judgments about six important areas of potential study bias: study participation, study attrition, prognostic/risk factor measurement, confounding measurement and account, outcome measurement, analysis and reporting (Hayden *et al.* 2006). The QUIPS tool was developed to assess risk of bias in studies of prognostic factors, but is also suitable for studies examining risk factors (Pace *et al.* 2014). It was developed in several phases and refined by a working group consisting of epidemiologists, clinicians and statisticians. An initial review of 163 systematic reviews of prognosis that included assessments of the methodological quality of studies identified the domains that should be assessed for risk of bias (Hayden *et al.* 2006). The items included for assessing these domains were then refined using a Delphi approach and nominal group techniques (Hayden *et al.* 2008). Hayden *et al.* (2013) subsequently surveyed 43 out of 83 research teams that had used the tool and found an interrater agreement of between 70-89.5% (median 83.5%) in nine review teams (assessing a total of 205 studies) that reported their interrater agreement. The Kappa statistic for independent rating of QUIPS items reported by the same nine review teams ranged from 0.56 to 0.82 (median 0.75).

Other tools considered in the protocol development phase were the Newcastle-Ottawa scale, the PROBAST tool, the CHARMS checklist and the ACROBAT-NRS tool. The Newcastle-Ottawa scale (NOS) uses a starring system with a maximum of nine stars awarded over three domains; selection, comparability and exposure (Wells *et al.*). Although this tool was recommended in the 2011 Cochrane Handbook (Higgins & Green 2011), the QUIPS tool was deemed more appropriate because it moves beyond a scoring (starring) system and assesses domains as having low, moderate or high risk of bias. In addition, the QUIPS tool addresses important study aspects such as 'analysis and reporting', not specified in the Newcastle-Ottawa scale.

The PROBAST (Prediction model studies Risk Of Bias Assessment Tool) was recently developed (Wolff *et al.* 2015) and includes five domains (participant selection, outcome, predictors, sample size and flow, and analysis). While these are similar to the domains used with QUIPS, the PROBAST tool focusses on prediction modelling studies, not risk/prognostic factor studies. Similarly, the Checklist for critical Appraisal and data extraction for systematic Reviews of prediction Modelling Studies (CHARMS) was developed to evaluated primary prediction modelling studies (Moons *et al.* 2014).

The extended Cochrane Risk of Bias tool for non-randomised studies of interventions (ACROBAT-NRS) was recently developed by the Cochrane Non-randomised Studies Methods Group. Although this tool was designed for non-randomised studies, it focuses on assessing risk of bias of intervention studies, which was not applicable for this systematic review. Subsequently, the QUIPS tool was deemed the most appropriate tool to assess risk of bias in this systematic review. The modified QUIPS tools for risk and prognostic factor studies used in this systematic review are presented in Appendix 3 and 4.

3.4.4 Data extraction

Data were extracted by two reviewers independently. Any disagreement was to be resolved by discussion or, if necessary, by a third reviewer (the latter was not required). Two data extraction forms were developed; one for studies examining risk factors (Appendix 5) and one for prognostic factor studies (Appendix 6). The data extraction forms were piloted on three papers and one minor addition, the inclusion of 'time of exposure measurement', was made to the prognostic studies form. In addition, 25% of the included papers and extracted data were fully re-checked for any errors.

To address objective 1, the data extracted from papers examining risk factors, where available, were:

a. Country where the study was conducted
b. Year when the study was conducted
c. Study design and setting
d. Number of participants and characteristics of the cohort
e. Examined risk factor(s), including definition(s) and method of assessment
f. Definition(s) of the outcomes PPGP, PLBP and/or PLPP and the method of assessment
g. Raw data: number of participants with and without the risk factor who did or did not develop the outcome (PPGP/PLBP or PLPP)
h. Unadjusted and adjusted effect measures of associations between the risk factor and the outcome, including details of any confounders that were adjusted for.

To address objective 2, the data extracted from papers examining prognostic factors, where available, were:

a. Country where the study was conducted
b. Year when the study was conducted
c. Study design and setting
d. Number of participants and characteristics of the cohort, including the definition of PPGP, PLBP, PLPP and the method of assessment

e. Examined prognostic factor(s), including definition(s) and method of assessment
f. Definition of the outcome persistent PPGP, PLBP and/or PLPP and the method of assessment
g. Time of follow-up (outcome measurement)
h. Raw data: number of participants with and without the prognostic factor who did or did not have the outcome (persistent PPGP/PLBP or PLPP)
i. Unadjusted and adjusted effect measures of associations between the prognostic factor and the outcome, including details of any confounders that were adjusted for.

Data were extracted by full-group in all instances and, additionally, where reported, by pre-specified subgroups as follows:

a. Nulliparous (risk studies)/primiparous (prognostic studies) - multiparous women
b. Inclusion of a physical examination – no inclusion of a physical examination in the definition of PPGP, PLBP, PLPP
c. Women with a history of pelvic girdle pain, low back pain and/or lumbopelvic pain – no history of pelvic girdle pain, low back pain and/or lumbopelvic pain

Data were also extracted by subgroups e.g. according to pain severity or pain pattern, when reported but had not been pre-specified in the protocol of this review.

To address the issue of the multitude of terminology used in papers and to enable appropriate comparisons and meta-analysis, all reported definitions were examined by each reviewer independently, and classified as PPGP, PLBP, or PLPP in accordance with the definitions specified in this review (Section 3.4.1.3). For example, when a study used the term 'low back pain', if it was defined as 'pain between the costal margin and the gluteal folds', this was classified as PLPP because it includes both low back and pelvic girdle areas. If the definition used in the study was not reported or unclear in the publication, this was also noted.

3.4.5 Data analysis

Data were stratified according to the outcomes PPGP, PLBP, and PLPP for risk factor studies, and persistent PPGP, PLBP, and PLPP for prognostic factor studies. All risk factors examined were organised by the trimester of pregnancy in which the outcome was measured (see objective 1) and all prognostic factors examined were organised according to the postpartum month when the outcome was measured (see objective 2). Where more than one study reported on a particular factor for the same outcome, these data were pooled if appropriate.

When only raw data could be extracted, we calculated the unadjusted odds ratio and the 95% confidence interval using the natural log scale, which was then converted back to normal scale (Altman 1991). When continuous data were reported, the Standardised Mean Difference (SMD) was calculated by dividing the difference between the means by the pooled standard deviation, and converted to an odds ratio (SMD = $\sqrt{3}/\pi$ x ln OR) to allow pooling of continuous and dichotomous study data where possible (Chinn 2000, da Costa *et al.* 2012).

Review Manager (The Nordic Cochrane Centre 2014) was used to conduct meta-analysis if valid data were available for two or more sufficiently homogenous studies. Statistical heterogeneity was assessed using T^2, I^2 and Chi^2 statistics. Heterogeneity is often considered substantial if $I^2 \geq 30\%$, the p-value is >0.10 in the chi^2 test or $T^2>0$ (Higgins & Green 2011). In the absence of substantial statistical heterogeneity, fixed effect meta-analysis is generally conducted, otherwise random effect meta-analysis is conducted (Higgins & Green 2011). However, due to significant methodological and clinical heterogeneity in the included studies, random effect meta-analysis was conducted regardless of the level of statistical heterogeneity (Section 3.5.5). The results of the meta-analysis are presented by the pooled estimate (risk or prognostic factor effect), 95% CI, and Tau^2 estimate. The data analysis plan included the computation of 95% prediction interval for the predictive (risk) or prognostic effect in an individual study setting when findings from three or more studies were included in the meta-analysis. This

was because random effect meta-analysis produces an estimate of an average effect rather than a common effect, and the prediction interval provides a more comprehensive summary (Riley *et al.* 2011). However, the small number of studies (<3) that could be pooled in any meta-analysis did not allow for this.

3.4.6 Subgroups analysis

The following subgroup analyses were planned but could not be carried out due to lack of reporting according to these subgroups in the included studies:

a. Nulliparous/primiparous versus multiparous women
b. Women with a history of low back pain and/or pelvic girdle pain compared to women without a history of low back pain and/or pelvic girdle pain.
c. Self-reported PLBP, PPGP and PLPP compared to studies where a clinical examination by a trained professional was also conducted

Meta-regression to explore possible causes of clinical, methodological and statistical heterogeneity was planned at the protocol stage (Thompson & Higgins 2002), but was not conducted due to insufficient data.

3.4.7 Sensitivity analysis

Sensitivity analysis was planned to explore the effect of risk of bias in included studies on the outcomes of the review; however, the limited number of studies examining a specific risk or prognostic factor made this impossible.

3.4.8 Reporting

Significant and non-significant findings obtained from bivariate (unadjusted) or multivariable (adjusted) analyses, and the adjusted factors for each association where appropriate, are reported according to the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines (Stroup *et al.* 2000).

3.4.9 Quality of evidence

We used the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) framework for prognosis research (Huguet *et al.* 2013), modified by Hayden *et al.* (2014) for prognostic factor reviews (Appendix 7). The key difference with the GRADE framework for intervention studies is that this GRADE framework for prognosis reviews begins with assessing the phase of investigation as starting point for evaluating the quality of evidence (Hayden *et al.* 2008). Briefly, Hayden *et al.* (2013) specified three phases of explanatory prognosis research (as opposed to outcome prediction research): (1) Identifying associations (exploration); (2) Testing independent associations (confirmation) and (3) Understanding prognostic pathways (Understanding).

We used this GRADE framework for studies examining risk factors and prognostic factors for PPGP/PLBP/PLPP (Appendix 7). The assessment was carried out by two reviewers independently and any disagreement was resolved by discussion.

3.4.10 Publication bias

Epidemiological studies are more prone to publication bias than randomised controlled trials (Easterbrook *et al.* 1991). In the protocol, funnel plot analysis was planned to assess publication bias when 10 or more studies were included in the meta-analysis (Higgins & Green 2011); however, none of the factors were examined in that number of studies.

3.5 Results

3.5.1 Results of the search and study selection

The search identified 3092 papers. After duplicate removal, 2383 papers were screened by title. Subsequently, 285 papers were screened by abstract, of which 211 went through to full-text selection. A total of 44 papers were included in the systematic review. This included 36 papers (reporting on 30 studies) examining risk factors and 8 papers (4 studies) examining prognostic factors. Figure 3-3 present the study selection process for this systematic review.

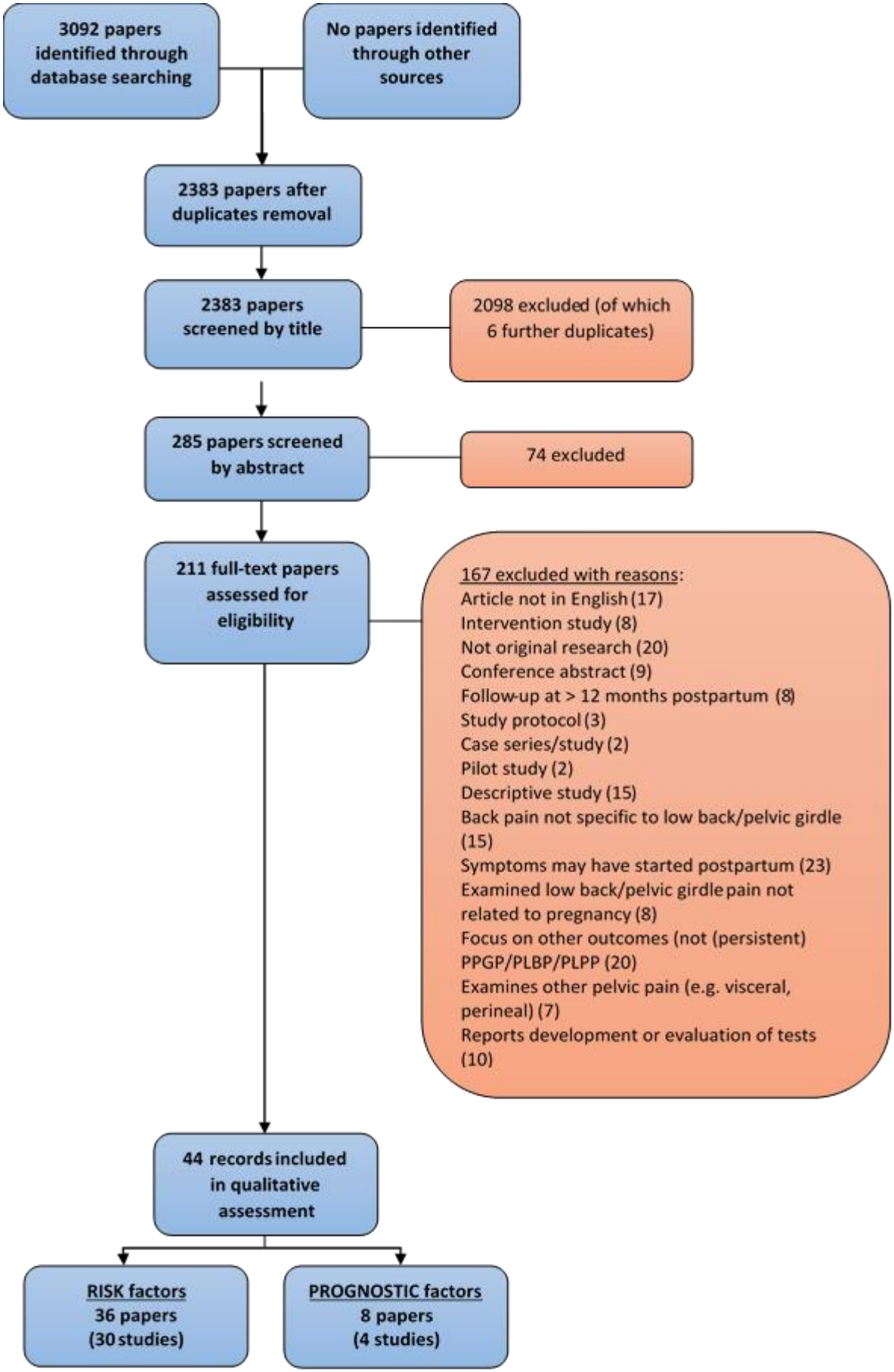

Figure 3-3 Systematic review study selection flow diagram

3.5.2 Included studies

A full description of the included studies is provided in appendix 8 and 9 for studies examining risk factors, and in appendix 10 and 11 for studies examining prognostic factors (Appendix 8 and 10 contain general study characteristics, and appendix 9 and 11 contain information regarding outcome assessment and subgroups).

3.5.2.1 Studies examining risk factors

Thirty-six papers examining risk factors were included reporting on 30 individual studies, of which 11 were prospective, 16 cross-sectional and three retrospective studies. Table 3-1 presents the number of papers/studies and type of studies by outcome(s). The four studies that had PLBP as outcome were conducted in Sweden, USA, Israel and Turkey. The 11 studies with PPGP as outcome took place in Sweden (1), Norway (5), Denmark (2), UK (2) and Israel (1). Eight studies had PLPP as outcome and were conducted in Sweden (1), the Netherlands (1), Canada (1), Iran (2), Kuwait (1) and Taiwan (2). Seven studies examined more than one outcome, conducted in Sweden (1), Norway (4), Spain (1) and Japan (1). All 30 studies together involved a total of 205,940 participants. The number of participants by outcome and whether or not subgroup analysis was conducted is shown in Table 3-2.

Outcome	**No of papers**	No of papers that did not clearly define pain location (marked with (?) in Appendix 8 and 9)	Papers containing sub-classification(s) of the outcome	**No of studies**	Prospective study	Cross-sectional study	Retrospective study	No of studies that included a physical examination in outcome assessment
PLBP	7	7	/	4	1	3	0	0
PPGP	13	6	9	11	5	4	2	3
PLPP	9	5	/	8	2	6	0	0
>1 outcome	7	5	/	7	3	3	1	0
Total	36	23	9	30	11	16	3	3

Table 3-1 Number of papers and studies per outcome

Outcome	Total no of participants* (n = 36 papers = 30 studies)	No of papers that specified how many nulliparous & multiparous women were in the sample	No of papers that did subgroup analysis for nulliparous & multiparous women	No of papers that did other subgroup analysis; by sub-outcomes
PLBP	3611	1	1	0
PPGP	184356	10	2	2
PLPP	3066	5	0	2
>1 outcome	14907	5	0	3
Total	205940	21	3	7

*Participants of studies with >1 paper were only counted once, and the report with the highest number of participants for that study was used in this case.

Table 3-2 Studies examining risk factors: Number of participants and subgroup analysis by outcome

The potential risk factors that were examined in the included studies were first stratified by outcome (PPGP/PLBP/PLPP). Factors that were examined in more than one study for the same outcome were identified and are presented separately to allow for qualitative comparison and meta-analysis when appropriate (Sections 3.6.1, 3.7.1, 3.8.1). Factors that were investigated in only one study were stratified according to trimester of pregnancy and further categorised according to the type of factor (physical/psychological/socio-demographic) for illustrative purposes.

3.5.2.2 Studies examining prognostic factors

Eight papers examining prognostic factors were included reporting on four individual studies, all prospective studies. Three papers (2 studies) reported on prognostic factors for PPGP (i.e. outcome persistent PPGP) of which one study reported on a subgroup of persistent PPGP (persistent pelvic girdle syndrome) as outcome, and one study involved a physical examination in identifying women with PPGP at baseline. The other five papers (2 studies) had persistent PLPP as outcome of which one study (4 papers) also reported on subgroups 'recurrent' and 'continuous' PLPP, but the studies did not involve a physical examination in assessing for PLPP. No studies were identified that examined prognostic factors for PLBP. The two studies that examined persistent PPGP were conducted in Norway, and the two studies with persistent PLPP as outcome took place in Sweden. All four studies together involved a total of 42517 participant. The number of participant by outcome and whether or not subgroup analysis was conducted is shown in Table 3-3.

Outcome	Total no of participants* (n = 8 papers = 4 studies)	No of papers that specified how many primiparous and multiparous women were in the sample	No of papers that did subgroup analysis for primiparous and multiparous women	No of papers that did other subgroup analysis (by sub-outcomes)
Persistent PPGP	934	2	0	2
Persistent PLPP	41583	0	0	4
Total	42517	2	0	6

*Participant of studies with >1 paper were only counted once, and the report with the highest no of participants for that study was used in this case.

Table 3-3 Studies examining prognostic factors: Number of participants and subgroup analysis by outcome

The potential prognostic factors that were examined in the included studies were first stratified by outcome (PPGP/PLBP/PLPP). None of the prognostic factors were examined in more than one study for the same outcome; hence, no comparisons (nor meta-analysis) could be made between studies. The prognostic factors were further classified according to the time of postpartum follow-up (as per objective) and are presented by type of factor (physical/psychological/socio-demographic) in sections 3.9 to 3.11.

3.5.3 Excluded studies

A total of 167 papers were excluded at the full-text selection level.

Table 3-4 provides an overview of the reasons for excluding these papers and a full description is provided in appendix 12. Notably, 23 studies defined PPGP, PLBP and/or PLPP as having started during pregnancy or after birth. The time that symptoms may have started postpartum and still were considered 'pregnancy-related' varied across these studies from weeks to no specified time-frame (e.g. 'shortly after delivery'). We decided to adhere to the pre-specified criteria of this review and only include studies that defined 'pregnancy-related' as 'up to the time of the birth'. These criteria were set at the protocol stage of the review based on a clinical rationale i.e. events that happen related to the birth or in the early postpartum period may potentially be the trigger of women's pelvic girdle and/or low back pain. Another common reason for exclusion was studies that examined back pain without specifying which area of the back they referred to or they included pain in all areas of the back (including e.g. thoracic pain) and did not analyse the data separately according to location.

Reasons for exclusion	Number of papers (n=167)
Articles not in English	17
Intervention	8
Not original research	20
Conference abstracts	9
Beyond 12 months follow-up	8
Study Protocol	3
Case series	2
Pilot study	2
Descriptive study	15
'Back pain' not specific to low back or pelvic girdle	15
Complaint may have started postpartum	23
Low back pain/pelvic girdle pain not related to pregnancy	8
Focus on an outcome other than (persistent) PPGP/PLBP	20
Other pelvic pain (visceral, perineal etc)	7
Diagnostic test development/evaluation	10

Table 3-4 Overview of reasons for exclusion of papers

3.5.4 Risk of bias of included studies

We examined the risk of bias for each included paper (rather than for each study/cohort), since some studies that reported more than one risk/prognostic factor in different papers could be rated differently in terms of risk of bias for different factors and analyses reported in the different publications. Retrospective and cross-sectional studies were rated as 'low risk of bias' for domain 2 (Study attrition) because no issues of loss to follow-up can occur due to the nature of this study design. If there was no adjustment for confounders in the analysis, then domain 5 (Study confounding) was rated as 'high risk of bias'.

3.5.4.1 Risk of bias of risk studies

Figure 3-1 gives an overview of the review authors' judgements of risk of bias in the studies, and reasons for these ratings are provided in appendix 13. Most papers examining risk factors were judged as having 'low risk of bias' for domain 1 (Study participation) and domain 2 (Study attrition) of the QUIPS tool. Exceptions for domain 1 were papers for which the

recruitment setting or sample characteristics were not described. One paper also had recruited a highly selected sample from a patient organisation (Vangen *et al.* 1999). In domain 2, one paper did not report the attrition rate at follow-up (Morino *et al.* 2014). The most common reason for papers to be rated down as having 'moderate' or 'high' risk of bias for domain 3 (risk factor measurement), was the absence of a clear statement of how the risk factor(s) were measured. In four papers (Melzack & Belanger 1989, Orvieto *et al.* 1994, Mazicioglu *et al.* 2006, Ansari *et al.* 2010), the risk factor data was obtained in an interview, which was identified as a potential source of bias. Domain 4 (outcome measurement) was the domain with highest risk of bias, in general, across papers. The two most common reasons for risk of bias in this domain were the absence of a clear definition of the outcome and how it was measured, and, secondly, the questions to assess the outcome were open to interpretation, for example leaving women to interpret what was considered 'pain of the pelvic girdle'. Other reasons for having 'moderate' or 'high' risk of bias in outcome measurement were the risk of recall bias when the outcome was assessed retrospectively (sometimes years after pregnancy), the outcome was assessed in an interview questionnaire, or whether or not the outcome was assessed depended on the clinicians' interpretation and reporting. Ten papers did not adjust for confounders, having 'high risk of bias' for domain 5. Finally, papers that had not adjusted for confounders were also rated as having 'moderate risk of bias' for domain 6 (Analysis and Reporting), because adjusting for appropriate confounders is important in conducting adequate analysis to examine the relationship between risk factors and an outcome.

Papers (Papers reporting data of the same study are highlighted in the same colour)	**QUIPS Risk of bias assessment Domains**					
	Study participation	Study attrition	Factor measurement	Outcome measurement	Study confounding	Statistical Analysis and Reporting
Chang et al 2014	-	-	-	+/-	-	-
Bjelland et al 2013a	-	-	-	+/-	-	-
Bakker et al 2013	+/-	-	-	-	-	-
Gjestland et al 2013	-	-	-	+/-	-	-
Al-Sayegh et al 2012	+	-	+/-	-	+	+/-
Malmqvist et al 2012	-	-	-	+	-	-
Kovacs et al 2012	-	-	-	-	-	-
Chang et al 2012	+	-	-	+	-	+
Bjelland et al 2011	-	-	-	+/-	-	-
Klemetti et al 2011	-	-	-	+	-	-
Bjelland et al 2010	-	-	-	+/-	-	-
Robinson et al 2010c	-	-	-	-	-	-
Lebel et al 2010	-	-	-	+	+/-	+/-
Ansari et al 2010	+	-	+/-	+/-	-	-
Mohseni-Bandpei et al 2009	-	-	-	+/-	-	-
Eberhard-Gran & Eskild 2008	-	-	+	+	-	-
Albert et al 2006	+/-	-	-	-	-	-
Mogren 2005	-	-	+/-	-	-	-
Mogren & Pohjanen 2005	-	-	-	-	-	-
Wang et al 2004	-	-	+/-	+	-	-
Kumle et al 2004	-	-	-	+	-	-
Vangen et al 1999	+	-	-	+	+	-
Larsen et al 1999	-	-	+/-	-	+/-	-
Wergeland & Strand 1998	-	-	-	+/-	-	-
Endresen 1995	-	-	-	+/-	-	-
Hakansson et al 1994	-	-	-	+	+	+/-
Orvieto et al 1994	-	-	+/-	+	+/-	+/-
Ostgaard et al 1991a	+/-	-	+/-	-	+	+/-
Ostgaard et al 1991b	+/-	-	+/-	-	+	+/-
Ostgaard et al 1991c	+/-	-	+/-	-	+	+/-
Melzack & Belanger 1989	+	-	+	+	+	+
Berg et al 1988	+/-	-	+	+	+	+/-
Mazicioglu et al 2006	-	-	+/-	+	-	-
Morino et al 2014	+	+	-	+	-	-
Denison et al 2009	+/-	-	-	+	+	-
Ostgaard et al 1993	+/-	-	+/-	-	+	+/-

+	High risk of bias	+/-	Moderate risk of bias	-	Low risk of bias

Figure 3-4 Risk of bias for each QUIPS domain for each of the included risk studies

3.5.4.2 Risk of bias of prognostic studies

The included studies examining prognostic factors were rated as having low risk of bias for the most of the six QUIPS domains. Figure 3-5 gives an overview of the review authors' judgement of risk of bias in these studies, and reasons for these ratings are provided in appendix 14. Two papers (1 study) (Bjelland *et al.* 2013b, Bjelland *et al.* 2013c) were judged as having moderate risk of bias for the domains of study participation and outcome measurement because the question asked to determine whether women had PPGP and persistent PPGP ("Do you have pain in the pelvic girdle?") depended on the women's interpretation of the boundaries of the pelvic girdle.

Paper (Papers reporting data of the same study are highlighted in the same colour)	**QUIPS Risk of bias assessment Domains**					
	Study participation	Study attrition	Factor measurement	Outcome measurement	Study confounding	Statistical Analysis and Reporting
Bjelland et al 2013c	+/-	-	-	+/-	-	-
Bjelland et al 2013b	+/-	-	-	+/-	-	-
Olsson et al 2012	-	-	-	-	-	-
Robinson et al 2010b	-	-	-	-	-	-
Mogren 2008	-	-	+/-	-	-	-
Mogren 2007b	-	-	-	-	+/-	-
Mogren 2007a	-	-	-	-	-	-
Mogren 2006	-	-	-	-	-	-

+	High risk of bias	+/-	Moderate risk of bias	-	Low risk of bias

Figure 3-5 Risk of bias for each QUIPS domain for each of the included prognostic studies

3.5.5 Heterogeneity

Heterogeneity is the term used to describe variability amongst studies, and non-randomised studies are more prone to heterogeneity resulting from unknown confounders (Maguire *et al.* 2008, Higgins & Green 2011). Several sources of heterogeneity were considered; clinical (variability in the participants, factors and outcomes), methodological (variability in study

design and risk of bias) and statistical heterogeneity (variability in the effects being evaluated in the different studies) (Higgins & Green 2011). Sources of heterogeneity were taken into account in deciding whether or not it was appropriate to pool data from different studies in meta-analysis. The rationale for this decision is specified for each factor in the results (Sections 3.6.1, 3.7.1 and 3.8.1). Moreover, in the discussion of the results (Section 3.12), heterogeneity between studies was considered.

3.5.5.1 Clinical heterogeneity

The study characteristics of the included studies are presented in appendix 8 to 11. Notably, wide variation existed amongst the studies. Despite stratification according to trimester of pregnancy (for risk factor studies) or months postpartum (for prognostic factor studies), as specified *a priori* in the objectives, there were other sources of clinical heterogeneity. Most studies examining risk factors (13) were conducted in a hospital setting although the number of hospitals and geographical location varied from a single hospital to nearly all maternity hospitals in a country. Four studies used a national/regional sample or national registers, and two studies recruited women from another study cohort. In addition, five studies included primary care centres and two studies recruited in both hospital and primary care centres. One study recruited women through ads in public venues as well as in hospital. The four studies examining prognostic factors were set in midwifery clinics (2) and maternity hospitals (2). One of these studies included nearly all maternity hospitals in one country (national sample).

Measurement of the outcome(s) also varied, with some studies using a pain diagram, others asking a narrative question to participants, and a few studies including a physical examination in their assessment. Measurement of risk/prognostic factors was sometimes different; for example, the time when Body Mass Index was calculated (pre-pregnancy/first antenatal visit). In addition, comparator groups/cut-off points varied between studies and the extent of clinical heterogeneity was sometimes difficult to judge due to poor reporting.

3.5.5.2 Methodological heterogeneity

Studies varied greatly methodologically. Both prospective, retrospective and cross-sectional studies were included. The level and type of analysis to examine the association between a risk/prognostic factor and the outcome were wide-ranging, from presentation of raw data (2x2 table), chi-squared/correlation/comparison of mean tests, to univariate and multivariable regression. Factors that were adjusted for in studies that conducted multivariable analysis were different across studies as well.

3.5.5.3 Statistical heterogeneity

Relatively few potential risk factors and no prognostic factors were examined in more than one study. Subsequently, meta-analyses were conducted for only three risk factors with only two studies included in each of these analyses. The I^2 for these meta-analyses were 91%, 0% and 0% respectively. However, random effect meta-analysis was conducted each time due to clinical and methodological heterogeneity.

3.5.6 Quality of evidence

The full Grading of Recommendations Assessment, Development and Evaluation (GRADE) tables, reporting the reasons for downgrading and upgrading the quality of evidence for each individual factor, are presented in Appendices. Shortened versions of these tables, only reporting the overall quality, are presented in the results sections 3.6-3.11.

During the consensus process and based on the guidance provided by Huguet *et al.* (2013), the following decisions were agreed and adhered to in the grading process:

- The adjusted effect measure was used (when deciding whether to upgrade for moderate/large effect) for factors where both unadjusted and adjusted measures were reported.
- We did not upgrade for moderate/large effect if only an unadjusted effect measure was reported, nor did we upgrade if the lower border of the confidence interval was close to no effect, regardless of the effect size.

- All risk/prognostic factors assessed in the same study were generally given the same phase of investigation. The exception was when, in addition to the reported adjusted effect measures in a phase 2 study, we extracted raw data for other factors and calculated unadjusted effect measures. In such cases, the latter was deemed as phase 1 of investigation.
- If subgroups were present, we included only the group including all participants in the GRADE table, but it was noted whether or not the results of subgroups were consistent in terms of direction and statistical significance of effect.
- If the same study (cohort) reported on the same factor in more than one publication with different findings, we included the findings of the publication that reported on the most complete sample size, or, if this was identical, we used the first publication.
- The quality was downgraded for publication bias if three or fewer studies examined a given factor.
- If only one study examined a given factor, we downgraded for inconsistency.

Overall, the quality of the evidence for the majority of risk and prognostic factors was 'very low' and no factors received a 'high quality' rating. This was partly because most factors were examined in only one study, which subsequently led to downgrading for inconsistency and publication bias (Huguet *et al.* 2013). Moreover, most included studies were 'Phase 1 of investigation' (exploration) studies, starting the quality rating already at a 'Moderate' level.

3.6 Risk factors for PPGP

Data on potential risk factors for PPGP were identified in 20 papers (18 studies); 13 papers (11 studies) examined only PPGP as outcome and seven papers (7 studies) examined PPGP amongst other outcomes relevant to this review (PLBP and/or PLPP). For the latter, only the findings for the outcome PPGP are reported in this section (3.6); the results for other outcome(s) are reported in the relevant sections (3.7 PLBP and 3.8 PLPP). Full data, including the adjusted and unadjusted effect measures, (sub)outcomes, and data on subgroups, are provided in Appendices.

3.6.1 Risk factors for PPGP examined in >1 study

Fourteen potential risk factors for PPGP were measured in at least two studies. After careful consideration of clinical and methodological heterogeneity, data were pooled in meta-analysis for three factors (Figure 3-6 to Figure 3-8). Other factors could not be pooled into meta-analysis due to insufficient data, varying categories, and different definitions of the outcome or factor. Full data are provided in appendix 15.

3.6.1.1 Physical factors

Eleven potential physical risk factors for PPGP were examined in more than one study (Table 3-5). Women with a history of low back pain were significantly more likely to have pelvic girdle syndrome in the third trimester (Figure 3-6), although this association does not seem to exist with symphysiolysis (defined as pain only at the pubic symphysis; anterior PPGP). Similarly, women with a history of low back pain not related to pregnancy and women with a history of low back pain or pelvic girdle pain in previous pregnancies (Figure 3-7) were more likely to have PPGP during pregnancy.

Two studies examined the impact of age of menarche on the development of PPGP. Women with an age of menarche of less than 14 years were more likely to have pelvic girdle syndrome in the third trimester of pregnancy, while this association was not statistically significant for any PPGP, which could be due to the relatively smaller sample size in the latter study (Kumle *et al.* 2004).

Nine studies examined the effect of parity on PPGP. Women who already had one, two, three or more children were more likely to develop PPGP in subsequent pregnancies (Figure 3-8). The exception was for the sub-outcome symphysiolysis, which did not seem to be associated with parity. One study (Eberhard-Gran & Eskild 2008) was also inconsistent with these findings and did not find a positive association between parity and pelvic girdle syndrome, whilst Albert *et al.* (2006) and Bjelland *et al.* (2010) did.

Smoking occasionally did not increase women's risk of developing pelvic girdle syndrome. However, daily smoking did significantly increase the risk of women developing pelvic girdle syndrome and disabling posterior PPGP,

but this association was not significant for severe pelvic girdle syndrome or any PPGP. The effect of any smoking compared to not smoking depended on the sub-outcome of PPGP examined and showed some conflicting results in different studies; smoking did not impact on pelvic girdle syndrome, one-sided and double-sided sacroiliac syndrome, but was significantly associated with symphysiolysis. Albert *et al.* (2006) and Larsen *et al.* (1999) found no significant association between smoking and PPGP, whilst Endresen (1995) did find a positive association.

Eight studies examined the impact of women's BMI on the development of PPGP; however, the time points of measuring BMI and the BMI categories of comparisons varied. Being overweight or obese seem to make women more likely to develop PPGP, the exception being Albert *et al.* (2006) who found no association; however, this study compared women with a BMI of over 30 to women with a BMI of less than 30, which means that the comparison group also contained women who were obese (World Health Organisation 2006).

Women with higher weight seemed somewhat more likely to develop pelvic girdle syndrome or symphysiolysis, but the association between maternal weight and any PPGP was conflicting in the three studies. Greater maternal height was only associated with a slight increased risk of one-sided sacroiliac syndrome, but not with any other sub-outcomes or any PPGP.

The two studies that examined the association between the weight of the newborn and PPGP had conflicting results.

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Uni-variate			Multi-variate			Dominant Phase**	Overall quality
			+	0	-	+	0	-		
History of low back pain*	Bjelland et al 2010 (75939); Albert et al 2006 (2224)	2 (2)	2	0	0	2	0	0	2	++
History of low back pain not related to pregnancy	Kovacs et al 2012 (1153); Larsen et al 1999 (1516)	2 (2)	1	0	0	1	0	0	1	++
Low back pain in previous pregnancies	Malmqvist et al 2012 (306); Kovacs et al 2012 (1164)	2 (2)	2	0	0	x	x	x	1	+
Pelvic girdle pain in previous pregnancies	Malmqvist et al 2012 (306); Larsen et al 1999 (1516)	2 (2)	2	0	0	1	0	0	1	++
Age of menarche (younger)	Bjelland et al 2011 (74973); Kumle et al 2004 (1861)	2 (2)	1	0	0	1	1	0	2	+
Parity≥1^	Bjelland et al 2010 (62189); Endresen 1995 (4055); Berg et al 1988 (660); Eberhard-Gran & Eskild 2008 (1816); Wergeland & Strand 1998 (3321); Albert et al 2006 (2224); Larsen et al 1999 (1516); Klemetti et al 2011 (2825); Malmqvist et al 2012 (306)	9 (9)	9	0	0	3	2	0	1	++
Smoking (vs not smoking) *	Bjelland et al 2010 (73164); Wergeland & Strand 1998 (3311); Albert et al 2006 (2224); Larsen et al 1999 (1516); Endresen 1995 (3062); Kumle et al 2004 (1861); Kovacs et al 2012 (1124)	7 (7)	4	1	0	3	1	0	1	++
Body Mass Index (BMI) (higher BMI or ≥30)*	Malmqvist et al 2012 (569); Kovacs et al 2012 (1149); Bjelland et al 2010 (63339); Denison et al 2009 (651); Eberhard-Gran & Eskild 2008 (1686); Albert et al 2006 (2224); Endresen 1995 (2853); Morino et al 2014 (355)	8 (8)	4	2	0	6	0	0	1	++
Weight before pregnancy*	Albert et al 2006 (2224); Larsen et al 1999 (1516); Kovacs et al 2012 (1149)	3 (3)	1	1	0	0	1	0	1	+
Weight of newborn^	Kumle et al 2004 (1861); Endresen 1995 (3062)	2 (2)	x	x	x	1	1	0	1	+
Maternal height*	Albert et al 2006 (2224); Kovacs et al 2012 (1149)	2 (2)	0	1	0	0	1	0	1	+

** If equal number of studies in different phases, then this was based on number of participants; Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-5 GRADE table (short version) for potential physical risk factors for PPGP examined in more than one study (Full GRADE table in appendix 16)

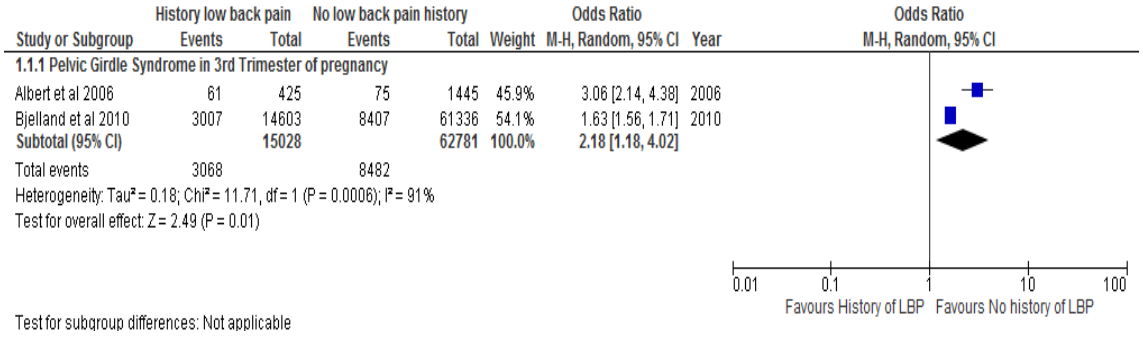

Figure 3-6 Forest plot of comparison: Outcome Pelvic Girdle Syndrome - History of low back pain compared with no history of low back pain

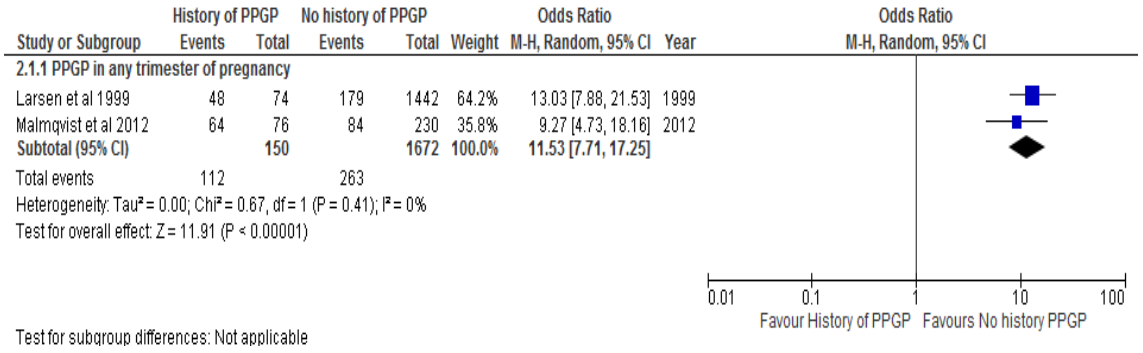

Figure 3-7 Forest plot of comparison: Outcome PPGP - Pelvic girdle pain in previous pregnancies compared with no pelvic girdle pain in previous pregnancies

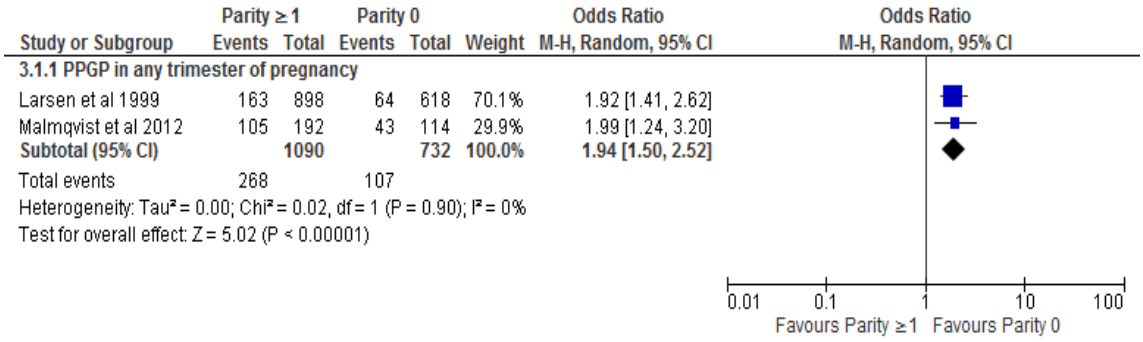

Figure 3-8 Forest plot of comparison: Outcome PPGP – Parity ≥1 compared with parity 0

3.6.1.2 Psychological factors

We did not identify any potential psychological risk factors for PPGP that were examined in more than one study.

3.6.1.3 Socio-demographic factors

Eight studies examined age and its relation with PPGP but used different age categories and some studied age as a continuous variable, making comparisons difficult. A young age (<25) compared to older age (>30) seemed to be associated with a higher risk of PPGP. However, Lebel *et al.* (2010) found that women with symphysiolysis were statistically significantly older and Klemetti *et al.* (2011) found that multiparous women over 35 were more likely to develop symphysis pubis dysfunction.

Four studies examined the association between PPGP and educational level. Women with a lower level of education were more likely to have PPGP. The two studies examining the impact of work satisfaction had conflicting results.

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Univariate			Multivariable			Dominant Phase**	Overall quality
			+	0	-	+	0	-		
Age (older)*	Klemetti et al 2011 (2825); Bjelland et al 2010 (75939); Larsen et al 1999 (1516); Kovacs et al 2012 (1149); Lebel et al 2010 (81142); Malmqvist et al 2012 (306); Wergeland & Strand 1998 (3321); Endresen 1995 (5438)	8 (8)	0	4	4	0	1	1	1	++
Educat-ional level (lower level)^	Kovacs et al 2012 (706); Wergeland & Strand 1998 (2439); Bjelland et al 2010 (63379); Malmqvist et al 2012 (306)	4 (4)	3	1	0	1	0	0	1	++
Work satisfact-ion (higher)*	Albert et al 2006 (2224), Larsen et al 1999 (1516)	2 (2)	0	1	0	0	0	1	1	+

** If equal number of studies in different phases, then this was based on number of participants; Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-6 GRADE table (short version) for potential socio-demographic risk factors for PPGP examined in more than one study (Full GRADE table in appendix 17)

3.6.2 Risk factors for PPGP in the 1st trimester of pregnancy (examined in only 1 study)

We did not identify any studies that examined any risk factors for PPGP in the 1st trimester of pregnancy.

3.6.3 Risk factors for PPGP in the 2nd trimester of pregnancy (examined in only 1 study)

3.6.3.1 Physical factors

Berg *et al.* (1988) examined the impact of physical workload on developing symphysiolysis at 20 weeks gestation (Table 3-7). Symphysiolysis is likely to refer to anterior PPGP; however, they did not report a definition of symphysiolysis. Full data are available in appendix 18.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Physical workload: heavy or very heavy (vs light)	513	Berg et al 1988	0	1	0	x	x	x	1	+
Physical workload: heavy or very heavy including lifting movements (vs light)	451	Berg et al 1988	0	1	0	x	x	x	1	+
Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high.										

Table 3-7 GRADE table (short version) for potential physical risk factors for PPGP in the 2nd trimester of pregnancy (Full GRADE table in appendix 19)

3.6.3.2 Psychological factors

We did not identify any studies that examined any psychological risk factors for PPGP in the 2nd trimester of pregnancy.

3.6.3.3 Socio-demographic factors

We did not identify any studies that examined any socio-demographic risk factors for PPGP in the 2nd trimester of pregnancy.

3.6.4 Risk factors for PPGP in the 3rd trimester of pregnancy (examined in only 1 study)

Full data are available in appendix 20.

3.6.4.1 Physical factors

Seven papers (6 studies) reported potential physical risk factors for PPGP in the third trimester (Table 3-8 to Table 3-11). Kovacs *et al.* (2012), Gjestland *et al.* (2013) and Robinson *et al.* (2010c) examined the outcome PPGP, while the other three papers reported on sub-classifications of PPGP including pelvic girdle syndrome (Albert *et al.* 2006, Bjelland *et al.* 2010, Bjelland *et al.* 2013a), symphysiolysis (Berg *et al.* 1988, Albert *et al.* 2006), one- and double-sided sacroiliac syndrome (Albert *et al.* 2006). Two studies (Albert *et al.* 2006, Robinson *et al.* 2010c) included a physical examination in their assessment of PPGP. Only in Bjelland *et al.* (2013a) data were reported separately for nulliparous and multiparous women for some, but not all, of the examined factors. One reporting error was spotted in the number of nulliparous participants in Bjelland *et al.* (2013a) (1000 women were not accounted for), which was corrected in data extraction of this review. Robinson *et al.* (2010c) examined both pain intensity and disability related to PPGP.

Potential risk factor identified	No. of partici-pants	Reference(s)	Uni-variate			Multi-variate			Phase	Overall quality
			+	0	-	+	0	-		
History of postpartum low back pain	1164	Kovacs et al 2012	1	0	0	x	x	x	1	+
Experiencing low back pain around the time when getting pregnant	1164	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical workload: heavy or very heavy vs light^	513	Berg et al 1988	1	0	0	x	x	x	1	+
Physical workload: heavy or very heavy including lifting movements vs light*	451	Berg et al 1988	0	1	0	x	x	x	1	+
Physically demanding work (yes vs no)^	68872	Bjelland et al 2010	1	0	0	1	0	0	2	+
Exercise frequency 1-2 per week during pregnancy vs <1 per week	check	Gesteland et al 2013	0	1	0	0	1	0	2	+
Exercise frequency ≥3 per week during pregnancy vs <1 per week	1575	Gesteland et al 2013	0	1	0	0	1	0	2	+
Hours of exercise per week before pregnancy	1149	Kovacs et al 2012	0	1	0	x	x	x	1	+
Hours of exercise per week during pregnancy	1149	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical activity level: minimally active vs sedentary	379	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical activity level: moderately active vs sedentary	582	Kovacs et al 2012	0	0	1	x	x	x	1	+
Physical activity level: active vs sedentary	492	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical activity level: very active vs sedentary	452	Kovacs et al 2012	0	1	0	x	x	x	1	+
Pre-pregnancy physical activity: < 1 per week vs ≥3 per week^	41070	Bjelland et al 2010	1	0	0	0	1	0	2	+
Pre-pregnancy physical activity: 1-2 per week vs ≥3 per week^	53827	Bjelland et al 2010	0	1	0	0	1	0	2	+
Stage of pregnancy (weeks)^	1158	Kovacs et al 2012	1	0	0	x	x	x	1	+
Lifetime duration of Combined oral contraceptive pills < 1 year vs never	28480	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Lifetime duration of Combined oral contraceptive pills 1-3 year vs never	38195	Bjelland et al 2013a	1	0	0	0	1	0	2	+

Table 3-8 GRADE table (short version) for potential physical risk factors for PPGP in the 3rd trimester of pregnancy (Full GRADE table in appendix 21)

Potential risk factor identified	No. of partici-pants	Reference(s)	Uni-variate			Multi-variate			Phase	Overall quality
			+	0	-	+	0	-		
Lifetime duration of Combined oral contraceptive pills 4-6 year vs never	40770	Bjelland et al 2013a	1	0	0	0	1	0	2	+
Lifetime duration of Combined oral contraceptive pills 7-9 year vs never	38418	Bjelland et al 2013a	1	0	0	1	0	0	2	+
Lifetime duration of Combined oral contraceptive pills ≥ 10 years (vs never)	35606	Bjelland et al 2013a	1	0	0	0	1	0	2	+
Lifetime duration of progestin-only oral contraceptive pills < 1 year vs never	87236	Bjelland et al 2013a	1	0	0	0	1	0	2	+
Lifetime duration of progestin-only oral contraceptive pills 1-3 year vs never	84257	Bjelland et al 2013a	1	0	0	0	1	0	2	+
Lifetime duration of progestin-only oral contraceptive pills 4-6 year vs never	81352	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Lifetime duration of progestin-only oral contraceptive pills 7-9 year vs never	81044	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Lifetime duration of progestin-only oral contraceptive pills ≥ 10 years vs never	80984	Bjelland et al 2013a	0	1	0	1	0	0	2	+
Combined OCP in last year before pregnancy vs no hormonal contraception^	82042	Bjelland et al 2013a	1	0	0	0	1	0	2	+
Progestin-only contraceptive pills in last year before pregnancy vs no hormonal contraception*	57282	Bjelland et al 2013a	1	0	0	0	1	0	2	+
Progestin injection in last year before pregnancy vs no hormonal contraception^	52724	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Progestin intrauterine devices in last year before pregnancy vs no hormonal contraception*	56603	Bjelland et al 2013a	1	0	0	1	0	0	2	+

Table 3-9 GRADE table (short version) for potential physical risk factors for PPGP in the 3rd trimester of pregnancy - continued (Full GRADE table in appendix 21)

Potential risk factor identified	No. of partici-pants	Reference(s)	Uni-variate			Multi-variate			Phase	Overall quality
			+	0	-	+	0	-		
Combined oral contraceptive pill 4 months before pregnancy vs no hormonal contraception in last year	68120	Bjelland et al 2013a	0	0	1	0	1	0	2	+
Progestin-only contraceptive pill 4 months before pregnancy vs no hormonal contraception in last year	54886	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Cessation of oral contraceptives 4 months before pregnancy vs no hormonal contraception in last year	68628	Bjelland et al 2013a	0	0	1	0	1	0	2	+
Combined oral contraceptive pill at the time of being pregnant vs no hormonal contraception in last year	53682	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Progestin-only contraceptive pill at the time of being pregnant vs no hormonal contraception in last year	52688	Bjelland et al 2013a	0	1	0	0	1	0	2	+
Cessation of oral contraceptives at the time of being pregnant vs no hormonal contraception in last year	85264	Bjelland et al 2013a	0	0	1	0	1	0	2	+
Weight increase during pregnancy^	2224	Albert et al 2006	X	x	x	0	1	0	1	+
Pain location: pubic symphysis vs no pain^	268	Robinson et al 2010c	1	0	0	1	0	0	1	++
Pain location: posterior pain only vs no pain*	268	Robinson et al 2010c	1	0	0	0	1	0	1	+
Pain location: posterior and pubic symphysis pain vs no pain^	268	Robinson et al 2010c	1	0	0	1	0	0	1	++
≥1 previous instrumented delivery	1164	Kovacs et al 2012	1	0	0	x	x	x	1	+
≥1 previous caesarean	1184	Kovacs et al 2012	0	1	0	x	x	x	1	+
≥1 previous epidural anaesthesia	1164	Kovacs et al 2012	1	0	0	x	x	x	1	+
Disability rating index in early pregnancy	268	Robinson et al 2010c	0	0	1	0	0	1	1	+
Trauma to the back*	2224	Albert et al 2006	X	x	x	1	0	0	1	++

Table 3-10 GRADE table (short version) for potential physical risk factors for PPGP in the 3rd trimester of pregnancy - continued (Full GRADE table in appendix 21)

Potential risk factor identified	No. of partici-pants	Reference(s)	Uni-variate			Multi-variate			Phase	Overall quality
			+	0	-	+	0	-		
Trauma to the back*	2224	Albert et al 2006	X	x	x	1	0	0	1	++
Years since last pregnancy^	2224	Albert et al 2006	0	1	0	x	x	x	1	+
Salpingitis previous year*	2224	Albert et al 2006	0	1	0	0	1	0	1	+
Hormone induced pregnancy^	2224	Albert et al 2006	0	1	0	x	x	x	1	+
Oral Contraceptive Pill^	2224	Albert et al 2006	0	1	0	x	x	x	1	+
Number of previous pregnancies: 2 vs 1	1081	Kovacs et al 2012	0	1	0	x	x	x	1	+
Number of previous pregnancies: 3 vs 1	804	Kovacs et al 2012	1	0	0	x	x	x	1	+
Number of previous pregnancies: 4 vs 1	770	Kovacs et al 2012	0	1	0	x	x	x	1	+
Number of previous pregnancies: 5 vs 1	761	Kovacs et al 2012	0	1	0	x	x	x	1	+
Current weight (3rd trimester of pregnancy)	1149	Kovacs et al 2012	1	0	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-11 GRADE table (short version) for potential physical risk factors for PPGP in the 3rd trimester of pregnancy - continued (Full GRADE table in appendix 21)

3.6.4.2 Psychological factors

Three studies reported psychological factors in relation to PPGP (Table 3-12) of which one study included a physical examination in the assessment of PPGP (Albert *et al.* 2006). Albert *et al.* (2006) also reported on sub-classification of PPGP and Bjelland *et al.* (2010) on pelvic girdle syndrome. Only Kovacs *et al.* (2012) conducted subgroup analysis including women who had been pregnant before, for the variable depression.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Depression: slightly (vs not)	1030	Kovacs et al 2012	1	0	0	x	x	x	1	+
Depression: moderately (vs not)	749	Kovacs et al 2012	1	0	0	x	x	x	1	+
Depression: seriously (vs not)	681	Kovacs et al 2012	0	1	0	x	x	x	1	+
Depression (BDI=II score)^	1158	Kovacs et al 2012	1	0	0	x	x	x	1	+
Daily stress levels*	2224	Albert et al 2006	x	x	X	1	0	0	1	+
Anxiety: Traces of anxiety (vs normal)	1019	Kovacs et al 2012	1	0	0	x	x	x	1	+
Anxiety: Pathological anxiety (vs normal)	907	Kovacs et al 2012	1	0	0	x	x	x	1	+
State Anxiety (STAI-S)	1149	Kovacs et al 2012	1	0	0	x	x	x	1	+
Trait Anxiety (STAI-T)	1149	Kovacs et al 2012	1	0	0	x	x	x	1	+
Anxiety (STAI score)	1149	Kovacs et al 2012	1	0	0	x	x	x	1	+
Emotional distress: yes (≥2) vs no (<2)^	74710	Bjelland et al 2010	1	0	0	1	0	0	2	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-12 GRADE table (short version) for potential psychological risk factors for PPGP in the 3rd trimester of pregnancy (Full GRADE table in appendix 22)

3.6.4.3 Socio-demographic factors

Albert *et al.* (2006) and Kovacs *et al.* (2012) examined socio-demographic factors (Table 3-13). Neither conducted subgroup analysis for these factors, but Albert *et al.* (2006) looked at sub-classifications of the outcome PPGP and included a physical examination in their assessment.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Social group 5 (no education)*	2224	Albert et al 2006	0	1	0	0	1	0	1	+
Work status: currently working vs not working	1139	Kovacs et al 2012	0	0	1	x	x	x	1	+
Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.										

Table 3-13 GRADE table (short version) for potential socio-demographic risk factors for PPGP in the 3rd trimester of pregnancy (Full GRADE table in appendix 23)

3.6.5 Risk factors for PPGP (any trimester/trimester not stated) (examined in only 1 study)

Full data are available in appendix 24.

3.6.5.1 Physical factors

Seven studies examined potential physical risk factors for PPGP in any trimester of pregnancy or did not state the time of follow-up (Table 3-14 to Table 3-16). In terms of the outcome; Malmqvist *et al.* (2012) only included women with moderate to severe PPGP. Lebel *et al.* (2010) only examined the sub-outcome symphysiolysis, Eberhard-Gran & Eskild (2008) examined pelvic girdle syndrome, and Wergeland & Strand (1998) examined posterior pain. None of the studies reported findings for nulliparous and multiparous women separately although Kumle *et al.* (2004) differentiated between PPGP in women's first or second pregnancy as two separate outcomes. Only Larsen *et al.* (1999) included a physical examination as part of their assessment of PPGP.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Low back pain during pregnancy	2853	Endresen 1995	x	X	x	1	0	0	1	+
Low back pain in the year before pregnancy	306	Malmqvist et al 2012	1	0	0	x	x	x	1	+
Pelvic girdle pain in the year before pregnancy	306	Malmqvist et al 2012	1	0	0	x	x	x	1	+
PPGP[?] In first pregnancy (Yes vs no)	1688	Kumle et al 2004	x	X	x	1	0	0	2	++
PPGP[?] In at least 1 of the 2 first pregnancy (Yes vs no)	682	Kumle et al 2004	x	X	x	1	0	0	2	++
PPGP[?] In the first 2 pregnancies (vs no PPGP In previous 2 pregnancies)	682	Kumle et al 2004	x	X	x	1	0	0	2	++
PPGP[?] In the first but not the second pregnancy (vs no PPGP In previous 2 pregnancies)	682	Kumle et al 2004	x	X	x	1	0	0	2	+
PPGP[?] Not in the first but in the second pregnancy (vs no PPGP In previous 2 pregnancies)	682	Kumle et al 2004	x	X	x	1	0	0	2	++
Symptom-giving pelvic girdle relaxation in mother or sister	1516	Larsen et al 1999	1	0	0	x	x	x	1	+
Exercised at least 2-3 times a week before pregnancy	306	Malmqvist et al 2012	0	0	1	x	x	x	1	+
Regular exercise (once a week)	1516	Larsen et al 1999	0	0	1	0	0	1	1	+
Pre-pregnancy physical activity	306	Malmqvist et al 2012	1	0	0	x	x	x	1	+
Combined OCP	1684	Kumle et al 2004	x	X	x	1	0	0	2	+
Hormonal contraceptive use before first birth (yes vs no)	1861	Kumle et al 2004	x	X	x	1	0	0	2	+
Length of hormonal contraceptive use before birth: 1-29 months (vs no)	1805	Kumle et al 2004	x	X	x	1	0	0	2	+
Length of hormonal contraceptive use before birth: 30-59 months (vs no)	1805	Kumle et al 2004	x	X	x	0	1	0	2	+

Table 3-14 GRADE table (short version) for potential physical risk factors for PPGP in any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 25)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Length of hormonal contraceptive use before birth: 60 or more months (vs no)	1805	Kumle et al 2004	x	X	x	0	1	0	2	+
Progestin-only contraceptives	1684	Kumle et al 2004	x	X	x	0	1	0	2	+
Diseases in the back, bones, or joints	1516	Larsen et al 1999	1	0	0	x	x	x	1	+
Suffering from lower abdominal pain	1516	Larsen et al 1999	1	0	0	x	x	x	1	+
Other diseases (Other than diseases in the back, bones, or joints)	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Previous lower abdominal pain (while not pregnant)	1516	Larsen et al 1999	x	X	x	1	0	0	1	+
Lifting heavy loads at work (10-20kg) (outcome Disabling posterior PPGP)	3284	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Heavy loads to carry (>10kg)	1516	Larsen et al 1999	1	0	0	x	x	x	1	+
Physically heavy work	306	Malmqvist et al 2012	0	1	0	x	x	x	1	+
Strain at work	3062	Endresen 1995	x	X	x	0	1	0	1	+
Work bending forward	3062	Endresen 1995	x	X	x	1	0	0	1	+
Twisting and bending	3062	Endresen 1995	x	X	x	1	0	0	1	+
Uncomfortable working positions	1516	Larsen et al 1999	1	0	0	1	0	0	1	+
Long walking distance at work	1516	Larsen et al 1999	1	0	0	x	x	x	1	+
Stairs more than 10 steps at work	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Working in draft and cold	1516	Larsen et al 1999	1	0	0	1	0	0	1	+
Working with chemicals	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Previous caesarian section	81142	Lebel et al 2010	0	1	0	x	x	x	1	+
Recurrent abortion	81142	Lebel et al 2010	0	1	0	x	x	x	1	+
Mild pre-eclampsia	81142	Lebel et al 2010	1	0	0	x	x	x	1	+
Severe pre-eclampsia	81142	Lebel et al 2010	0	1	0	x	x	x	1	+

Table 3-15 GRADE table (short version) for potential physical risk factors for PPGP in any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 25)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Chronic hypertension	81142	Lebel et al 2010	0	1	0	x	x	x	1	+
Diabetes mellitus (outcome symphysiolysis)	81142	Lebel et al 2010	1	0	0	x	x	x	1	+
Diabetes mellitus (outcome pelvic girdle syndrome)	1816	Eberhard-Gran & Eskild 2008	1	0	0	1	0	0	2	++
Gestational diabetes mellitus	81142	Lebel et al 2010	1	0	0	x	x	x	1	+
Pregestational diabetes mellitus	81142	Lebel et al 2010	0	1	0	x	x	x	1	+
Premature rupture of membranes	81142	Lebel et al 2010	0	1	0	x	x	x	1	+
Time since last delivery: <5 years (vs ≥5 years)	1816	Eberhard-Gran & Eskild 2008	1	0	0	0	1	0	2	+
Time since first birth	1861	Kumle et al 2004	x	X	x	0	1	0	2	+
≥ 4 cups of coffee	3286	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Treatment of low back pain by doctor (vs untreated)	869	Larsen et al 1999	0	1	0	x	x	x	1	+
Treatment of low back pain by chiropractor (vs untreated)	1009	Larsen et al 1999	0	1	0	x	x	x	1	+
Treatment of low back pain by physiotherapist (vs untreated)	1163	Larsen et al 1999	0	1	0	x	x	x	1	+
Untreated low back pain	1516	Larsen et al 1999	1	0	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings. [?] Definition of PPGP not clearly defined.

Table 3-16 GRADE table (short version) for potential physical risk factors for PPGP in any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 25)

3.6.5.2 Psychological factors

No studies were identified that examined psychological risk factors for PPGP in any trimester/trimester not stated.

3.6.5.3 Socio-demographic factors

Seven studies examined potential socio-demographic risk factors for PPGP in any trimester of pregnancy (Table 3-17 and Table 3-18). Three studies examined sub-outcomes of PPGP; Eberhard-Gran & Eskild (2008) examined pelvic girdle syndrome, Hakansson (1994) looked at the sub-outcome symphysiolysis, and Wergeland & Strand (1998) examined only posterior pain. None of the studies reported findings for nulliparous and multiparous women separately. Only Larsen *et al.* (1999) included a physical examination as part of their assessment of PPGP.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Woman's year of birth^	3062	Endresen 1995	x	X	x	1	0	0	1	+
Age at last delivery: ≥25 (vs <25)	1791	Eberhard-Gran & Eskild 2008	1	0	0	1	0	0	2	++
Age at first birth 21-25 (vs ≤20)	1861	Kumle et al 2004	x	X	x	0	1	0	2	+
Age at first birth ≥26 (vs ≤20)	1861	Kumle et al 2004	x	X	x	0	1	0	2	+
Partner's education level: primary or secondary 9-10 years (vs university/ college)	1822	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Partner's education level: secondary 11-12 years (vs university/ college)	2275	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Years of education 10-12 (vs 7-9 years)	1861	Kumle et al 2004	x	X	x	0	1	0	2	+
Years of education 13-15 (vs 7-9 years)	1861	Kumle et al 2004	x	X	x	0	1	0	2	+
Years of education 16+ (vs 7-9 years)	1861	Kumle et al 2004	x	X	x	0	1	0	2	+
Pakistani (vs Norwegian)	137	Vangen et al 1999	0	0	1	x	x	x	1	+
Being in work	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Monotonous work	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Working part-time	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Shiftwork	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Fixed salary	1516	Larsen et al 1999	0	1	0	x	x	x	1	+

Table 3-17 GRADE table (short version) for potential physical risk factors for PPGP in any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 26)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Living in a house (yes vs no)	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Having more than 3 rooms at home	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Having a lift at home	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Having stairs with more than 10 steps at home	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Living with or married to partner	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Children at home	1516	Larsen et al 1999	1	0	0	x	x	x	1	+
Doing more than 50% of the housework	1516	Larsen et al 1999	0	1	0	x	x	x	1	+
Influence on breaks at work (yes vs no)	3272	Wergeland & Strand 1998	0	0	1	x	x	x	1	+
Influence on work pace (yes vs no)	3272	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Level of work pace control: No (vs high)	3321	Wergeland & Strand 1998	x	X	x	1	0	0	1	+
Level of work pace control: low (vs high)	3321	Wergeland & Strand 1998	x	X	x	0	1	0	1	+
Level of work pace control: medium (vs high)	3321	Wergeland & Strand 1998	x	X	x	0	1	0	1	+
Externally paced work (yes vs no)	3280	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Manual work (yes vs no) (Outcome Disabling posterior PPGP)	3280	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Manual work (yes vs no) (outcome symphysiolysis)	360	Hakansson et al 1994	0	1	0	x	x	x	1	+
Influence on work content (yes vs no)	3262	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Work with video display terminals (yes vs no)	3187	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Weekly hours of paid work ≥35 (yes vs no)	3168	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Weekly hours of pain work >40 (yes vs no)	3168	Wergeland & Strand 1998	0	1	0	x	x	x	1	+
Economic dependence	3062	Endresen 1995	x	X	x	0	1	0	1	+
Permanently employed	1737	Endresen 1995	x	X	x	0	1	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-18 GRADE table (short version) for potential socio-demographic risk factors for PPGP in any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 26)

3.7 Risk factors for PLBP

Thirteen papers (10 studies) examined risk factors for the outcome PLBP; seven papers (4 studies) only reported on the outcome PLBP and six papers (6 studies) reported the outcome PLBP as well as other outcomes explored in this review (PPGP and/or PLPP). However, in 10 of these 13 papers the pain location was not clearly specified or the questions to assess pain location were open to significant interpretation. Full data, including the adjusted and unadjusted effect measures, (sub)outcomes, and data on subgroups, are provided in Appendices.

3.7.1 Risk factors for PLBP examined in >1 study

Sixteen potential risk factors for PLBP were examined in more than one study. No meta-analyses were deemed appropriate. Full data are provided in appendix 27.

3.7.1.1 Physical factors

Thirteen potential physical risk factors for PLBP were examined in at least two studies (Table 3-19 and Table 3-20). Women with a history of low back pain, women with a history of low back pain not related to pregnancy, and women who had experienced low back pain in previous pregnancies, were more likely to develop PLBP than women without a low back pain history. The oral contraceptive pill was not significantly associated with the development of PLBP.

Three studies examined the association between parity and PLBP, but results were inconsistent. Wergeland & Strand (1998) and Endresen (1995) found that having one or more child(ren) made women more likely to develop PLBP in subsequent pregnancies, whilst Berg *et al.* (1988) did not find a significant association. The first two studies assessed the outcome postpartum (period prevalence in pregnancy), while Berg *et al.* (1988) assessed the outcome at three times points (20, 30, 35 weeks gestation), which may have affected this discrepancy in results. The number of previous pregnancies that women had had did not significantly impact on the development of PLBP.

Four studies examined the association between smoking and PLBP. There did not seem to be an association, although Wergeland & Strand (1998) did

find that more women who smoked daily developed PLBP and Kovacs *et al.* (2012) found there was a positive association between smoking 1-10 cigarettes/day and PLBP when compared to non-smoking; however, this association was not significant for higher quantities of cigarettes per day.

Three of the four studies that examined the association between BMI and PLBP found no association, whereas Morino *et al.* (2014) found that women with a BMI of <18 or a BMI ≥22 were more likely to have PLBP in the 3rd trimester of pregnancy, but not in the 2nd trimester. Women's weight before pregnancy, women's height, and gestational age were not significantly associated with having PLBP during pregnancy. Similarly, women who had physically heavy work or work that involved bending forward were not more likely to develop PLBP.

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Univariate			Multi-variate			Dominant phase**	Overall quality
			+	0	-	+	0	-		
History of low back pain	Orvieta et al 1994 (449); Ostgaard 1991b (804)	2	2	0	0	x	x	x	1	++
History of low back pain not related to pregnancy	Kovacs et al 2012 (1153); Wang et al 2004 (950)	2 (2)	2	0	0	1	0	0	1	++
Low back pain in previous pregnancies^	Malmqvist et al 2012 (214), Kovacs et al 2012 (1153), Wang et al 2004 (950), Orvieto et al 1994 (449)	4 (4)	4	0	0	x	x	x	1	+
Oral contraceptive pill	Wang et al 2004 (950); Ostgaard et al 1991a (895)	3 (2)	0	2	0	x	x	x	1	++
Parity*	Wergeland & Strand 1998 (3321); Berg et al 1988 (660); Endresen 1995 (2853)	3 (3)	1	1	0	1	0	0	1	++
Number of previous pregnancies^	Kovacs et al 2012 (1087); Wang et al 2004 (950); Orvieto et al 1994 (449); Mazicioglu et al 2006 (1357); Ostgaard et al 1991a (855)	6 (5)	0	5	0	x	x	x	1	+
Smoking	Mazicioglu et al 2006 (1357); Wang et al 2004 (950); Wergeland & Strand 1998 (3311); Kovacs et al 2012 (1022)	4 (4)	1	3	0	x	x	x	1	+

Table 3-19 GRADE table (short version) for potential physical risk factors for PLBP examined in more than one study (Full GRADE table in appendix 28)

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Univariate			Multivariable			Dominant phase**	Overall quality
			+	0	-	+	0	-		
Body Mass Index (BMI)*	Orvieto et al 1994 (449); Kovacs et al 2012 (1153); Malmqvist et al 2012 (214); Morino et al 2014 (355)	4 (4)	0	3	0	1[j]	1[j]	0	1	+
Weight before pregnancy	Wang et al 2004 (950); Orvieto et al 1994 (449); Mazicioglu et al 2006 (1357); Kovacs et al 2012 (1153)	4 (4)	0	4	0	x	x	x	1	+
Physically heavy work	Malmqvist et al 2012 (214),Ostgaard et al 1991a (855)	2 (2)	0	2	0	x	x	X	1	++
Work bending forward^	Ostgaard et al 1991a (855); Endresen 1995 (2911)	2 (2)	0	1	0	0	1	0	1	++
Height	Kovacs et al 2012 (1153); Orvieto et al 1994 (449)	2 (2)	0	2	0	x	x	X	1	++
Gestational age	Orvieto et al 1994 (449); Kovacs et al 2012 (1153)	2 (2)	0	2	0	x	x	X	1	++

** If equal number of studies in different phases, then this was based on number of participants; Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-20 GRADE table (short version) for potential physical risk factors for PLBP examined in more than one study - continued (Full GRADE table in appendix 28)

3.7.1.2 Psychological factors

We did not identify any potential psychological risk factors for PLBP that were examined in more than one study.

3.7.1.3 Socio-demographic factors

Three socio-demographic factors were examined in more than one study (Table 3-21). Nine papers (7 studies) reported on the association between age and PLBP. Three studies (5 papers) found that younger women were more likely to develop PLBP than older women, while the other four studies found no significant association. Six studies examined any impact of women's educational level on the development of PLBP. Three studies found that women with a lower level of education were more likely to have PLBP, but the other studies did not find a significant association. On the other hand, being in work seemed to reduce to likelihood of having PLBP compared to not being in work, but the types of occupation (clerk, technical or housewife) did not impact on PLBP.

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Univariate			Multivariable			Dominant phase**	Overall quality
			+	0	-	+	0	-		
Age	Wang et al 2004 (950); Orvieto et al 1994 (449); Ostgaard et al 1991a (855); Mazicioglu et al 2006 (1357); Kovacs et al 2012 (1153); Malmqvist et al 2012 (214); Wergeland & Strand 1998 (2038)	9 (7)	2	4	1	x	x	x	1	+
Educational level*	Kovacs et al 2012 (711); Wergeland & Strand 1998 (1965); Mazicioglu et al 2006 (1357); Ostgaard et al 1991a (855); Endresen 1995 (2853); Malmqvist et al 2012 (214)	6 (6)	1	3	1	0	0	1	1	+
Work/ occupation (in work)	Kovacs et al 2012 (1144); Mazicioglu et al 2006 (1357)	2 (2)	0	1	1	x	x	x	1	+

** If equal number of studies in different phases, then this was based on number of participants; Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-21 GRADE table (short version) for potential socio-demographic risk factors for PLBP examined in more than one study (Full GRADE table in appendix 29)

3.7.2 Risk factors for PLBP in the 1st trimester of pregnancy (examined in only 1 study)

We did not identify any studies that examined any risk factors for PLBP in the 1st trimester of pregnancy.

3.7.3 Risk factors for PLBP in the 2nd trimester of pregnancy (examined in only 1 study)

We did not identify any studies that examined any risk factors for PLBP in the 2nd trimester of pregnancy.

3.7.4 Risk factors for PLBP in the 3rd trimester of pregnancy (examined in only 1 study)

Full data are provided in appendix 30.

3.7.4.1 Physical factors

Kovacs *et al.* (2012) examined several potential physical risk factors for PLBP that were not assessed in any other studies. They did not report outcomes for nulliparous and multiparous subgroups and the assessment of the outcome did not include a physical examination (Table 3-22).

Potential risk factor identified	No. of partici -pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
History of postpartum low back pain^	394	Kovacs et al 2012	1	0	0	x	x	x	1	+
Experiencing low back pain around the time when getting pregnant	1153	Kovacs et al 2012	1	0	0	x	x	x	1	+
Physical activity level: minimally active (vs sedentary)	383	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical activity level: moderately active (vs sedentary)	584	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical activity level: active (vs sedentary)	495	Kovacs et al 2012	0	1	0	x	x	x	1	+
Physical activity level: very active (vs sedentary)	456	Kovacs et al 2012	0	1	0	x	x	x	1	+
≥1 previous instrumented delivery	1153	Kovacs et al 2012	0	1	0	x	x	x	1	+
≥1 previous caesarian	1153	Kovacs et al 2012	0	1	0	x	x	x	1	+
≥1 previous epidural anaesthesia	1153	Kovacs et al 2012	1	0	0	x	x	x	1	+
Previous lumbar surgery^	1158	Kovacs et al 2012	x	X	x	0	0	1	1	+
Current weight (3rd trimester of pregnancy)	1153	Kovacs et al 2012	x	X	x	0	1	0	1	+
Hours of exercise per week before pregnancy	1153	Kovacs et al 2012	x	X	x	0	1	0	1	+
Hours of exercise per week during pregnancy	1153	Kovacs et al 2012	x	X	x	0	1	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-22 GRADE table (short version) for potential physical risk factors for PLBP in 3rd trimester of pregnancy (Full GRADE table in appendix 31)

3.7.4.2 Psychological factors

Kovacs *et al.* (2012) were also the only authors that reported on the association between depression or anxiety and PLBP (Table 3-23).

Potential risk factor identified	No. of partici-pants		Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Depression: slightly (vs not)	1036	Kovacs et al 2012	1	0	0	x	x	x	1	+
Depression: moderately (vs not)	752	Kovacs et al 2012	1	0	0	x	x	x	1	+
Depression: seriously (vs not)	685	Kovacs et al 2012	1	0	0	x	x	x	1	+
Anxiety: Traces of anxiety (vs normal)	1024	Kovacs et al 2012	1	0	0	x	x	x	1	+
Anxiety: Pathological anxiety (vs normal)	910	Kovacs et al 2012	1	0	0	x	x	x	1	+
Anxiety (STAI score)^	1158	Kovacs et al 2012	x	X	x	1	0	0	1	+
State Anxiety (STAI-S)	1153	Kovacs et al 2012	x	X	x	1	0	0	1	+
Trait Anxiety (STAI-T)	1153	Kovacs et al 2012	x	X	x	1	0	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-23 GRADE table (short version) for potential psychological risk factors for PLBP in 3rd trimester of pregnancy (Full GRADE table in appendix 32)

3.7.4.3 Socio-demographic factors

We did not identify any studies that examined any socio-demographic risk factors for PLBP in the 3rd trimester of pregnancy.

3.7.5 Risk factors for PLBP (any trimester/trimester not stated) (examined in only 1 study)

Full data are provided in appendix 33.

3.7.5.1 Physical factors

Nine studies examined several potential physical risk factors for PLBP in any trimester of pregnancy, which had not been examined in any other studies (Table 3-24 and Table 3-25). Only Orvieto *et al.* (1994) reported the findings for first-time mothers and multiparous women separately. Malmqvist *et al.* (2012) only included women with moderate to severe PLBP in their outcome. None of these nine studies included a physical examination as part of their assessment of PLBP.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Pelvic pain during pregnancy	2853	Endresen 1995	x	x	x	1	0	0	1	+
Low back pain in the year before pregnancy	214	Malmqvist et al 2012	1	0	0	x	x	x	1	+
Pelvic girdle pain in the year before pregnancy	214	Malmqvist et al 2012	0	1	0	x	x	x	1	+
Experience of low back pain before first pregnancy	449	Orvieto et al 1994	1	0	0	x	x	x	1	+
Previous pain before pregnancy	1357	Mazicioglu et al 2006	1	0	0	x	x	x	1	+
Physical workload: heavy or very heavy (vs light)*	513	Berg et al 1988	1	0	0	x	x	x	1	+
Physical workload: heavy or very heavy including lifting movements (vs light)^	451	Berg et al 1988	1	0	0	x	x	x	1	+
Exercised at least 2-3 times a week before pregnancy	214	Malmqvist et al 2012	0	1	0	x	x	x	1	+
Pre-pregnancy physical activity	950	Wang et al 2004	0	1	0	x	x	x	1	+
Repetitive daily activities	950	Wang et al 2004	0	1	0	x	x	x	1	+
Weight gain during pregnancy	855	Ostgaard et al 1993	0	1	0	x	x	x	1	+
Spinal or epidural anaesthesia	950	Wang et al 2004	0	1	0	x	x	x	1	+
Lifting heavy loads at work (10-20kg)	3284	Wergeland & Strand 1998	1	0	0	x	x	x	1	+

Table 3-24 GRADE table (short version) for potential physical risk factors for PLBP in any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 34)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Lifting at work	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Strain at work^	2911	Endresen 1995	x	x	x	1	0	0	1	+
Twisting and bending^	2911	Endresen 1995	x	x	x	1	0	0	1	+
Twisting when working	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Ability to change work posture	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Standing work posture	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Work above shoulder^	2853	Endresen 1995	x	x	x	1	0	0	1	+
Oswestry back pain scale	1357	Mazicioglu et al 2006	1	0	0	x	x	x	1	+
Hormone induced pregnancy	950	Wang et al 2004	0	1	0	x	x	x	1	+
Caffeine use during pregnancy	950	Wang et al 2004	0	1	0	x	x	x	1	+
≥ 4 cups of coffee per day	3286	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Posterior/ fundal location of the placenta^	449	Orvieto et al 1994	0	1	0	x	x	x	1	+
PPGP in previous pregnancies	214	Malmqvist et al 2012	1	0	0	x	x	x	1	+
History of low back pain during menstruation	950	Wang et al 2004	1	0	0	x	x	x	1	+
Nulliparous	214	Malmqvist et al 2012	0	1	0	x	x	x	1	+
Birthweight baby	855	Ostgaard et al 1991c	0	1	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-25 GRADE table (short version) for potential physical risk factors for PLBP in any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 34)

3.7.5.2 Psychological factors

Mazicioglu *et al.* (2006) assessed depression using the Zung depression scale, but did not find any association with PLBP (Table 3-26).

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Zung depression scale	1357	Mazicioglu et al 2006	0	1	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high.

Table 3-26 GRADE table (short version) for potential psychological risk factors for PLBP in any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 35)

3.7.5.3 Socio-demographic factors

Six studies examined different potential socio-demographic risk factors for PLBP (Table 3-27 and Table 3-28). None of these studies reported results for nulliparous and multiparous women separately and they did not include a physical examination when assessing for PLBP.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Woman's year of birth^	2853	Endresen 1995	x	X	x	1	0	0	1	+
African-American (compared to other women)	950	Wang et al 2004	1	0	0	x	x	x	1	+
Sephardic origin	449	Orvieto et al 1994	1	0	0	x	x	x	1	+
Monotonous work	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Self-rated income: fair (vs good)	1357	Mazicioglu et al 2006	0	1	0	x	x	x	1	+
Self-rated income: bad (vs good)	1357	Mazicioglu et al 2006	0	1	0	x	x	x	1	+
Birth place: suburban (vs urban)	1357	Mazicioglu et al 2006	0	1	0	x	x	x	1	+
Birth place: rural (vs urban)	1357	Mazicioglu et al 2006	0	1	0	x	x	x	1	+

Table 3-27 GRADE table (short version) for potential socio-demographic risk factors for PLBP in any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 36)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Assistant for housework (no vs yes)	1357	Mazicioglu et al 2006	1	0	0	x	x	x	1	+
Influence on breaks at work (yes vs no)	3272	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Ability to take breaks at work	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Influence on work pace (yes vs no)	3272	Wergeland & Strand 1998	0	0	1	x	x	x	1	+
Level of work pace control: No (vs high)	3321	Wergeland & Strand 1998	x	X	x	1	0	0	1	+
Level of work pace control: low (vs high)	3321	Wergeland & Strand 1998	x	X	x	0	1	0	1	+
Level of work pace control: medium (vs high)	3321	Wergeland & Strand 1998	x	X	x	0	1	0	1	+
Externally paced work (yes vs no)	3280	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Manual work (yes vs no)	3273	Wergeland & Strand 1998	1	0	0	x	x	x	1	+
Influence on work content (yes vs no)	3262	Wergeland & Strand 1998	0	0	1	x	x	x	1	+
Work with video display terminals (yes vs no)	3187	Wergeland & Strand 1998	0	0	1	x	x	x	1	+
Weekly hours of paid work ≥35 (yes vs no)	3186	Wergeland & Strand 1998	0	0	1	x	x	x	1	+
Weekly hours of pain work >40 (yes vs no)	3186	Wergeland & Strand 1998	0	0	1	x	x	x	1	+
Sick listed for back pain before pregnancy	855	Ostgaard et al 1991a	1	0	0	x	x	x	1	+
Economic dependence*	2853	Endresen 1995	x	X	x	1	0	0	1	+
Sex of colleagues (F/M; 0,1)^	2853	Endresen 1995	x	X	x	0	0	1	1	+
Work satisfaction	855	Ostgaard et al 1991a	0	0	1	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-28 GRADE table (short version) for potential socio-demographic risk factors for PLBP in any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 36)

3.8 Risk factors for PLPP

Eleven studies (10 papers) examined potential risk factors for PLPP. Of these, two studies (Malmqvist *et al.* 2012, Gjestland *et al.* 2013) also reported on other outcomes of interest in this review (PPGP and/or PLBP) but these findings are reported in sections 3.6 and 3.7. Full data, including the adjusted and unadjusted effect measures, (sub)outcomes, and data on subgroups, are provided in Appendices.

3.8.1 Risk factors for PLPP examined in >1 study

Twelve potential risk factors for PLPP were examined in more than one study. No meta-analyses was deemed appropriate. Full data are provided in appendix 37.

3.8.1.1 Physical factors

Eight physical potential risk factors for PLPP were examined in at least two studies (Table 3-29). Women with a history of low back pain, women with a history of low back pain in previous pregnancies, and women with a later gestational age were more likely to experience PLPP, although it did not seem to influence pain intensity and pain interference associated with PLPP. Two studies examined the association between a history of low back pain during menstruation and PLPP, but had inconsistent results.

Three studies assessed the association between parity and PLPP; however, findings were inconsistent with only one study (Mogren & Pohjanen 2005) reporting a significant increased likelihood of having PLPP with parity, although, in this study, there was no association between PLPP and having more than three children. The number of previous pregnancies that women had did not significantly impact whether or not they would develop PLPP.

Five studies examined the association between BMI and PLPP. Results were inconsistent with three studies indicating no association, while two studies found women with a higher BMI were at greater risk of developing PLPP. The workload of women did not significantly impact whether or not they would experience PLPP during pregnancy.

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Univariate			Multivariable			Dominant phase**	Overall quality
			+	0	-	+	0	-		
History of low back pain^	Chang et al 2014 (179); Ansari et al 2010 (103); Mohseni-Bandpei et al 2009 (1062)	3 (3)	2	0	0	2	1	0	1	+
Low back pain in previous pregnancies	Malmqvist et al 2012 (281); Mohseni-Bandpei et al 2009 (427)	2 (2)	2	0	0	1	0	0	1	+
History of low back pain during menstruation	Ansari et al 2012 (103); Melzack & Belanger 1989 (113)	2 (2)	1	1	0	x	x	x	1	+
Gestational age^	Chang et al 2014 (179); Al-Sayegh et al 2012 (280)	2 (2)	2	0	0	x	x	x	1	+
Parity*	Chang et al 2012 (183); Mohseni-Bandpei et al 2009 (1100); Mogren & Pohjanen et al 2005 (891)	3 (3)	1	1	0	1	2	0	1	+
Number of previous pregnancies	Al-Sayegh et al 2012 (280); Ansari et al 2010 (65)	2 (2)	0	2	0	x	x	x	1	+
Body Mass Index (BMI)	Al-Sayegh et al 2012 (280); Mohseni-Bandpei et al 2009 (608); Mogren & Pohjanen 2005 (514); Chang et al 2012 (183); Malmqvist et al 2012 (281)	5 (5)	2	3	0	1	0	0	1	+
Workload	Chang et al 2012 (183); Ansari et al 2010 (69)	2 (2)	0	1	0	0	1	0	1	+

** If equal number of studies in different phases, then this was based on number of participants; Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-29 GRADE table (short version) for potential physical risk factors for PLPP examined in more than one study (Full GRADE table in appendix 38)

3.8.1.2 Psychological factors

Pain catastrophising was found to be positively associated with developing PLPP in two studies (Table 3-30).

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Uni-variate			Multi-variate			Dominant phase**	Overall quality
			+	0	-	+	0	-		
Pain catastrophising^	Chang et al 2014 (179); Chang et al 2012 (183)	2 (2)	x	X	x	2	0	0	1	+

** If equal number of studies in different phases, then this was based on number of participants; Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-30 GRADE table (short version) for potential psychological risk factors for PLPP examined in more than one study (Full GRADE table in appendix 39)

3.8.1.3 Socio-demographic factors

Age, educational level and occupation were examined as potential risk factors for PLPP (Table 3-31). In the five studies that assessed age, no association was found with PLPP. The exception was Mohseni-Bandpei *et al.* (2009) who found that women aged 21-26 were more likely to have PLPP. Women's educational level was not related to whether or not they would experience PLPP, based on four studies. Only two studies examined the impact of women's occupation on PLPP. Being employed did not make women more or less likely to experience PLPP. The type of occupation also did not have a significant impact; except, women on parental leave or sick leave were more likely to experience high pain-score PLPP.

Potential risk factor identified	References (No. of participants)	No. of papers (no. of studies)	Univariate			Multivariable			Dominant phase**	Overall quality
			+	0	-	+	0	-		
Age	Al-Sayegh et al 2012 (280); Chang et al 2012 (183); Malmqvist et al 2012 (281); Mohseni-Bandpei et al 2009 (1062); Mogren & Pohjanen 2005 (456)	5 (5)	0	4	0	1*	2	0	1	+
Educational level^	Chang et al 2012 (183); Mohseni-Bandpei et al 2009 (160); Mogren & Pohjanen et al 2005 (891); Malmqvist et al 2012 (281)	4 (4)	0	3	0	0	4	0	1	++
Occupation^ (employed vs unemployed)	Mohseni-Bandpei et al 2009 (1062); Mogren 2005 (641)	2 (2)	0	2	0	0	1	0	1	+

** If equal number of studies in different phases, then this was based on number of participants. * Unclear from publication whether older or younger age was positively associated. Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-31 GRADE table (short version) for potential socio-demographic risk factors for PLPP examined in more than one study (Full GRADE table in appendix 40)

3.8.2 Risk factors for PLPP in the 1st trimester of pregnancy (examined in only 1 study)

Full data are provided in appendix 41.

3.8.2.1 Physical factors

We did not identify any studies that examined any physical risk factors for PLPP in the 1st trimester of pregnancy.

3.8.2.2 Psychological factors

Only Bakker *et al.* (2013) examined the impact of psychological factors on whether women would experience PLPP (Table 3-32). No subgroup analysis was carried out for nulliparous and multiparous women in this study and their assessment of PLPP did not include a physical examination.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Perceived stress (Perceived stress scale)	217	De Bakker et al 2013	1	0	0	1	0	0	2	++
Pregnancy-related anxiety	217	De Bakker et al 2013	1	0	0	1	0	0	2	++
Physical and psychologi-cal distress	217	De Bakker et al 2013	1	0	0	1	0	0	2	++
Coping styles: problem focused	217	De Bakker et al 2013	0	1	0	0	1	0	2	++
Coping styles: emotion focused	217	De Bakker et al 2013	0	1	0	0	1	0	2	++

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high.

Table 3-32 GRADE table (short version) for potential psychological risk factors for PLPP in the 1st trimester of pregnancy (Full GRADE table in appendix 42)

3.8.2.3 Socio-demographic factors

We did not identify any studies that examined any socio-demographic risk factors for PLPP in the 1st trimester of pregnancy.

3.8.3 Risk factors for PLPP in the 2nd trimester of pregnancy (examined in only 1 study)

Full data are provided in appendix 43.

3.8.3.1 Physical factors

We did not identify any studies that examined any physical risk factors for PLPP in the 2nd trimester of pregnancy.

3.8.3.2 Psychological factors

In addition to the 12 week gestation follow-up, Bakker *et al.* (2013) also assessed PLPP at 24 weeks gestation and examined the same psychological factors as in section 3.8.2.2 in terms of their relation with PLPP (Table 3-33).

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Perceived stress (Perceived stress scale)	98	De Bakker et al 2013	1	0	0	1	0	0	2	++
Pregnancy-related anxiety	98	De Bakker et al 2013	0	1	0	0	1	0	2	++
Physical and psychological distress	98	De Bakker et al 2013	0	1	0	0	1	0	2	++
Coping styles: problem focused	98	De Bakker et al 2013	0	1	0	0	1	0	2	++
Coping styles: emotion focused	98	De Bakker et al 2013	0	1	0	0	1	0	2	++
Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high.										

Table 3-33 GRADE table (short version) for potential psychological risk factors for PLPP in the 2nd trimester of pregnancy (Full GRADE table in appendix 44)

3.8.3.3 Socio-demographic factors

We did not identify any studies that examined any socio-demographic risk factors for PLPP in the 2nd trimester of pregnancy.

3.8.4 Risk factors for PLPP in the 3rd trimester of pregnancy (examined in only 1 study)

Full data are provided in appendix 45.

3.8.4.1 Physical factors

Three studies reported potential physical risk factors for PLPP in the third trimester of pregnancy (Table 3-34). Chang *et al.* (2014) excluded anterior pain of the pelvic girdle from their definition of PLPP. Both Chang *et al.* (2012) and Chang *et al.* (2014) measured the outcomes pain intensity and pain interference related to PLPP. None of the three studies included a physical examination in their assessment of PLPP, nor did they report findings for nulliparous and multiparous women separately.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Average pain intensity at gestation week 24^	179	Chang et al 2014	x	X	x	1	0	0	1	+
Average pain intensity this pregnancy	183	Chang et al 2012	x	X	x	1	0	0	1	+
History of lumbopelvic pain before pregnancy^	183	Chang et al 2012	x	X	x	0	1	0	1	+
Physical workload^	179	Chang et al 2014	x	X	x	0	1	0	1	+
Exercise frequency 1-2 per week during pregnancy (vs <1 per week)	2013	Gjestland et al 2013	0	1	0	0	1	0	2	+
Exercise frequency ≥3 per week during pregnancy (vs <1 per week)	1575	Gjestland et al 2013	0	1	0	0	1	0	2	+
Regular exercise^	183	Chang et al 2012	x	X	x	0	1	0	1	+
Amniotic fluid index^	183	Chang et al 2012	x	X	x	0	1	0	1	+
Estimated body weight (fetus)^	183	Chang et al 2012	x	X	x	0	1	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-34 GRADE table (short version) for potential physical risk factors for PLPP in the 3rd trimester of pregnancy (Full GRADE table in appendix 46)

3.8.4.2 Psychological factors

Bakker *et al.* (2013) conducted a third follow-up in the third trimester of pregnancy for the same five psychological factors (Section 3.8.2.2 and 3.8.3.2). In addition, Chang *et al.* (2014) examined the impact of depression on experiencing PLPP in the 3rd trimester (Table 3-35).

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Depression*	179	Chang et al 2014	x	x	X	1	0	0	1	+
Perceived stress (Perceived stress scale)	171	De Bakker et al 2013	0	1	0	0	1	0	2	++
Pregnancy-related anxiety	171	De Bakker et al 2013	0	1	0	0	1	0	2	++
Physical and psychological distress	171	De Bakker et al 2013	0	1	0	0	1	0	2	++
Coping styles: problem focused	171	De Bakker et al 2013	0	1	0	0	1	0	2	++
Coping styles: emotion focused	171	De Bakker et al 2013	0	1	0	0	1	0	2	++

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-35 GRADE table (short version) for potential psychological risk factors for PLPP in the 3rd trimester of pregnancy (Full GRADE table in appendix 47)

3.8.4.3 Socio-demographic factors

Two studies assessed the association between socio-demographic factors and PLPP in the third trimester, both which examined pain intensity and interference related to PLPP as outcomes, although Chang *et al.* (2014) only included women with posterior symptoms (Table 3-36).

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Social support^	179	Chang et al 2014	x	X	x	0	1	0	1	+
Monthly income NTD 19999 or below^	183	Chang et al 2012	x	X	x	0	1	0	1	+
Monthly income NTD 20000-39999^	183	Chang et al 2012	x	X	x	0	1	0	1	+
Monthly income NTD 60000-79999^	183	Chang et al 2012	x	X	x	0	1	0	1	+
Monthly income NTD 80000 or above^	183	Chang et al 2012	x	X	x	0	1	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-36 GRADE table (short version) for potential socio-demographic risk factors for PLPP in the 3rd trimester of pregnancy (Full GRADE table in appendix 48)

3.8.5 Risk factors for PLPP (any trimester/trimester not stated) (examined in only 1 study)

Full data are provided in appendix 49.

3.8.5.1 Physical factors

Seven studies examined a variety of potential physical risk factors for PLPP whereby the time of follow-up was not specified or included women with PLPP in any trimester (Table 3-37 to Table 3-40). These studies did not include a physical examination in assessing PLPP. Malmqvist *et al.* (2012) only included women with moderate to severe PLPP and Mogren (2005) examined both any PLPP and high pain-score PLPP as outcomes. Mogren (2005) was the only study that conducted subgroup analysis for nulliparous women for some factors.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
History of acute low back pain (3 or more episodes of pain which lasted 3 days or more during the 5 years before pregnancy)	113	Melzack & Belanger 1989	1	0	0	x	x	x	1	+
History of lumbopelvic pain before pregnancy	280	El-Sayegh et al 2012	1	0	0	x	x	x	1	+
Low back pain in the year before pregnancy	281	Malmqvist et al 2012	1	0	0	x	x	x	1	+
Pelvic girdle pain in the year before pregnancy	281	Malmqvist et al 2012	1	0	0	x	x	x	1	+
History of lumbopelvic pain in past pregnancies	281	El-Sayegh et al 2012	1	0	0	x	x	x	1	+
History of lumbopelvic pain during menstruation	280	El-Sayegh et al 2012	0	1	0	x	x	x	1	+
History of menstrual pain front (abdomen)	113	Melzack & Belanger 1989	0	1	0	x	x	x	1	+
History of PLPP in mother*	891	Mogren & Pohjanen 2005	0	1	0	0	1	0	1	+
At least 1 sister with history of PLPP	891	Mogren & Pohjanen 2005	1	0	0	1	0	0	1	++
Exercised at least 2-3 times a week before pregnancy	281	Malmqvist et al 2012	0	1	0	x	x	x	1	+
Regular physical activity during some period in life (yes vs no)^	881	Mogren 2005	0	1	0	x	x	x	1	+
Age at start of Regular physical activity ^	677	Mogren 2005	0	1	0	x	x	x	1	+
No. of years of regular physical activity: 6-10 (vs 1-5)^	891	Mogren 2005	0	1	0	0	1	0	1	+
No. of years of regular physical activity: 11-15 (vs 1-5)^	891	Mogren 2005	0	1	0	0	1	0	1	+
No. of years of regular physical activity: 16-20 (vs 1-5)^	891	Mogren 2005	0	1	0	0	1	0	1	+
No. of years of regular physical activity: 21-38 (vs 1-5)^	891	Mogren 2005	1	0	0	1	0	0	1	+

Table 3-37 GRADE table (short version) for potential physical risk factors for PLPP in the any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 50)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Trimester of pregnancy: first	280	El-Sayegh et al 2012	1	0	0	x	x	x	1	+
Trimester of pregnancy: first or second	280	El-Sayegh et al 2012	1	0	0	x	x	x	1	+
OCP	280	El-Sayegh et al 2012	0	1	0	x	x	x	1	+
Combined OCP (Yes vs no)	891	Mogren & Pohjanen 2005	0	1	0	x	x	x	1	+
Mini pill (Yes vs no)	891	Mogren & Pohjanen 2005	0	1	0	x	x	x	1	+
No. of prior deliveries: 1 (vs 0)	71	Ansari et al 2010	0	1	0	x	x	x	1	+
No. of prior deliveries: 2 (vs 0)	58	Ansari et al 2010	0	1	0	x	x	x	1	+
No. of prior deliveries: 3 (vs 0)	47	Ansari et al 2010	0	1	0	x	x	x	1	+
No. of prior deliveries: ≥4 (vs 0)	44	Ansari et al 2010	0	1	0	x	x	x	1	+
Multiple gestations	280	El-Sayegh et al 2012	0	1	0	x	x	x	1	+
Spinal or epidural anaesthesia	280	El-Sayegh et al 2012	0	1	0	x	x	x	1	+
Number of abortions: 1 (vs 0)	101	Ansari et al 2010	0	1	0	x	x	x	1	+
Number of abortions: ≥2 (vs 0)	92	Ansari et al 2010	0	1	0	x	x	x	1	+
Trauma during pregnancy	103	Ansari et al 2010	0	1	0	x	x	x	1	+
Self-rated health: healthy (vs unhealthy)	1062	Mohseni-Bandpei et al 2009	0	0	1	0	0	1	1	+
Age of menarche	891	Mogren & Pohjanen 2005	0	1	0	x	x	x	1	+
History of Menstruations: mainly irregular (vs mainly regular)	789	Mogren & Pohjanen 2005	0	1	0	x	x	x	1	+
History of Menstruations: mainly regular with one or more periods of amenorrhea (vs mainly regular)	755	Mogren & Pohjanen 2005	1	0	0	x	x	x	1	+

Table 3-38 GRADE table (short version) for potential physical risk factors for PLPP in the any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 50)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
History of Menstruations: mainly irregular with one or more periods of amenorrhea (vs mainly regular)	748	Mogren & Pohjanen 2005	0	1	0	x	x	x	1	+
History of Menstruations: other bleeding pattern (vs mainly regular)	713	Mogren & Pohjanen 2005	0	1	0	x	x	x	1	+
one or more periods of amenorrhea (irrespective of regular or irregular) (vs mainly regular)^	891	Mogren & Pohjanen 2005	1	0	0	1	0	0	1	+
Diagnosed with hypermobility (vs not diagnosed with hypermobility)^	891	Mogren & Pohjanen 2005	1	0	0	1	0	0	1	+
Diagnosed with hypermobility and/or with a history of hypermobility in the family (yes vs no)	891	Mogren & Pohjanen 2005	1	0	0	1	0	0	1	+
Mainly active occupation (vs sedentary)*	595	Mogren 2005	0	1	0	x	x	x	1	+
Alternating sedentary and active occupation (vs sedentary)*	441	Mogren 2005	0	1	0	x	x	x	1	+
Physically demanding occupation (vs physically light occupation)^	501	Mogren 2005	1	0	0	x	x	x	1	+
Alternating physically demanding and light occupation (vs physically light occupation)^	616	Mogren 2005	0	1	0	x	x	x	1	+
Physically heavy work	281	Malmqvist et al 2012	1	0	0	x	x	x	1	+
Lifting heavy loads at work (10-20 kg)	1116	Endresen 1995	x	X	x	1	0	0	1	+
Strain at work	1228	Endresen 1995	x	X	x	1	0	0	1	+
Twisting and bending	1116	Endresen 1995	x	X	x	1	0	0	1	+
Work above shoulders	1228	Endresen 1995	x	X	x	1	0	0	1	+
PPGP in previous pregnancies	281	Malmqvist et al 2012	1	0	0	x	x	x	1	+

Table 3-39 GRADE table (short version) for potential physical risk factors for PLPP in the any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 50)

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Nulliparous (vs multiparous)	281	Malmqvist et al 2012	0	1	0	x	x	x	1	+
Smoking	280	El-Sayegh et al 2012	0	1	0	x	x	x	1	+
Birthweight baby: ≥4000g (<4000g)	891	Mogren & Pohjanen 2005	1	0	0	0	1	0	1	+
Maternal weight gain	103	Ansari et al 2010	0	1	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-40 GRADE table (short version) for potential physical risk factors for PLPP in the any trimester of pregnancy or the trimester was not stated - continued (Full GRADE table in appendix 50)

3.8.5.2 Psychological factors

Mogren (2005) assessed psychological aspects of women's occupation in relation to PLPP (Table 3-41). Subgroup analysis was conducted for the outcome high pain-score PLPP.

Potential risk factor identified	No. of partici-pants	Referen-ce(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Mentally unstimulating occupation (vs mentally stimulating occupation)^	388	Mogren 2005	0	1	0	x	X	x	1	+
Alternating mentally unstimulating and stimulating occupation (vs mentally stimulating occupation)^	611	Mogren 2005	0	1	0	x	X	x	1	+
Intellectually unstimulating occupation (vs intellectually stimulating occupation)^	487	Mogren 2005	0	1	0	x	X	x	1	+
Alternating Intellectually unstimulating and stimulating occupation (vs Intellectually stimulating occupation)	724	Mogren 2005	0	1	0	x	X	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-41 GRADE table (short version) for potential psychological risk factors for PLPP in the any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 51)

3.8.5.3 Socio-demographic factors

Mohseni-Bandpei *et al.* (2009) and Endresen (1995) assessed socio-demographic factors and their association with PLPP in any trimester of pregnancy (Table 3-42). They did not include a physical examination in assessing for PLPP and did not conduct any subgroup analysis.

Potential risk factor identified	No. of partici-pants	Reference(s)	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Living area: rural (vs urban)	1062	Mohseni-Bandpei et al 2009	0	0	1	0	0	1	1	+
Assistant for housework: with servant (vs without servant)	1062	Mohseni-Bandpei et al 2009	0	0	1	1	0	0	1	+
Woman's year of birth	1228	Endresen 1995	x	x	X	1	0	0	1	+
Sex of colleagues (F/M; 0,1)	1228	Endresen 1995	x	x	X	0	0	1	1	+
Permanently employed	1228	Endresen 1995	x	x	X	0	0	1	1	+
Occupation: Student (vs unemployed/searching for work)^	142	Mogren 2005	0	1	0	x	x	x	1	+
Occupation: Parental leave (vs unemployed/ searching for work)*	102	Mogren 2005	0	1	0	x	x	x	1	+
Occupation: Sick leave (vs unemployed/ searching for work)*	112	Mogren 2005	0	1	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-42 GRADE table (short version) for potential socio-demographic risk factors for PLPP in the any trimester of pregnancy or the trimester was not stated (Full GRADE table in appendix 52)

3.9 Prognostic factors for PPGP

Three papers (Robinson *et al.* 2010b, Bjelland *et al.* 2013b, Bjelland *et al.* 2013c) from two studies examined prognostic factors for PPGP. Bjelland *et al.* (2013c) and Bjelland *et al.* (2013b) more specifically examined the outcome persistent pelvic girdle syndrome, which is one subgroup of PPGP whereby the woman experiences pain of the pubic symphysis and both sacroiliac joints, and also conducted subgroup analysis for severe pelvic girdle syndrome.

3.9.1 Prognostic factors for PPGP persisting up to one month postpartum

We did not identify any studies that examined any prognostic factors for PPGP persisting up to one month postpartum.

3.9.2 Prognostic factors for PPGP persisting ≥ 1 month and < 3 months postpartum

Full data are provided in appendix 53.

3.9.2.1 Physical Factors

Robinson *et al.* (2010b) examined several physical factors potentially affecting the prognosis of PPGP at 12 weeks postpartum (Table 3-43). Analysis included 179 participants. This study included a physical examination in its assessment of PPGP but did not report findings according to parity or a history of low back and/or pelvic girdle pain, hence subgroup analyses could not be carried out.

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Pre-pregnancy low back pain	179	Robinson et al 2010b	1	0	0	1	0	0	1	+
Pain in 1 locations of the pelvic girdle*	179	Robinson et al 2010b	1	0	0	1	0	0	1	+
Pain in 2 locations of the pelvic girdle^	179	Robinson et al 2010b	0	1	0	0	1	0	1	+
Pain in ≥3 locations of the pelvic girdle^	179	Robinson et al 2010b	1	0	0	1	0	0	1	+
Pre-pregnancy BMI ≥25*	179	Robinson et al 2010b	1	0	0	0	1	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-43 GRADE table (short version) for potential physical prognostic factors for PPGP persisting 1-3 months postpartum (Full GRADE table in appendix 54)

3.9.2.2 Psychological Factors

We did not identify any studies that examined any psychological prognostic factors for PPGP persisting 1-3 months postpartum.

3.9.2.3 Socio-demographic Factors

We did not identify any studies that examined any socio-demographic prognostic factors for PPGP persisting 1-3 months postpartum.

3.9.3 Prognostic factors for PPGP persisting ≥ 3 months and < 6 months postpartum

No studies were identified that examined any prognostic factors for PPGP persisting between 3-6 months postpartum.

3.9.4 Prognostic factors for PPGP persisting ≥ 6 months and < 9 months postpartum

Full data are provided in appendix 55.

3.9.4.1 Physical Factors

Two studies (Bjelland *et al.* 2013b, Bjelland *et al.* 2013c) involving the same cohort of women examined several potential physical factors (Table 3-44) affecting the prognosis of (severe) pelvic girdle syndrome. None of the studies included a physical examination in their assessment and no studies reported findings according to parity or a history of low back and/or pelvic girdle pain, hence the subgroup analyses could not be carried out.

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Obstetric complications^	10400	Bjelland et al 2013c	0	1	0	0	1	0	2	+
Birthweight <3000g^	9753	Bjelland et al 2013c	0	1	0	0	1	0	2	+
Birthweight ≥4500g^	9489	Bjelland et al 2013c	0	1	0	0	1	0	2	+
BMI 25-30 (vs <25)	34103	Bjelland et al 2013b	1	0	0	0	1	0	2	+
BMI ≥30 (vs <25)	27025	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Occasional smoker*	38865	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Daily smoker^	38856	Bjelland et al 2013b	1	0	0	0	1	0	2	+
Instrumental delivery*	9002	Bjelland et al 2013c	1	0	0	1	0	0	2	+
Emergency caesarean section*	9060	Bjelland et al 2013c	0	1	0	0	1	0	2	+
Planned caesarean section*	8952	Bjelland et al 2013c	0	1	0	0	1	0	2	+
Other pain conditions^	10400	Bjelland et al 2013c	1	0	0	1	0	0	2	+
Use of crutches in week 30 of pregnancy^	10400	Bjelland et al 2013c	1	0	0	1	0	0	2	++
Co-morbidity index: 1 disease*	25313	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Co-morbidity index: 2-3 disease^	25093	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Co-morbidity index: ≥4 disease^	13165	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Age of menarche ≤10 (vs ≥13)^	26126	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Age of menarche 11 (vs ≥13)^	29383	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Age of menarche 12 (vs ≥13)*	35736	Bjelland et al 2013b	1	0	0	0	1	0	2	+
Previous low back pain^	41421	Bjelland et al 2013b	1	0	0	1	0	0	2	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-44 GRADE table (short version) for potential physical prognostic factors for PPGP persisting 6-9 months postpartum (Full GRADE table in appendix 56)

3.9.4.2 Psychological Factors

Bjelland *et al.* (2013b) examined the effect of emotional distress on the prognosis of pelvic girdle syndrome six months postpartum (this data was also reported in Bjelland *et al.* (2013c) but on a smaller sample of the same cohort) (Table 3-45). This study did not include a physical examination in the assessment of PPGP and did not report findings according to parity or a history of low back and/or pelvic girdle pain, hence subgroup analyses could not be carried out.

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Emotional distress at 17 weeks or 30 weeks pregnancy^	40029	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Emotional distress at 17 weeks and 30 weeks pregnancy^	37909	Bjelland et al 2013b	1	0	0	1	0	0	2	+
Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.										

Table 3-45 GRADE table (short version) for potential psychological prognostic factors for PPGP persisting 6-9 months postpartum (Full GRADE table in appendix 57)

3.9.4.3 Socio-demographic Factors

No studies were identified that examined any socio-demographic prognostic factors for PPGP persisting between 6-9 months postpartum.

3.9.5 Prognostic factors for PPGP persisting ≥ 9 months and ≤ 12 months postpartum

No studies were identified that examined any prognostic factors for PPGP persisting between 9-12 months postpartum.

3.10 Prognostic factors for PLBP

No studies were identified that examined any prognostic factors for PLBP persisting postpartum.

3.11 Prognostic factors for PLPP

Five papers (Mogren 2006, Mogren 2007b, Mogren 2007a, 2008, Olsson *et al.* 2012) reporting on two studies examined prognostic factors for PLPP. All papers by Mogren conducted further subgroup analyses for 'recurrent' and 'continuous' PLPP.

3.11.1 Prognostic factors for PLPP persisting up to one month postpartum

No studies were identified that examined any prognostic factors for PLPP persisting up to one month postpartum.

3.11.2 Prognostic factors for PLPP persisting ≥ 1 months and < 3 months postpartum

No studies were identified that examined any prognostic factors for PLPP persisting between 1-3 months postpartum.

3.11.3 Prognostic factors for PLPP persisting ≥ 3 months and < 6 months postpartum

No studies were identified that examined any prognostic factors for PLPP persisting between 3-6 months postpartum.

3.11.4 Prognostic factors for PLPP persisting ≥ 6 months and < 9 months postpartum

Full data are provided in appendix 58.

3.11.4.1 Physical Factors

Four papers (Mogren 2006, 2007a, 2008, Olsson *et al.* 2012) examined several physical factors and their effect on the prognosis of PLPP, of which three reports examined different factors on the same cohort (Mogren 2006, 2007a, 2008) (Table 3-46 and Table 3-47). These three papers differentiated between recurrent and continuous PLPP. None of the studies included a physical examination in their assessment of PLPP and no studies reported findings according to parity or a history of low back and/or pelvic girdle pain, hence the subgroup analyses could not be carried out.

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Vacuum extraction vs unassisted vaginal delivery^	376	Mogren 2006	0	1	0	x	x	x	1	+
Forceps vs unassisted vaginal delivery^	345	Mogren 2006	0	1	0	x	x	x	1	+
Elective caesarean vs unassisted vaginal delivery^	386	Mogren 2006	1	0	0	x	x	x	1	+
Emergency caesarean vs unassisted vaginal delivery^	384	Mogren 2006	0	1	0	x	x	x	1	+
Caesarean section vs no caesarean	110	Olsson et al 2012	0	1	0	x	x	x	1	+
Elective caesarean vs emergency caesarean*	86	Mogren 2007a	1	0	0	1	0	0	2	+++
Epidural or spinal anaesthesia during delivery^	462	Mogren 2007a	0	1	0	x	x	x	1	+
Epidural or spinal anaesthesia during caesarean section*	85	Mogren 2007a	0	1	0	x	x	x	1	+
Exercise before pregnancy	111	Olsson et al 2012	0	1	0	x	x	x	1	+
Pre-pregnancy physical activity*	461	Mogren 2008	0	0	1	x	x	x	1	+
Age at the start of physical activity^	341	Mogren 2008	0	1	0	x	x	x	1	+
Mean number of weekly events of physical activity^	189	Mogren 2008	0	1	0	x	x	x	1	+
Start of physical activity after pregnancy^	186	Mogren 2008	0	1	0	x	x	x	1	+
Exercise at present	110	Olsson et al 2012	0	1	0	0	1	0	1	+
Current physical activity*	463	Mogren 2008	0	1	0	x	x	x	1	+
Number of years of physical activity 6-10 (vs 1-5)	369	Mogren 2008	0	1	0	0	1	0	2	+
Number of years of physical activity 11-15 (vs 1-5)	370	Mogren 2008	0	1	0	0	1	0	2	+
Number of years of physical activity 16-20 (vs 1-5)	371	Mogren 2008	0	1	0	0	1	0	2	+

Table 3-46 GRADE table (short version) for potential physical prognostic factors for PLPP persisting 6-9 months postpartum (Full GRADE table in appendix 59)

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Number of years of physical activity 21-38 (vs 1-5)	372	Mogren 2008	0	1	0	0	1	0	2	+
Previous pregnancies	111	Olsson et al 2012	0	1	0	x	x	x	1	+
Reporting pain daily or constant pain during pregnancy	112	Olsson et al 2012	0	1	0	x	x	x	1	+
Pain intensity >33 (100 scale VAS) during pregnancy	112	Olsson et al 2012	0	1	0	0	1	0	1	+
Pain intensity >69 (100 scale VAS) at worst during pregnancy	112	Olsson et al 2012	0	1	0	0	1	0	1	+
Onset of PLPP ≤11 weeks gestation	112	Olsson et al 2012	1	0	0	0	1	0	1	+
Disability Rating Index total <25 during pregnancy	112	Olsson et al 2012	0	1	0	1	0	0	1	+
Maximum pain level during pregnancy >2-4 (10 scale VAS)	436	Mogren 2006	0	1	0	0	1	0	1	+
Maximum pain level during pregnancy >4-6 (10 scale VAS)	436	Mogren 2006	1	0	0	0	1	0	1	+
Maximum pain level during pregnancy >6-8 (10 scale VAS)	436	Mogren 2006	1	0	0	1	0	0	1	++
Maximum pain level during pregnancy >8-10 (10 scale VAS)	436	Mogren 2006	1	0	0	1	0	0	1	++
Hypermobility (reported being diagnosis)^	458	Mogren 2006	0	1	0	x	x	x	1	+
Hypermobility (reported being diagnosis and/or perception)*	458	Mogren 2006	1	0	0	x	x	x	1	+
Nottingham health profile >13.6 (vs ≤13.6)	112	Olsson et al 2012	1	0	0	1	0	0	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: + (coloured orange), rated lower than very low; +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-47 GRADE table (short version) for potential physical prognostic factors for PLPP persisting 6-9 months postpartum - continued (Full GRADE table in appendix 59)

3.11.4.2 Psychological Factors

Three papers examined potential psychological prognostic factors for PLPP persisting 6 months postpartum of which two involved the same cohort of women (Mogren 2006, Mogren 2007b, Olsson *et al.* 2012) (Table 3-48 and Table 3-49). None of the studies included a physical examination in their assessment of PLPP and no studies reported findings according to parity or a history of low back and/or pelvic girdle pain, hence the subgroup analyses could not be carried out.

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Pain Catastrophising (PCS score >17)	112	Olsson et al 2012	0	1	0	1	0	0	1	+
Fear avoidance beliefs (FABQ >12.3)	112	Olsson et al 2012	0	1	0	0	1	0	1	+
Perceived health before pregnancy: very good vs quite good^	414	Mogren 2007b	0	0	1	x	x	x	1	+
Perceived health before pregnancy: fair vs quite good^	251	Mogren 2007b	0	1	0	x	x	x	1	+
Perceived health before pregnancy: quite poor vs quite good^	219	Mogren 2007b	0	1	0	x	x	x	1	+
Perceived health before pregnancy: poor vs quite good^	213	Mogren 2007b	0	1	0	x	x	x	1	+
Perceived health during pregnancy: very good vs quite good^	246	Mogren 2007b	0	1	0	x	x	x	1	+
Perceived health during pregnancy: fair vs quite good^	300	Mogren 2007b	0	1	0	x	x	x	1	+
Perceived health during pregnancy: quite poor vs quite good*	218	Mogren 2007b	1	0	0	x	x	x	1	+
Perceived health during pregnancy: poor vs quite good*	184	Mogren 2007b	1	0	0	x	x	x	1	+

Table 3-48 GRADE table (short version) for potential psychological prognostic factors for PLPP persisting 6-9 months postpartum (Full GRADE table in appendix 60)

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Perceived health after pregnancy: very good vs quite good^	344	Mogren 2007b	0	0	1	x	x	x	1	+
Perceived health after pregnancy: fair vs quite good*	297	Mogren 2007b	1	0	0	x	x	x	1	+
Perceived health after pregnancy: quite poor vs quite good*	221	Mogren 2007b	0	1	0	x	x	x	1	+
Perceived health after pregnancy: poor vs quite good*	221	Mogren 2007b	0	1	0	x	x	x	1	+
Satisfaction with pre-pregnancy weight*	462	Mogren 2006	0	1	0	x	x	x	1	+
Perceived problems with actual or previous weight*	457	Mogren 2006	0	1	0	x	x	x	1	+
No satisfying sexual life before pregnancy^	440	Mogren 2007b	0	1	0	x	x	x	1	+
No satisfying sexual life during pregnancy^	411	Mogren 2007b	1	0	0	x	x	x	1	+
No satisfying sexual life after pregnancy^	414	Mogren 2007b	0	1	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-49 GRADE table (short version) for potential psychological prognostic factors for PLPP persisting 6-9 months postpartum - continued (Full GRADE table in appendix 60)

3.11.4.3 Socio-demographic Factors

Three papers (Mogren 2006, Mogren 2007b, Olsson *et al.* 2012) examined the prognostic ability of several socio-demographic factors related to women's family situation, relationship, occupation, education and sick leave (Table 3-50 and Table 3-51). None of the studies included a physical examination in their assessment of PLPP and no studies reported findings according to parity or a history of low back and/or pelvic girdle pain, hence subgroup analyses could not be carried out.

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Married or cohabiting	111	Olsson et al 2012	0	1	0	x	x	x	1	+
Cohabiting (asked within 24 hrs after birth) vs married ^	451	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship not cohabiting (asked within 24 hrs after birth) vs married ^	166	Mogren 2007b	0	1	0	x	x	x	1	+
Single mother (asked within 24 hrs after birth) vs married ^	165	Mogren 2007b	0	1	0	x	x	x	1	+
Cohabiting (6 months pp) vs married ^	453	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship not cohabiting (6 months pp) vs married ^	169	Mogren 2007b	0	1	0	x	x	x	1	+
Single mother (6 months pp) vs married ^	171	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship before pregnancy (very good vs good)^	444	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship during pregnancy (neither good nor bas vs good)^	95	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship during pregnancy (bad vs good)^	85	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship during pregnancy (very bad vs good)^	87	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship after pregnancy (asked at 6 months pp) (very good vs good)^	407	Mogren 2007b	0	1	0	x	x	x	1	+

Table 3-50 GRADE table (short version) for potential socio-demographic prognostic factors for PLPP persisting 6-9 months postpartum (Full GRADE table in appendix 61)

Potential prognostic factor identified	No. of partici-pants	Reference	Univariate			Multivariable			Phase	Overall quality
			+	0	-	+	0	-		
Relationship after pregnancy (asked at 6 months pp) (very good vs good)^	407	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship after pregnancy (asked at 6 months pp)(neither good nor bas vs good)^	225	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship after pregnancy (asked at 6 months pp) (bad vs good)^	180	Mogren 2007b	0	1	0	x	x	x	1	+
Relationship after pregnancy (asked at 6 months pp) (very bad vs good)^	179	Mogren 2007b	0	1	0	x	x	x	1	+
Change in relationship during pregnancy: improved vs no difference^	429	Mogren 2007b	0	1	0	x	x	x	1	+
Change in relationship during pregnancy: impaired vs no difference*	277	Mogren 2007b	0	1	0	x	x	x	1	+
Change in relationship after pregnancy: improved vs no difference^	393	Mogren 2007b	0	1	0	x	x	x	1	+
Change in relationship after pregnancy: impaired vs no difference^	330	Mogren 2007b	0	1	0	x	x	x	1	+
Sedentary occupation	98	Olsson et al 2012	0	1	0	x	x	x	1	+
Sick leave	111	Olsson et al 2012	0	1	0	x	x	x	1	+
Educational level^	463	Mogren 2006	0	1	0	x	x	x	1	+

Phase, phase of investigation. For uni- and multivariable analyses: +, number of significant effects with a positive value; 0, number of non-significant effects; -, number of effects with a negative value; x, not reported. For overall quality of evidence: +, very low; ++, low; +++, moderate; ++++, high. After the name of the factor: *, subgroups present with inconsistent findings; ^, subgroups present with consistent findings.

Table 3-51 GRADE table (short version) for potential socio-demographic prognostic factors for PLPP persisting 6-9 months postpartum - continued (Full GRADE table in appendix 61)

3.11.5 Prognostic factors for PLPP persisting ≥ 9 months and ≤ 12 months postpartum

No studies were identified that examined any prognostic factors for PLPP persisting between 9-12 months postpartum.

3.12 Discussion

The findings of this systematic review are discussed separately for risk and prognostic factors for PPGP, PLBP and PLPP. This discussion provides a narrative summary of the factors and discusses issues concerning risk of bias and the quality of evidence (GRADE).

3.12.1 Risk factors for PPGP, PLBP and PLPP

In this comprehensive review, 168 risk factors for PPGP, 92 factors for PLBP, and 107 for PLPP were evaluated in 36 papers (30 studies). The vast majority of those factors was only examined in a single study and the quality of evidence was graded as either low or very low using the adapted GRADE assessment (Huguet *et al.* 2013). A history of low back pain was a risk factor for pelvic girdle syndrome (2 studies, 62781 participants, OR 2.18, 95% CI 1.18-4.02), and a history of PPGP was a significant risk factor PPGP in subsequent pregnancies (2 studies, 1672 participants, OR 11.53, 95% CI 7.71-17.25). A history of low back pain or pelvic girdle pain, in previous pregnancies or not related to pregnancy, were also risk factors for developing PLBP and PLPP. Increased parity was not associated with PLBP and PLPP, but findings for PPGP were inconsistent across studies with some studies suggesting that increased parity is associated with PPGP (2 studies, 732 participants, OR 1.94, 95% CI 1.50-2.52). Similarly, being obese (BMI ≥30) was associated with PPGP in most (although not all) studies, but this was not the case for the outcome PLBP. Age was not associated with PLBP or PLPP, but interestingly, half of the studies that examined the association between age and PPGP found that an older age was protective. Higher gestational age was associated with PPGP and PLPP, but not PLBP. A lower educational level was associated with PPGP, but not PLBP and PLPP. The evidence regarding the relation between smoking and PPGP, PLBP and PLPP was conflicting. Physically demanding/heavy work was not associated with

PLBP and PPGP in the second trimester or any trimester of pregnancy, but was positively associated with PPGP in the third trimester and with PLPP.

For factors that were only examined in a single study, it is more difficult to draw strong conclusions. The inherent nature of observational research is open to bias, hence repetition of research with consistent results increases the certainty with which we can determine risk factors. These factors included twisting and bending and lifting at work which were positively associated with both PPGP, PLBP and PLPP. A history of trauma to the back was positively associated with PPGP, but not examined in relation to PLBP and PLPP. Women's level of exercise/physical activity was not associated with PPGP, PLBP or PLPP, the exception being for women with PPGP in any trimester, exercising 2-3 times a week had a protective effect.

There was no association between hormonal contraception and PLBP or PLPP. Results from studies examining hormonal contraception in relation to PPGP were conflicting. Progestin intrauterine devices and long term use of progestin-only contraception may increase the risk for pelvic girdle syndrome in the third trimester. Any hormonal contraception may also be positively associated with PPGP in any trimester, although results were conflicting in terms of the length of contraception use. Diabetes mellitus and gestational diabetes were positively associated with PPGP, but were not assessed in relation to PLBP and PLPP. Evidence on the relation between age of menarche and PPGP was conflicting. Age of menarche was not associated with PLPP and not examined in relation to PLBP. In terms of psychological factors, PPGP was associated with depression, anxiety and stress. Depression and anxiety were also associated with PLBP in the third trimester, but not with PLBP in any trimester. The relation between PLBP and stress had not been examined in any study. Finally, PLPP in the first trimester was positively associated with stress, depression and anxiety, but only with stress in the second trimester, and only with depression in the third trimester. Pain catastrophising was positively associated with PLPP.

This review represents the current best available evidence on risk factors for PPGP, PLBP and PLPP, but its findings also present a challenge to further unravel the role of each individual risk factor in the development of these conditions. Issues to consider include the consistency of the association across studies, and, if present, the strength of the association, the timing of the association and the dose-response relation where appropriate. For example, there is a positive association between anxiety and PPGP/PLBP, but anxiety has also been linked to low back pain not related to pregnancy (Pincus *et al.* 2002) and a history of low back pain is also associated with PPGP/PLBP. For other factors, variables are dichotomised and the choice of cut-off point may also influence the result. There is a clear need for further research to assess these aspects of and inter-relations between factors.

This review also emphasises the difficulty of varying terminology in the current literature and a lack of detail in reporting definitions of outcomes and factors. More consistency of definitions and terminology can hopefully be expected in future since clear guidelines have been published (Vleeming *et al.* 2008). Nine papers (eight studies) reported findings for PLPP only, without differentiating between PPGP and PLBP. The inclusion of a potentially more heterogeneous groups may lead to confounding of associations, and future research would best differentiate PPGP from PLBP. Detailed information about the reliability and validity of the instrument or method used to assess the factor(s) and outcome was often lacking. In addition, efforts should be made to clearly report times of follow-up.

The findings of this review can be used to design robust prospective observational studies to further understand the development of PPGP and PLBP. Such research can provide strategies to improve management of these common conditions. For now, the findings of this review present the best available evidence of risk factors for PPGP and PLBP, and can be used to develop intervention studies to target modifiable risk factors.

3.12.2 Prognostic factors for PPGP and PLPP

Twenty-six potential prognostic factors for PPGP and 73 for PLPP were examined in eight papers (4 studies). Experiencing pain in ≥3 locations of the pelvic girdle during pregnancy made women more likely to have persistent PPGP symptoms 12 weeks postpartum. Having had low back pain before pregnancy did not affect the prognosis 12 weeks postpartum, but was associated with persistent PPGP six months after birth. Instrumental birth was positively associated with persistent PPGP, but there was no such association with caesarean section (emergency or elective). On the other hand, persistent PLPP was positively associated with elective caesarean section, but not with instrumental birth. Some factors were only associated with persistent symptoms for a subgroup of the sample. Having a caesarean section (planned or emergency) was associated with persistent pelvic girdle syndrome (pain in pubic symphysis and both sacroiliac joints) six months postpartum, although this was not the case for women who had not had to use crutches in the 30th week of pregnancy. Having one other disease or being an occasional smoker were positively associated with persistent pelvic girdle syndrome, but not with severe persistent pelvic girdle syndrome. Daily smoking was positively associated with persistent PPGP and women with a higher BMI (>25) may be more likely to have persistent PPGP 12 weeks and 6 months postpartum, but these relations were not assessed for the outcome PLPP.

Epidural or spinal analgesia was not associated with persistent PLPP and had not been examined in relation to PPGP. A younger age of menarche (<13) during pregnancy was associated with persistent PPGP six months postpartum but was not assessed in relation to PLPP. Exercise before pregnancy, and current and past level of physical activity were not associated with persistent PLPP, but were not assessed in relation to PPGP. An early onset of symptoms during pregnancy and higher pain rating during pregnancy (>4 on 10 point scale) were associated with persistent PLPP six months postpartum, but another study using a different scale and cut-off point (>33 on 100 point scale) did not find a significant association. Similarly, disability level during pregnancy (>27 on 100 point scale) did not

make women more likely to have persistent PLPP. On the other hand, the need to use crutches in week 30 of pregnancy was associated with persistent PPGP. The cut-off points chosen in the studies might explain the differences in results. Women who were diagnosed with hypermobility were not more likely to have persistent PLPP, but women who perceived themselves to be hypermobile were.

In terms of psychological factors, emotional distress was associated with persistent PPGP, but pain catastropising and fear avoidance beliefs were not associated with persistent PLPP. Women who rated their health during pregnancy as poor or quite poor were more likely to have persistent PLPP. Satisfaction with sexual life before and after pregnancy were not associated with PLPP, but not having a satisfying sexual life during pregnancy was associated with persistent PLPP. Whether or not women were married, in a relationship or changed relationship at any point, was not associated with persistent PLPP.

The evidence for only one factor was rated (GRADE) as 'moderate', three factors had a 'low' rating, and the evidence for all other factors was considered 'very low' quality. The fact that no factor was examined in more than one study contributed to the downgrading of the quality of evidence because of the likely publication bias and inability to assess consistency of results across studies (Huguet *et al.* 2013). Only eight papers, reporting on four studies, were identified and the times of follow-up were limited to 1-3 months and 6-9 months postpartum for persistent PPGP and only 6-9 months postpartum for persistent PLPP. There is a need for more studies that assess and report prognostic factors for different time points. This should take into account whether women continue to have symptoms or may have recovered/relapsed during that time.

3.13 Conclusion

A comprehensive systematic review was conducted of risk factors and prognostic factors for PPGP, PLBP and PLPP. Significant risk factors for PPGP that emerged from the review were a history of low back or pelvic girdle pain, higher gestational age, being obese, a lower educational level, doing physically demanding work, a history of trauma to the back, diabetes, gestational diabetes, the progestin-intrauterine device, stress, depression, and anxiety. Significant prognostic factors for PPGP included having pain in multiple pelvic girdle locations during pregnancy, a history of low back pain, instrumental birth, having one other condition, a higher BMI, an early onset of symptoms during pregnancy, a higher pain rating during pregnancy, emotional distress, and the use of crutches during pregnancy. A history of low back or pelvic girdle pain, stress, depression, and anxiety were also risk factors for PLBP, but prognostic factors have not been examined. Similarly, a history of low back or pelvic girdle pain, a higher gestational age, stress, depression, anxiety, and pain catastrophising were associated with an increased risk of PLPP during pregnancy, and, having an elective caesarean birth, poor self-rated health, poor satisfaction with sexual life during pregnancy, and perceived hypermobility were significant prognostic factors for PLPP. Other examined potential risk factors had conflicting results, including parity, age, smoking and age of menarche.

When interpreting these findings, it is important to bear in mind the existing substantial limitations of the literature that leave us uncertain about the significance of risk and prognostic factors. Only a minority of risk factors were examined in more than one study and meta-analysis was often not possible due to significant clinical, methodological and statistical heterogeneity. None of the prognostic factors were examined in more than one study, not allowing for any comparisons between studies. The quality of evidence was subsequently 'very low' or 'low' for most factors. Most included studies were phase 1 of investigation studies (Hayden *et al.* 2008). Careful design of more phase 2 and phase 3 studies, to move beyond the exploratory phase of identifying associations to the next stage of testing

independent associations (Phase 2) and understanding pathways (Phase 3), is necessary.

The review was limited to evaluating published research and hence is subject to publication bias. Observational research is even more subject to publication bias than controlled trials which nowadays tend to be registered in advance. The language restriction to English was another limitation of this review. Strengths of this review lie in its rigorous systematic review methodology with independent screening of studies, data extraction, risk of bias and GRADE quality assessment.

This PhD study contributes to the body of evidence on risk and prognostic factors for PPGP specifically, outlined in Chapter 6, where results of this PhD study are presented and comparisons with the findings of this systematic review are made.

Chapter 4 Theoretical framework

4.1 Introduction

This chapter adds to Chapter 2 and 3 by looking at the broader theoretical concepts that surround PPGP and persistent PPGP as the topic of this study. The theoretical framework in which this study is set comprises of two components; pain theory and early motherhood theory, which are interlinked in the context of persistent PPGP. PPGP is a pain syndrome, hence in-depth understanding of the concept of pain is key in the interpretation of the findings of this study. As the focus of phase 2 (qualitative) of this study is on persistent PPGP in primiparous women, early motherhood theory also needs to be considered for a more complete perspective. The role of this theoretical framework is to provide a comprehensive context in which to understand and interpret the findings, presented in Chapters 6 and 7.

4.2 Theoretical framework

A theoretical framework is 'a logical grouping of related concepts or theories created to draw several different aspects together that are relevant to a complex situation' (Chinn & Kramer 2011) (pp246). The use of theory in research differs substantially, from studies that use theory deductively in which hypotheses are tested, to research in which theories are generated. Alternatively, theory may provide a lens or perspective for the study, or some studies do not employ any explicit theory (Creswell 2014). The latter is often adopted in studies that try to construct a detailed description of a phenomenon of interest (Creswell 2014), although it has been disputed as being impossible (Schwandt 1993). Mills (1993) provides a more practical definition of a theoretical framework and describes it as 'an analytical and interpretative framework that helps the researcher make sense of what it going on in the setting being studied' (pp103). In a similar way, this study is not theory-driven and does not aim to test or develop a theory. The theoretical concepts described in this chapter were not measured in this study. Instead, the purpose of the theoretical framework (section 4.3) is to provide a context in which to understand the findings.

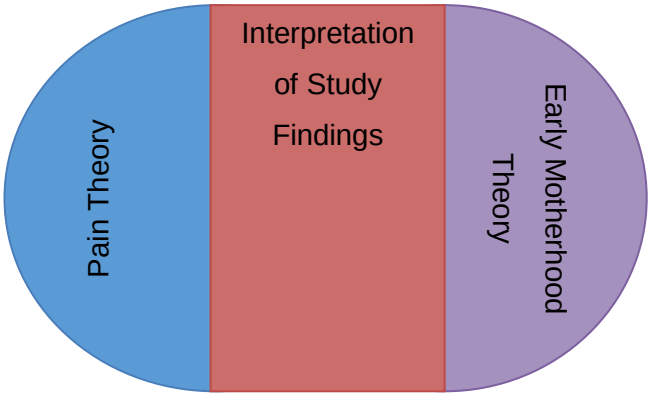

Figure 4-1 Purpose and components of the Theoretical Framework of this study

4.2.1 Pain Theory

4.2.1.1 Pain: Definition and the Biopsychosocial Model

Pain is defined as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage' (Loeser 2012) (pp209). This definition, constructed by the International Society of the Study of Pain, demonstrates its multi-facetted nature. Pain is a *perception,* which goes beyond any historical views of pain as a mere physical sensation with a direct proportional relationship with tissue injury (Gatchel *et al.* 2007), but instead underlines the complexity of the pain experience. The current model of pain encompasses a biopsychosocial approach with attention to physical (nociception), affective (emotional), cognitive, behavioural and social components (Figure 4-2). An individual in pain will have certain beliefs and thoughts about what the pain means, which in turn will direct the emotional response to the pain, and pain suffering may be enhanced by negative cognitions and emotions (Eccleston 2001, Gatchel *et al.* 2007). Musculoskeletal pain is a risk factor for poor self-rated health in primiparous postpartum women (Schytt & Waldenstrom 2007) and postpartum PPGP is associated with depressive symptoms (Gutke *et al.* 2011), findings which are congruent with this model. One's behavioural response to pain is also intimately linked to the cognitive interpretation and emotional response to pain, for example, by disengagement from activities or active help-seeking (Waddell 2004). The final 'layer' of the biopsychosocial model is the social context in which the pain experience takes place, with the perceptions, expectations and

reactions of others, and cultural factors, all influencing the other components of the pain experience.

The impact, meaning of, and influences on pain are thus multi-factorial, which should be taken into consideration in the management of, and research on, any pain syndrome. This demands exploration beyond mere quantification. Subsequently, the findings from this study were interpreted within the biopsychosocial model of pain (Figure 4-2). Key neuroscientific theories that underpin the biopsychosocial model of pain are outlined in section 4.2.1.2 and section 4.2.1.3. The different 'layers' of the biopsychosocial model of pain are further described in section 4.2.1.5.

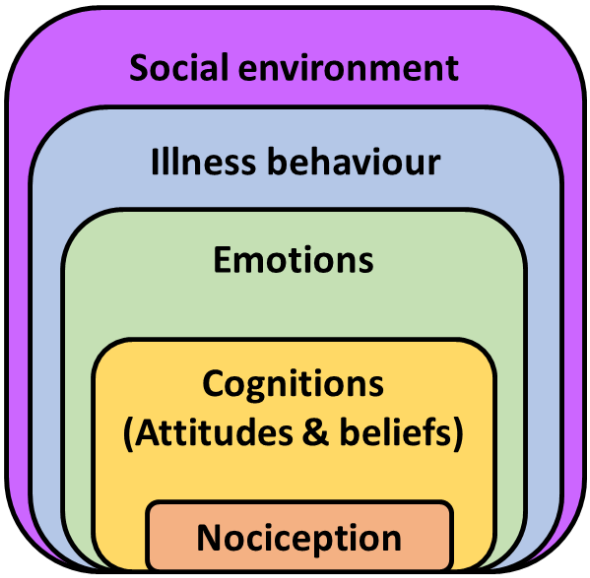

Figure 4-2 The biopsychosocial model of pain (Adapted from Loeser (1980)).

4.2.1.2 From Gate Control Theory to Neuromatrix to Pain Matrix

At a neurophysiological level, the biopsychosocial model of pain is reflected in the Gate Control Theory of pain (GCT), which introduced pain as a multi-factorial phenomenon and mapped the interrelated emotional, behavioural and physical aspects of the pain experience (Melzack & Wall 1965). The innovative nature of the GCT at the time was its emphasis on the role of the nervous system as a dynamic system that can modulate pain, rather than being merely responsible for passive pain transmission. It focussed on the central processing of pain signals, more specifically at the 'pain gate',

located in the dorsal horn (substantia gelatinosa) of the spinal cord, where the transmission of pain from peripheral nerves is modulated by intrinsic neurons and descending inhibition (Melzack & Wall 1965). Since the GCT was first introduced, the body of evidence investigating the functioning of the brain has grown substantially. The observation of phantom limb pain, pain in a limb that is no longer present, indicated more extensive involvement of the brain above the midbrain in the pain experience (Melzack & Loeser 1978, Woodhouse 2005). This has led the GCT to evolve to the Neuromatrix Theory, introducing the concept of the 'body-self neuromatrix', a neural network that creates a pain output pattern by integrating inputs from various areas of the central nervous system (Melzack 1989, Melzack 1996). The pattern generated by this widely dispersed neuromatrix, is referred to as the 'neurosignature'. This neurosignature pattern, a continuous outflow from the body-self neuromatrix, proceeds to the 'sentient neural hub' that converts it into awareness, and to an 'action neuromatrix' to produce muscle patterns and actions (Melzack 1996). This theory that incorporated the GCT and more recent advances in neuroscience, further explains pain as a multidimensional experience with the neuromatrix comprising of sensory, cognitive and affective neuromodules (Melzack 1999). Its output pattern (neurosignature) is genetically determined but triggered and modified by sensory-discriminative, affective-emotional and evaluative-cognitive factors that all converge in this neural network (Melzack 1999). It is important to note that sensory input is only one influence, and that the neurosignature is also generated and can produce pain in the absence of sensory nociceptive stimuli (Melzack 2001). This is particularly relevant in understanding chronic pain syndromes, where injury is often minimal or even non-existent. In the context of the Neuromatrix Theory, phantom limb pain may occur because the active neuromatrix is deprived of input from the limb(s) leading to abnormal firing as a substitute and, as a result, the neurosignature becomes a pain memory (Woodhouse 2005). However, one should note that in the original theory that was proposed by Melzack (1989), the neuromatrix is not pain-specific and the perception of pain is considered only one of its perceptual outputs. With advances in brain functional imaging in the last decade, the Neuromatrix Theory was further developed

to the concept of a 'Pain Matrix', a pain processing functional neural network that is pain-specific (Brooks & Tracey 2005). However, whether or not the brain responses triggered by pain stimuli are pain-specific remains an area of debate, with some studies suggesting that other sensory input can trigger similar brain activity (Downar *et al.* 2003, Mouraux & Iannetti 2009, Mouraux *et al.* 2011), and a growing consensus that this network is involved in detecting and reacting to any salient sensory events (Legrain *et al.* 2011). The study of pain is a field of neuroscience that continues to evolve. For this study, it demonstrates the key concept that pain is a perception and multi-factorial in nature, and this is unanimously agreed upon within the literature.

4.2.1.3 Neural plasticity

The dynamic nature of the neuromatrix and its output is significant in understanding potential changes in the pain experience. The capacity of neurons to change their function, chemical profile, or structure is referred to as 'neural plasticity' (Cramer *et al.* 2011). Woolf & Salter (2000) propose a conceptual model comprising of a continuum of three levels of neural plasticity; activation, modulation and modification. 'Activation' involves activity-dependent plasticity at the nociceptors, sensory receptors for pain caused by physical and/or chemical painful stimuli that damage or threaten the body's integrity (Dorland 2003), and at the dorsal horn of the spinal cord. This form of neural plasticity has a fast onset and is readily reversible. 'Modulation' refers to the concepts of peripheral and central sensitisation. Peripheral sensitisation occurs at the level of the nociceptors, which can be sensitised after injury, reducing their threshold within the area of injury that is exposed to inflammatory mediators subsequent to the injury (Bishop *et al.* 2010). Central sensitisation is defined as an amplification of neural signalling within the central nervous system that elicits pain hypersensitivity through enhanced synaptic activity triggered by nociceptive stimuli (Woolf 2011). This involves activation of intracellular signalling that leads to facilitated excitatory synaptic responses and depressed inhibition, with a potential spread of pain sensitivity to non-injured areas (Ji *et al.* 2003). Peripheral and central sensitisation are thought to increase the alertness of the system in conditions where risk of further injury is high (Latremoliere &

Woolf 2009). Peripheral changes tend to drive altered activity in the central nervous system that amplify and prolong incoming sensory signals, hence it is the process of central sensitisation that dissociates the feeling of pain from peripheral activity and further uncouples any clear stimulus-response relationship (McMahon *et al.* 1993). These changes are reversible and the heightened sensitivity will over time return to its normal threshold when healing is complete, no further injury occurs, and other factors including psychosocial factors also do not adversely impact on the pain experience.

Finally, 'Modification', the third form of neural plasticity, is mediated by induced expression of gene products, loss of inhibitory interneurons, and establishment of aberrant excitatory synaptic connections (Woolf 2011). This results in long-lasting alterations to the nervous system, and Voscopoulos & Lema (2010) suggest these are related to the transition of acute to chronic pain. However, central sensitisation, which according to Woolf & Salter (2000)'s model is part of modulation neuroplastic changes, is also frequently linked to chronicity (Roussel *et al.* 2013). This may be due to the way the terminology is used; for example, Ji *et al.* (2003) describe two forms of central sensitisation, with late onset transcription-dependent central sensitisation showing overlap with 'modification' in Woolf & Salter (2000)'s model.

To conclude, the phenomenon of neural plasticity demonstrates how the neuromatrix involved in experiencing pain can change. It also gives an important background to the findings of this study in terms of what may be happening at a neurophysiological level when women experience (persistent) PPGP. It has relevance to this study in the interpretation of the findings, and to any future research examining management strategies.

4.2.1.4 Acute & Chronic pain

Definitions of what constitutes acute and chronic pain vary in the literature. Chronic pain is often described as pain that is present for longer than three months (Airaksinen *et al.* 2006), while acute pain is considered pain that lasts for less than 12 weeks. Sometimes this is further categorised with subacute pain being defined as pain between 6 and 12 weeks duration (van Tulder *et al.* 2006). However, recently, chronic pain has been described as pain lasting longer than its expected course, instead of using exact time-

frames (Loeser 2012). This is in line with a growing understanding of the different neurophysiological events that occur when acute pain becomes chronic (Voscopoulos & Lema 2010), which may not exhibit the exact same time-frames in different individuals or for different conditions.

The role of acute pain can be explained as a warning system or sign of tissue injury (Eccleston & Crombez 1999). This understanding of pain as an indicator of damage is a common view people hold (Aldrich & Eccleston 2000). However, it is largely no longer applicable to chronic pain where pain is not simply a secondary symptom due to tissue damage. Chronic pain is considered a disease characterised by dysfunction of neural mechanisms (Melzack 2001), but, as demonstrated in the GCT, even for acute pain, the extent of damage is not directly related to the pain level experienced and psychosocial factors play a role in any pain.

Although the exact cause of PPGP is unknown, and biomechanical and hormonal changes seem to play a role (Chapter 2, section 2.3.3), any pain syndrome involves activity of the neuromatrix and all dimensions should be taken into consideration. Moreover, if PPGP starts early on in pregnancy and persists postpartum, further neuroplastic changes may occur that can potentially impede recovery and lead to chronicity as ongoing nociception may be associated with cortical and subcortical reorganisation (Roussel *et al.* 2013). Therefore, all 'layers' (Figure 4-2) of the pain experience that impact on this process need to be explored (section 4.2.1.5) and add a further dimension when interpreting the findings of this study.

4.2.1.5 Physical, cognitive, emotional, social and behavioural aspects of pain

The GCT of pain and succeeding theories integrated in the biopsychosocial model of pain, as described above, emphasise the multi-factorial nature of pain. This section is a discussion of the different aspects (physical, cognitive, emotional, behavioural and social) of the pain experience and related concepts that have emerged in the literature that are relevant to this study. References are made to these concepts in the discussion and interpretation of the findings of this study. Although these are outlined separately, they are all interdependent. An overview of these key concepts in pain theory is also presented visually in appendix 62.

Physical aspects of pain (a)

Nociception

Although there is clearly no direct relation between the extent of tissue damage and the amount of pain a person experiences, there is still an important role of noxious stimuli in producing pain. Woolf & Salter (2000) describe three types of pain; physiological, inflammatory and neuropathic pain. Physiological and inflammatory pain are together sometimes referred to as nociceptive pain, nociception being defined as the afferent neural activity transmitting sensory information about noxious stimuli (Dorland 2003). Although stimulation of nociceptors is often the cause of pain, it is not synonymous with pain as pain is a conscious experience that can even occur in the absence of nociception (Iannetti & Mouraux 2010).

Physiological pain is initiated in peripheral terminals of nociceptors when a threshold is reached and membrane depolarisation occurs as a result of a noxious stimulus (Eilers & Schumacher 2005). It is a warning signal and triggers a reflex withdrawal, while inflammatory pain results from damage to tissue causing an inflammatory response (Kidd & Urban 2001). Neuropathic pain arises due to damage to nerves or dysfunctional altered nerve function (Suzuki & Dickenson 2000), and particularly inflammatory and neuropathic pain can cause significant neuroplastic changes in the spinal cord and brain functioning (Dickenson 2002).

Another important physical component of the pain experience to consider, is the influences of other sensory input on pain. In the context of the GCT, stimulation of large (diameter) afferent fibres (Aα and Aβ) through other physical stimuli such as touch and pressure, results in the activation of inhibitory interneurons at the level of the 'pain gate' (dorsal horn) where small nociceptive afferent fibres (Aδ and c fibres) synapse with afferent neurons in the central nervous system that convey the signal further (Melzack 1996).

Cognitive aspects of pain: Thoughts, attitudes and beliefs (b)

Pain Appraisal & Beliefs

Pain appraisal refers to the meaning that is ascribed to pain by an individual (Sharp 2001). Lazarus & Folkman (1984) proposed a transactional model of stress that distinguishes between appraisals, beliefs and coping, and can be applied to pain (Thorn *et al.* 1999). In this model, primary appraisals are judgments about whether a potential stressor is irrelevant, benign, positive, or stressful. These interact with secondary appraisals about coping options and their possible effectiveness which then dictates any coping responses. Beliefs can be defined as assumptions about reality that shape how one interprets events and thus can be considered as determinants of appraisal (Gatchel *et al.* 2007). Pain appraisals and beliefs in turn influence affective and behavioural responses to pain (Jensen *et al.* 1994, Smith *et al.* 1998). This relationship between the meaning of and beliefs about pain, and pain responses, was already demonstrated by Beecher (1956) who compared the pain intensity and use of pain medication in soldiers and civilians. He found no relationship between the extent of the wound and pain intensity, which he suggested was because of the meaning of their pain; for the soldiers it meant they could go home. Although this demonstrates that appraisal of one's pain is influenced by contextual factors in terms of its meaning, pain cognitions are largely shaped by an individual's learning history, both from their own experience and from others. Cognitive frameworks or concepts that help organise and interpret information and from which cognitions emerge, have been referred to as 'schemata' (Piaget 1971). A schema denotes the organisation of knowledge about a particular concept, and is assimilated throughout childhood and continues to change over time (Van Ryckeghem *et al.* 2013). This concept originates from learning theory (Carbon & Albrecht 2012), but gained momentum in the pain literature as the foundation of pain cognitions.

Catastrophising

Catastrophising has been defined as expecting or worrying about major negative consequences from a situation (Turner *et al.* 2000). Pain-related catastrophising refers to a set of exaggerated negative cognitions during actual or anticipated painful stimulation (Quartana *et al.* 2009). Two main

measurement scales exist that capture this concept. The Catastrophising Scale (which is part of the Coping Strategies Questionnaire) examines helplessness in the context of pain (Rosenstiel & Keefe 1983). In constructing the Pain Catastophising Scale, Sullivan *et al.* (1995) elaborated the concept and described three components of catastrophising; excessive magnification, active rumination and feelings of helplessness.

Catastrophising has received great attention in the context of pain, particularly its role in affecting pain-related outcomes and in facilitating chronicity. Catastrophising has been related with increased physical and psychological dysfunction in patients with chronic pain as well as in pain-free volunteers in experimental studies (Leung 2012). Catastrophising has been associated with increased pain intensity, emotional distress, disability, depression, narcotic use and healthcare utilisation (Keefe *et al.* 1989, Hassett *et al.* 2000, Edwards *et al.* 2006a, Forsythe *et al.* 2008). Pain catastophising is also a predictor of pain-related fear (Leeuw *et al.* 2007), which in turn, within the Fear-Avoidance Model (FAM) of pain enhances disuse, disability and depression, leading to chronicity (the FAM is further outlined below). Demmelmaier *et al.* (2010) in a study examining catastrophic thoughts in patients with a first episode of back pain, found that pain catastrophising was related to pain and disability severity and pain catastrophising increased over time (12 months). In addition, when a painful stimulus persists, catastrophising may take attention away from other tasks (Turner *et al.* 2000), and may further lead to depressive symptoms and feelings of helplessness (Keefe *et al.* 1989). In a sample of 1512 patients with chronic pain, Edwards *et al.* (2006b) even found pain catastrophising to be related to increased suicidal ideation.

As a cognitive construct, catastrophising has been thought to occur to avoid disengaging attention from a painful stimulus (Eccleston & Crombez 1999), in order to stimulate action (Keefe *et al.* 1997), due to the motivational nature (motivation to act) of pain (Auvray *et al.* 2010). However, Turner *et al.* (2000) argues that it is not a coping strategy, based on the findings from a sample of 169 patients presenting at a pain clinic, in which catastrophising predicted depression independently from other pain beliefs and coping

strategies. Moreover, coping scores independently predicted physical disability, and pain belief scores independently predicted both physical disability and depression, demonstrating that measures of catastrophising differ from measures of coping and other pain-related beliefs. However, apart from being a cognitive concept, catastrophising has also been seen as an interpersonal style of coping (i.e. a behavioural coping strategy) to elicit support from others (Keefe *et al.* 2003). This is discussed in further detail in the section below on social aspects of the pain experience.

Physiologically, pain catastrophising is associated with central sensitisation, reduced inhibition of pain (Weissman-Fogel *et al.* 2008), and altered hypothalamic-pituitary-adrenal axis activity (Johansson *et al.* 2008). Moreover, it is related to exaggerated muscular responses to pain (Quartana *et al.* 2007), and enhanced activity in brain areas involved in affective processing of pain on functional MRI (Seminowicz & Davis 2006).

In conclusion, catastrophising, although primarily seen as a cognitive concept, is complex and interlinked with physiological, cognitive, behavioural and social aspects relevant to the pain experience.

Attention versus Distraction

Attention bias refers to giving preferential attention to information that is related to the content of emotional concerns of patients (Cisler & Koster 2010). Pain has a natural tendency to draw one's attention to it, interrupting activities at hand, even in non-catastrophisers (Eccleston & Crombez 1999). Although this could be considered a normal process related to an increased awareness of somatic sensations, pain-related worries, often triggered by increased pain, are more attention-demanding and more negatively valent than non-pain related worries (Eccleston *et al.* 2001). Attentional interference refers to the deterioration in task performance as a result of the disruption by pain on performance (Vancleef & Peters 2006). Subsequently, people with chronic pain often experience cognitive impairment during everyday tasks (Dick *et al.* 2002). Patients with chronic pain also tend to ruminate upon potential causes of their pain, especially if the exact cause is unknown (Eccleston *et al.* 2001). Such habitual attention

to pain is predictive of the level of disability, distress and use of healthcare resources (Eccleston *et al.* 1997, McCracken 1997, McCracken 2007).

Crombez *et al.* (2013) conducted a meta-analysis examining attention bias to pain-related stimuli. Acute, procedural and experimental pain groups did not have significant attention bias to pain-related information. Patients with chronic pain did show attention bias, although the effect size was small ($d=0.134$, $p<0.01$), and pain severity, pain-related fear, anxiety, and depression did not affect the magnitude of attention bias. However, the type of pain-stimulation and the exposure time affected attention bias in patients with chronic pain, with sensory pain-characteristic words and longer exposure times leading to greater attention bias. Based on these findings, Crombez *et al.* (2013) suggested that attention bias in chronic pain does not seem to rely on pre-attentive processes to assess threats such as in anxiety and phobias, which show greater attention bias, but instead is a more conscious process that maintains longer attention to the pain-related information.

Some literature also refers to the concept of pain hypervigilance, which is defined as a tendency to attend selectively to pain-related stimuli rather than to neutral stimuli (Reiss & McNally 1985), and can thus be considered attention bias to pain. This is dependent on the goal to escape and avoid pain (Crombez *et al.* 2005). Moreover, pain hypervigilance seems to happen unintentionally (Crombez *et al.* 1998), and has been associated with greater pain-related fear (Wong *et al.* 2014).

In contrast to attention bias and pain hypervigilance, distraction away from pain reduces pain levels and improves task performance (Verhoeven *et al.* 2011). Both low and high catastrophisers perceive less pain when distracted from a painful stimulus, and for high catastrophisers increased motivational relevance of the distraction task may enhance its effect (Verhoeven *et al.* 2010).

Acceptance

Acceptance is described as an acknowledgment of pain that is neutrally framed as a willingness to live with the pain (McCracken & Eccleston 2003), and is characterised by a shift away from pain to non-pain aspects of life (Risdon *et al.* 2003). This is in contrast to catastrophising, in which the acknowledgment of the pain is not neutral but instead is characterised by magnification and feelings of helplessness. de Boer *et al.* (2014), in a sample of 82 patients with chronic pain, found a significant negative correlation between acceptance and pain catastrophising ($r=20.42$, $p<0.001$). Acceptance of pain is also inversely related to pain intensity, disability, depression and pain-related anxiety and activity avoidance, and is related to better work status (McCracken 1998).

Acceptance as a cognitive concept is different from coping. McCracken & Eccleston (2003) examined the relationship between acceptance and coping in 230 adults in a pain management centre and found that acceptance is only associated with some subsets of coping, and that it is not captured in most coping models. Acceptance was, however, negatively associated with the praying and hoping items of the Coping Strategies Questionnaire, which in turn was linked to greater pain and less healthy functioning.

Emotional aspects of pain (c)

The definition of pain from the International Society of the Study of Pain specifically states that 'pain is an unpleasant sensory and emotional experience…' (Loeser 2012). Emotions play an important role in the experience of pain in different ways. From a cognitive perspective, the extent of pain suffering depends on the affective response to the cognitive appraisal of the symptoms, and worrying thoughts may subsequently lead to anxiety, distress and low mood (Liu & Chen 2014). However, the interdependence of affective/emotional aspects of pain with other elements of the pain experience is complex and multi-directional. The link between negative emotions and pain has many ways of interacting, in that emotions can be predisposing, modulating or perpetuating factors, and/or can be a consequence of persistent pain (Fernandez & Turk 1992, Fernandez & Milburn 1994, Asmundson *et al.* 2000). Lang (1995) described the emotional experience as an interaction of the two dimensions; valence

(pleasant–unpleasant) and arousal (calm–excited), and suggested that the function of emotions involves facilitating appropriate reactions. Subsequently, both the perception of, and response to, pain can be modulated by emotions.

The affective component of pain incorporates a range of emotions/concepts, predominantly negative, that interact with each other. These include feelings of anxiety, fear, depression/low mood, anger/frustration, which are described below. In addition, trait characteristics that make people more vulnerable to such feelings have also been examined in the context of pain psychology, including Anxiety Sensitivity, Negative Affectivity and Illness Sensitivity (Leeuw *et al.* 2007, Newton-John *et al.* 2014).

Anxiety and Fear

The function of anxiety is thought to be the early detection of threatening events generally characterised by apprehensive anticipation of potential threats (Eysenck 1997, Rhudy & Meagher 2000). People commonly are anxious and worry about their pain, particularly if it is unexplained (Henningsen *et al.* 2003). If pain persists people might be anxious about the implications for their future. Nevertheless, reduced pain-related anxiety predicts improvement in affective distress, pain, functioning and pain-related activity interference (McCracken & Gross 1998).

Fear is also an emotion that is intimately linked to pain, and is considered a key driver of activity avoidance, as people are afraid to exacerbate their symptoms (Boersma & Linton 2005), which is described in the Fear-Avoidance model of pain (Lethem *et al.* 1983). This pain-related fear is not only driven by actual sensory experiences, but may emerge from fear-avoidance beliefs; another example of how cognitions and affective experiences interact closely (Vlaeyen & Linton 2000). Fear is an alarm reaction that enhances physiological arousal and inhibits pain to escape a threat (Barlow *et al.* 1996, Rhudy & Meagher 2000); however, if persistent this increased muscle tension may further exacerbate symptoms (Robinson & Riley 1999). Asmundson *et al.* (2004) expanded the Fear-Avoidance model of pain, in which fear about the nature and potential consequences of

pain leads to disengagement and activity avoidance (described further below under behavioural aspects of pain section), to a Fear-Anxiety model, in which anxiety occurs in anticipation of pain, whereas fear may be felt when the threat of pain is already present. However, the value of this addition to the model is unclear, particularly as the differences between the concepts of fear and anxiety remain an area of debate (Leeuw *et al.* 2007). Fear of injury or movement strongly predicts functional limitation (Crombez *et al.* 1999, Turk *et al.* 2004). People with fear of pain also have an attentional bias to pain-related information (Keogh *et al.* 2001).

Anxiety Sensitivity

Anxiety sensitivity is a specific tendency to react anxiously to one's own anxiety and anxiety-related sensations. This heightened sensitivity or fear of anxiety sensations arises from beliefs that the sensations have harmful consequences, and it is one of the three fundamental fears or 'sensitivities', within the expectancy model of fear, that underlie common fears, the other two being fear of injury ('Illness/Injury Sensitivity') and fear of negative evaluation (Reiss *et al.* 1986). This is different from anxiety, which is the occurrence of anxiety, although there is overlap between the two concepts (Reiss *et al.* 1986, McWilliams & Cox 2001). People with anxiety sensitivity tendency also exhibit increased fear of pain when pain is experienced, which leads to pain-related avoidance (Asmundson & Taylor 1996). Moreover, anxiety sensitivity has been associated with increased cognitive disruption of pain (deterioration of task performance) and increased analgesic use (Asmundson & Norton 1995). A recent study found that, in a sample of 401 people with chronic musculoskeletal pain, anxiety sensitivity enhanced the effect of pain catastrophising on hypervigilance (Wong *et al.* 2014). However, in contrast to pain catastrophising, anxiety sensitivity did not impact on the attentional interference of pain (Vancleef & Peters 2006).

Illness/Injury Sensitivity

Illness Sensitivity is related to general negative expectations and anticipations of putative future injury and illness (Reiss 1991), and is another personality trait that has been suggested to determine one's

reaction to pain. Keogh & Asmundson (2004) suggested that illness sensitivity may be a higher order factor of the common fear of pain.

Negative Affectivity

Negative affectivity has been defined as a personality trait characterised by low mood and the predisposition to appraise personal and emotional situations as threatening, and high levels of negative affectivity may result in negative emotions (Watson & Pennebaker 1989, Watson *et al.* 1994). Fillingim *et al.* (2005) found that negative affectivity predicted a lower pain threshold. Negative affectivity has been also associated with hypervigilance of body sensations (Stegen *et al.* 2000), although this does not seem to be the case in patients with chronic pain (Crombez *et al.* 2002).

Negative affectivity, anxiety sensitivity and illness sensitivity are all closely related with catastrophising (Vlaeyen & Linton 2000). Vancleef *et al.* (2006) found illness sensitivity to be the single best predictor of pain catastrophizing, fear of pain and pain avoidance. However, Hirsh *et al.* (2007), investigating how pain catastrophising is different from other constructs, raised the issue of concept redundancy. Nevertheless, literature emphasising the importance of pain catastrophising in the pain experience does seem to justify the concept (Quartana *et al.* 2009).

Depression

Chronic pain has been strongly linked to depression (Banks & Kerns 1996, Dersh *et al.* 2006). Involvement of neurotransmitters in pain as well as depression in the central nervous system and maladaptive pain responses such as catastrophising, are thought to play an important role (Campbell *et al.* 2003). This relationship is bi-directional in that chronic pain can cause depression and vice versa. Fishbain *et al.* (1997) conducted a review examining this relationship and concluded that persistent pain is more likely to lead to depression than the other direction; however, depression has also been found to be a stronger predictor for low back pain than clinical and anatomical factors (Atkinson *et al.* 1991, Magni *et al.* 1994, Jarvik *et al.* 2005). Depression also seems to be more common among people with chronic pain than among people with other chronic illnesses (Anderson *et al.*

2001) and severe pain has been associated with higher suicidal ideation (Fishbain *et al.* 1997). Turk *et al.* (1995) examined the pain-depression relationship in 100 patients with chronic pain and found that appraisal of the effects of the pain on one's life and one's ability to control the pain, are two important mediating factors, and people were less likely to have depressive symptoms if they thought they could continue to function and maintain some control despite having the pain.

Frustration & Anger

Frustration and anger are closely related and feelings of frustration often anticipate anger (Pawliczek *et al.* 2013). Anger is associated with acute and experimental pain (Bruehl *et al.* 2002, Bruehl *et al.* 2003, Burns *et al.* 2004) and can exacerbate chronic pain (Wade *et al.* 1990, Bruehl *et al.* 2002, Burns *et al.* 2014). It has been suggested that the relationship between anger and pain is opioid-mediated, with acute anger increasing endogenous opioid release leading to activation of this inhibitory opioidergic mechanism parallel to pain facilitating mechanisms, thus reducing pain sensitivity. However, patients with chronic pain seem to have impaired opioid buffering (Burns *et al.* 2009), and anger in chronic patients is positively correlated with pain intensity, pain disability and depression (Kerns *et al.* 1994, Okifuji *et al.* 1999). Frustrations related to the persistence of symptoms, unknown aetiology, treatment failure, and anger towards healthcare providers, insurers and particularly to themselves, are related to chronic pain and contribute to dysphoric moods (Okifuji *et al.* 1999). Nevertheless, similar to other emotional concepts related to pain, the cause-effect relationship between anger and pain is unclear (Gatchel *et al.* 2007). Moreover, anger seems linked to other affective states and procedures evoking anger also tend to evoke other emotional responses such as fear and anxiety (Rhudy & Meagher 2003).

Behavioural aspects of pain (d)

Self-efficacy

Self-efficacy is defined as confidence that one can successfully execute a course of action to produce a desired outcome in a given situation (Bandura 1997). In the context of pain this relates to the confidence that one can

control one's pain. The extent of self-efficacy will impact on how much effort and persistence people exhibit in the face of aversive experiences, in this case pain (Bandura 1997). In a meta-analysis examining the relation between self-efficacy and pain, Jackson *et al.* (2014) concluded that higher self-efficacy is associated with less functional impairment, less affective distress and reduced pain.

Coping styles

In the context of pain, coping strategies can be broadly defined as any behaviour in response to pain (McCracken & Eccleston 2003). Brown & Nicassio (1987) conceptualised pain coping as being active or passive. An active coping style, in which a person takes responsibility for managing their pain or attempts to function in spite of the pain, is associated with increased activity and less distress (Lynn Snow-Turek *et al.* 1996). Passive coping on the other hand, is a strong predictor of increased disability in neck or back pain (Mercado *et al.* 2005).

Fear-Avoidance Behaviour

The Fear-Avoidance Model was introduced by Lethem *et al.* (1983), to explain why some people develop chronic pain and others do not. Within the fear-avoidance model, catastrophising is considered the key cognitive construct that leads to fear of movement and subsequently to inappropriate disengagement of activities based on fear, also called 'Fear-Avoidance Behaviour' (Dawson *et al.* 2011). Activity avoidance in the short term is reinforced by a reduction of suffering associated with a painful stimulus (McCracken *et al.* 1993); however, if it persists it may result in disability and persistence of pain. In this way, fear of movement and fear of re-injury are better predictors of functional limitations than biomedical parameters (Vlaeyen *et al.* 1995, Crombez *et al.* 1999, Turk *et al.* 2004). In contrast to fear-avoidance behaviour, confrontation and active coping strategies reduce the likelihood of chronicity (Figure 4-3). Fear of pain is fed by other constructs including catastrophising, anxiety sensitivity, illness/injury sensitivity and pain hypervigilance; all potential antecedents of pain-related fear (Wong *et al.* 2014). Apart from being a key step in the fear-avoidance model, catastrophising has also been associated with other pain and illness

behaviours such as over-the-counter medication use, and increased frequency of visits to healthcare professional (Bedard *et al.* 1997, Sullivan *et al.* 2001).

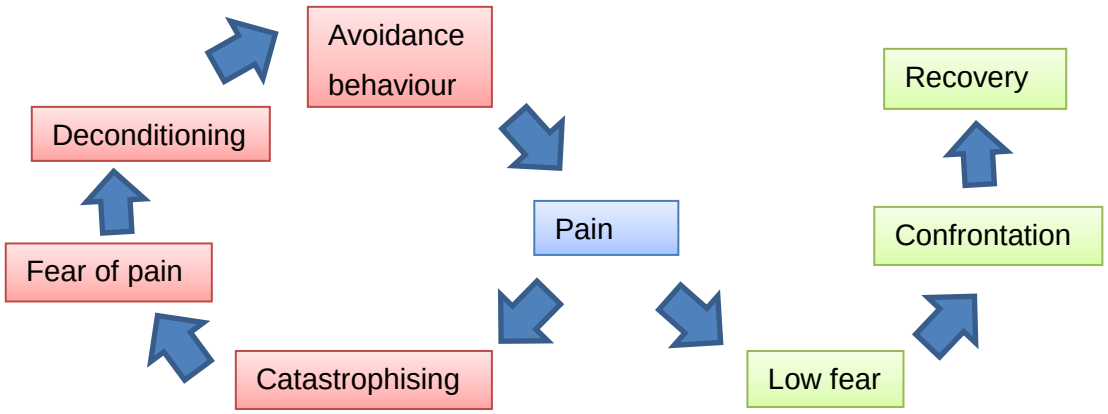

Figure 4-3 Fear Avoidance Model of Pain: Adapted from (Vlaeyen & Linton 2000, Leeuw *et al.* 2007)

Conditioning

Conditioning has been broadly classified as classical and operant conditioning. Classical conditioning occurs when pairing an initially innocuous stimulus (conditioned stimulus) with a biologically relevant stimulus (unconditioned stimulus) causes subsequent presentations of the conditioned stimulus to elicit a conditioned response that is usually similar to the unconditioned response evoked by the biologically relevant stimulus (Pavlov 1927). Operant conditioning on the other hand is a concept proposed by Skinner (1938) and refers to reinforcement of behaviours.

In relation to pain, conditioning plays a role in modulating pain sensitivity and affects how a person responds to pain (Miguez *et al.* 2014). For example, the reinforcement of avoidance behaviour in the short term, by the reduction of suffering linked with pain (McCracken *et al.* 1993, Vlaeyen & Linton 2000), could be considered operant conditioning. The impact of conditioning on pain is also demonstrated by its role in the placebo effect and its interaction with one's expectancy of pain (Kirsch *et al.* 2014). Moreover, a stress-response results in analgesia through activation of endogenous opioid mechanisms, and this can be classically conditioned by pairing an originally neutral stimulus with a stressor (Flor *et al.* 2002,

Miguez *et al.* 2014). However, this analgesic mechanism can also be inhibited through conditioning (Watkins *et al.* 1998) and hyperalgesic responses to injury/illness can become conditioned (Wiertelak *et al.* 1994, Watkins *et al.* 1998).

Social aspects of pain (e)

Krahe *et al.* (2013) conducted a systematic review examining social modulation of pain. Twenty-six experimental studies were included and findings suggested that positive interactions reduce pain, whilst ambiguous or negative interactions lead to an increase in pain-related measures. They also propose that interpersonal interactions may affect the precision of an individual's predictions and thus pain, by signalling the safety or threat of painful stimuli (interoceptive salience), or by signalling the safety or threat of the environment in which stimuli occur (environmental salience). However, this is influenced by individual differences such as pain catastrophising and attachment styles (see below).

Catastrophising as a social construct

The last decade, catastrophising, in addition to being considered a cognitive concept to prevent disengagement from a painful stimulus (as discussed above), has also been conceptualised as an interpersonal construct within a communal coping model (Sullivan *et al.* 2001, Keefe *et al.* 2003, Lackner & Gurtman 2004). In this context, catastrophising is seen as a behavioural coping strategy that is related to the social support one receives as it is aimed at maximising proximity, or soliciting assistance or empathic responses from others (Sullivan *et al.* 2001, Quartana *et al.* 2009). Cano (2004) examined the relationship between catastrophising, psychological distress, and perceived support from close others in 96 married patients with chronic pain. They found that this relationship was dependent on the duration of pain. For shorter pain durations, solicitous spouse responses were associated with more catastrophising, while for longer pain durations, it was less perceived spousal support that was related to catastrophising.

Attachment theory

Attachment theory provides insight into how interpersonal developmental processes may affect healthcare seeking and pain responses. Attachment styles are cognitive schema that influence the way people interact and their interpretations of interactions, and these schemas form based on early experiences with caregivers (Bowlby 1973). Secure and insecure attachments styles are described. People with secure attachment styles have a positive view of themselves as worthy of care, and of others as trustworthy to provide care when needed (Bartholomew & Horowitz 1991). Insecure attachment styles include preoccupied, fearful and dismissive attachment styles. Insecure attachment styles may negatively impact on patients' adjustments to chronic pain and are associated with increased negative affect (Ciechanowski *et al.* 2003). Tremblay & Sullivan (2010) suggested that anxiety and catastrophising mediate the link between attachment and pain-outcomes. Moreover, attachment styles influence social modulation of pain, accounting for some of the individual differences in the effect of interpersonal factors on the pain experience (Krahe *et al.* 2013).

Secondary gains

Within the literature on biopsychosocial aspects of pain, secondary gains are also often proposed as an influencing factor on people's response to pain, and are important in the generation and maintenance of illness behaviour and indeed pain (Fishbain *et al.* 1995). Freud (1959) defined secondary gain as an interpersonal or social advantage attained by the patient as a consequence of his/her illness. This can however be broadly interpreted to include any such external factors that motivate certain pain behaviours. For instance, a solicitous response from one's spouse may be a secondary gain (Newton-John & Williams 2006). Exemption from work or financial reimbursement in medico-legal cases are other examples of a potential secondary gain (Lancourt & Kettelhut 1992). The latter have received most attention in more recent literature particularly in terms of proposing tests to assess such factors (Kumar *et al.* 2012).

Summary

Pain is a complex experience. The biopsychosocial model integrates physical, cognitive, emotional, behavioural and social aspects of the pain experience. Interaction between all these factors seems multi-directional; hence, many of the proposed concepts within the current literature overlap or are related.

4.2.2 Early motherhood theory

When PPGP persists after birth, the context of a woman's pain experience encompasses the care of her child. The postpartum period is a time of great change for primiparous mothers. Infant care is a demanding task and may go together with challenges such as exhaustion, changes in relationship when becoming a parent, and financial burdens. Hence, the second arm of the theoretical framework of this study concerns theory related to this transition to motherhood.

Transitions, in general, have been defined as the processes or periods of changing from one state or condition to another (Stevenson 2010). They include illness experiences, social and cultural transitions and lifespan experiences (Schumacher & Meleis 1994). Transitions not only result in, but can also be a result of, a change in lives, health, relationships, and environments (Meleis *et al.* 2000). Subsequently, the transition to motherhood may overlap with other transitions related to changes in health; for example, related to the persistence of PPGP.

Within the literature 'transition to motherhood', has been described as "a process of personal and interpersonal change when a woman assumes maternal tasks and appraises herself as a mother" (Pridham & Chang 1992) (pp204). The nature of this transition also impacts on developing mother/child relationships (Nelson 2003), is important for maternal emotional wellbeing, and has longer-term implications for child development outcomes (Anhalt *et al.* 2007). This dynamic process is influenced by women's physical, social and psychological well-being (Mercer 2010), and delayed postpartum recovery adds to the disruption inherent in this

transition (Lee 1997). Life transitions are also characterised by increased stress levels and reduced coping abilities (Rasmussen *et al.* 2013), yet postnatal care is often directed towards the infant (Walker & Wilging 2000).

In early work, Rubin (1967a) introduced the concept of Maternal Role Attainment, a process leading to a women's achievement of maternal role identity that takes place both pre- and postpartum (Rubin 1967a, 1967b, Mercer 1985). Progressive stages of Maternal Role Attainment were described, from information seeking and mimicking observations, to seeking expert models, role-playing and fantasising about herself as a mother. In the next stage, a woman introjects observed behaviours of others, projects how these behaviours would be for her, and rejects behaviours that she considers inappropriate. Finally, this leads to an image of maternal identity being incorporated into her self-system (Rubin 1967a, Mercer 2004). In later work, Rubin (1984) incorporated maternal identity into the whole personality and modified her earlier model of Maternal Role Attainment, renaming the stages as replication, fantasy, dedifferentiation and identity. Mercer (1985) applied Thornton & Nardi (1975)'s model of role attainment to Maternal Role Attainment with the anticipatory stage being before the birth, the formal stage starting after the baby is born, followed by the informal stage in which the mother uses her own judgement more with regards to the care of her infant. The final stage of maternal identity brings a sense of harmony and satisfaction in the maternal role and attachment to her infant (Mercer 1985, Mercer 2004). However, within the model of Maternal Role Attainment, maternal identity was defined as an endpoint of the process (Rubin 1967a, 1967b). Parratt & Fahy (2011) critiqued Rubin and Mercer's earlier work for not being women-centred, and that in practice each women should be asked about her life and the factors that she thinks are impacting upon her transition. Work by Barclay *et al.* (1997) subsequently led to the development of a new theory of this transition. They conducted 55 focus groups with women and six categories emerged under the core category 'Becoming a mother'. These were; realising, unready, drained, loss, aloneness, working it out. Three factors mediated the process and influenced these experiences; previous experiences with infants, social support and the baby's behaviour (Barclay *et al.* 1997, Rogan

et al. 1997). In later work, Mercer (2004) also affirmed the appropriateness of the concept of 'Becoming a mother' instead of 'Maternal Role Attainment' because it better represents the dynamic nature of this transformation.

Nelson (2003) conducted a meta-synthesis of studies examining the transition to motherhood. Nine studies were included in the analysis and based on these findings they constructed a model that consists of two processes inherent to this transition: the primary process of engagement, and the secondary process of growth and transformation. In addition, they identified five thematic categories of areas of disruption in this transition to motherhood (Figure 4-4). This model of transition to motherhood is adopted within the theoretical framework for this study.

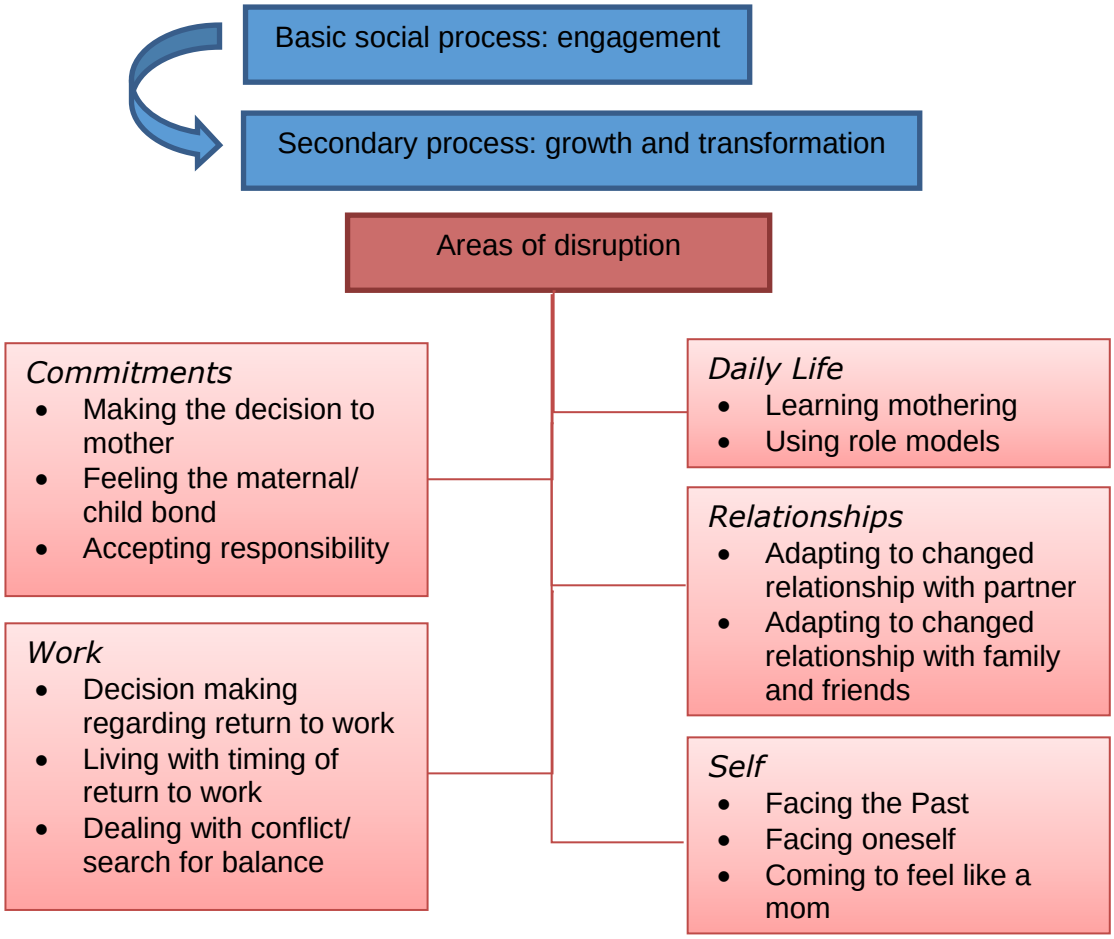

Figure 4-4 Transition to Motherhood model: Adapted from Nelson (2003)

Currie (2009) explored how women cope with the transition to motherhood and interviewed nine mothers about their beliefs and ideas about strategies they used to maintain a sense of wellbeing. Three main strategies were identified to manage the transition to motherhood: (1) obtaining help (mainly from own mother or husband), (2) having a plan and being organised or having a schedule, and (3) taking time-out from the rigorous regime of household work.

4.3 The role of this theoretical framework on the study

While the findings of the quantitative phase (1) are discussed initially in the context of the systematic review of the literature on risk and prognostic factors for PPGP (section 6.6 and 6.10), the concepts and models of both pain theory (section 4.2.1) and early motherhood theory (section 4.2.2) are used in the discussion of findings of the qualitative phase of this study (section 7.4) to help contextualise specific findings as well as reflect upon potential sources of women's thoughts and actions and their implications for health care. Importantly, in the overall conclusion chapter (8), the theoretical framework is used in a similar way, i.e. to gain a better understanding the findings of this study. Moreover, it provides a grid to discuss which aspects of (persistent) PPGP have been addressed in this study and which elements warrant future research, by linking the study back to the different layers of the theoretical framework that encompass the wider literature.

4.4 Conclusion

This chapter outlined theoretical concepts that provide a broader understanding of the topic of this study. In Chapters 6 to 8, findings of this study will be interpreted in the context of the biospsychosocial model of pain and, for postpartum findings (particularly phase 2; chapter 7), early motherhood theory. In the next Chapter (5), a detailed description of the study design and methods used to address the objectives of this study is outlined.

Chapter 5 Paradigm, Methodological Approach & Methods

5.1 Introduction

Following on from the rationale for this study (Chapter 1), the literature review (Chapter 2), and the systematic review (Chapter 3), this chapter explores the study's paradigm and outlines the research design and methods that were used to address this study's aim and objectives:

The **aim** was to identify the prevalence and factors associated with PPGP antenatally and up to 12 months postpartum in nulliparous women in Ireland, and to explore the experiences and health-seeking behaviours of women with persistent PPGP postpartum.

The research **objectives** were:

(1) To identify the existence and prevalence of self-reported PPGP during pregnancy and 0-3, 3-6, 6-9 and 9-12 months postpartum in 1478 nulliparous women in Ireland

(2) To identify pre-pregnancy risk factors for self-reported PPGP in (a) early/mid pregnancy and (b) the last months of pregnancy

(3) To identify pre-pregnancy, pregnancy-related, birth-related and postnatal prognostic factors for self-reported PPGP that persists 0-3, 3-6, 6-9 and 9-12 months postpartum

(4) To explore women's experiences with regard to the impact of self-reported persistent PPGP postpartum on their life, in particular on the care of their infant and parental role

(5) To explore the health-seeking behaviours of women with PPGP that persists postpartum.

This chapter is structured using a model adapted from Crotty's levels of developing a research study (Crotty 1998) (Figure 5-1). An outline of the study's paradigm and the philosophical underpinning of the methodological choices that were made is described in section 5.2. The study design and methodologies used are then presented in section 5.3. Finally, section 5.4 includes a detailed description of the methods that were adopted.

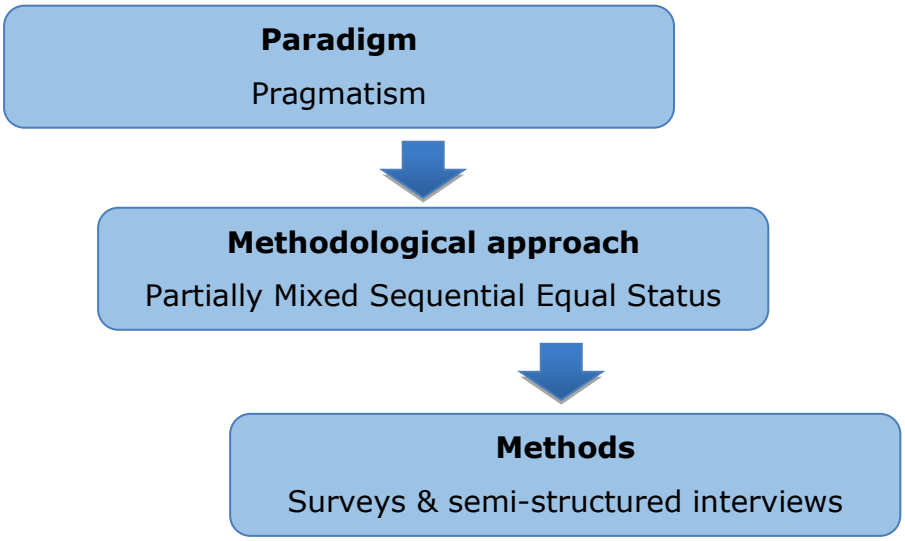

Figure 5-1 Study paradigm, methodology and methods overview (Adapted from Crotty 1998)

5.2 Study Paradigm - Pragmatism

Pragmatism arose at the beginning of the 20th century as a philosophy, but more recently has received much attention as a study paradigm, particularly with the surge of mixed methods research and the ongoing debate about the compatibility of quantitative and qualitative methods. In general, three approaches have emerged when addressing the paradigm issue in mixed methods research: the a-paradigmatic stance, the multiple paradigm approach and the single paradigm approach (Biesta 2010). Pragmatism has gained considerable momentum as a 'single paradigm' for mixed methods research (Greene & Hall 2010), but some argue that pragmatism is non-paradigmatic, i.e. researchers make pragmatic decisions without making use of the foundations of pragmatism as a philosophy (Denzin 2010; Green & Hall 2010). However, Morgan (2014) advocates moving beyond the narrow approaches that reduce pragmatism to practicality and use its deeper philosophical content about the nature of reality, truth and knowledge. In this way, pragmatism became the paradigm of this study, providing the 'philosophical underpinnings' and the basis of how and why choices were made in the design and conduct of this study (Morgan 2014). What follows is a description of key attributes of pragmatism and how they are reflected in this study.

Pragmatism as a philosophy is 'distinctive in its emphasis, even in theoretical matters, on practice' (Mounce 2000) (pp 80), and the pragmatic stance 'positions philosophical traditions and multiple perspectives in service of the inquiry problem at hand' (Greene & Hall 2010) (pp 131). Pragmatism is not a unitary philosophy and this study's philosophical underpinnings are based on traditional pragmatic concepts mainly coming from the writings of Sanders Pierce, William James and particularly John Dewey (Greene & Hall 2010). Johnson & Onwuegbuzie (2004) endorsed pragmatism as a philosophy to underpin research enquiry and described the key characteristics of pragmatism based on the work of classical pragmatists. These are summarised in Table 5-1.

Basic characteristics of classical pragmatism
Rejects traditional mind and matter dualism
A problem-solving, action-focused enquiry process
Views knowledge as both constructed and based on the reality of the world we experience and live in
Recognises that knowledge is fallible because we can never be certain that our current knowledge will be appropriate for future enquiry problems
Believes that truth comes from experience and that the absolute truth will be determined at the end of history
Theories are viewed instrumentally (they become true and they are true to different degrees based on how well they currently work; workability is judged especially on the criteria of predictability and applicability).
Justification comes in the form of what Dewey called "warranted assertibility." (assertions can be warranted only in specific enquiry contexts and their value must be re-established in new enquiries)
Prefers action to philosophising (pragmatism is, in a sense, an anti-philosophy).

Table 5-1 Basic characteristics of classical pragmatism (Adapted from Johnson & Onwuegbuzie 2004)

Creswell (2011) further condensed the basic characteristics of pragmatism to being problem-centred, pluralistic, real-world practice-oriented and focussed on the consequences of research. What follows in this section (5.2) is a more detailed description of some of the key ideas within the pragmatic philosophical stance, which are then put in the context of how they shaped this study.

The Pragmatic Maxim

At the core of pragmatism lies the 'pragmatist maxim', which is a way of clarifying concepts and hypotheses by identifying their practical consequences (Hookeway 2013). This disambiguates research questions and eliminates any conflict in using quantitative and qualitative approaches in research. Sanders Pierce stated that 'our idea of anything is our idea of its sensible effects' (Hookway 2012) (pp 167). In other words, a concept

becomes clear when there are conceivable circumstances that would call for different patterns of action. He in turn described the maxim as a logical, methodological principle, where experiments/research are rational actions that will, or fail to, have some sensible effect. John Dewey expanded on this, saying that all enquiry is practical in some sense and that it is concerned with transforming and evaluating the features of the situations in which we find ourselves. Hence, pragmatism rejects the idea that science and practice are different and advocates an intimate relationship between the two (Biesta 2003). In the context of this study, the research questions, design and methods came about through a constant bi-directional influence between generating knowledge, i.e. the impact of PPGP and persistent PPGP in Ireland, and potential actions i.e. what it could practically mean and its implications for maternity care services.

Epistemology & Ontology

Epistemologically, this study, in line with pragmatism, adopted a focus on practicality whereby data were collected by 'what works' to address research questions (Johnson & Onwuegbuzie 2004, Biesta 2010). Research is a process through which knowledge is generated and 'knowing' according to John Dewey is considered the mode of experience that in some way supports action, and thus knowledge is at the same time constructed and real. In Dewey's transactional theory of knowledge, 'experience' refers to transaction between organisms with their environment (Biesta 2003), whereas 'knowledge' has to do with discovering and arises from experience and reflection upon the consequences of action; hence, 'knowing' can increase the ability to plan intelligently and direct actions (Greene & Hall 2010). Subsequently, knowledge is 'fallible' because it depends on our actions and there is possibility for error (Hookeway 2013). Although knowledge is about the relationship between actions and consequences, observation is itself a transaction; hence, it does not refute non-interventional designs such as this study (Greene & Hall 2010). 'Truth' is in turn a provisional and instrumental matter of the outcomes of a competent process of enquiry, and 'warranted assertibility' replaces the absolute certainty of truth with the products of competent investigation, creating an interdependency of truth and the process of inquiry (Dewey 1938).

Ontologically, pragmatism suggests that 'everyone's experience is equally real' and 'what is experienced is itself real' (Biesta 2003) (pp 43). Dewey's concepts of 'intersubjectivity' entails that we construct our world for our own individual purposes (subjectivity), but through interaction, cooperation and communication with others, an 'intersubjective world' is constructed (Greene 2010). This means considering varying lines of action, conducting actions together and developing mutual understanding (Biesta 2003). In line with Dewey, William James stated that 'no theory is absolutely a transcript of reality, but any of them may from some point of view be useful' and he saw scientific theory to be 'an instrument, designed to achieve a purpose to facilitate action or increase understanding' (James *et al.* 1978) (pp 33).

Axiology

A pragmatic stance entails that values are situational and relative, and both biased and unbiased perspectives are included in this study (Creswell 2011). Values are thus not eternal, but they are created, and if they are useful, their selection is appropriate (Beatty *et al.* 2009).

Purposes and practical roles of research

Reflecting a pragmatic paradigm, this study was designed to increase our understanding of (persistent) PPGP with the further purpose of informing and optimising care provision, through a problem-solving, action-focused enquiry process (Biesta 2003). Johnson & Onwuegbuzie (2004) point out some of the potential weaknesses of pragmatism as a paradigm for research. One key issue they raise is that pragmatic researchers often fail to communicate clearly what is meant by usefulness and workability of practical results and for whom these are useful. In this study 'usefulness' and 'workability' is defined in terms of what the results mean to maternity care; in other words, how the understanding/knowledge emerging from this study can provide a stronger basis to direct care. This in turn is relevant ('useful') to service providers to organise care and direct resources, to healthcare practitioners to guide management and provide accurate information to patients, and to women with (persistent) PPGP to receive appropriate care and information.

5.3 Study Design – Mixed Methods

The purpose of this study could be broadly summarised in the central question "What is the impact of pelvic girdle pain on women during pregnancy and postpartum in Ireland?" This question is a multi-faceted in nature. It entails the question of the extent to which PPGP affects women nationally in the context of public maternal health on the one hand, and, on the other hand it requires a deeper exploration of the impact of PPGP in term of what it 'means' to these women's lives. Therefore, this study's aim and objectives called for an integration of both quantitative and qualitative methodologies. A Mixed Methods design was chosen as defined by Johnson *et al.* (2007) (pp 123) ; '*Mixed methods research is the type of research in which a researcher combines elements of qualitative and quantitative research approaches (e.g. use of quantitative and qualitative viewpoints, data collection, analysis, inference techniques) for the purposes of breadth and depth of understanding and corroboration*.' Greene (2007) described five purposes of mixing methods: triangulation, complementarity, development, initiation and expansion. Mixed Methods was used for this study for the purpose of 'complementarity', whereby methods were used that tap into different facets or dimensions of the same complex phenomenon. Bryman (2006) proposed a different typology of reasons for using Mixed Methods with 16 possible purposes. Within this framework, this study used Mixed Methods for 'completeness', to answer 'different research questions', and to facilitate 'sampling' whereby the sample for phase 2 was selected based on the phase 1 data. Moreover, qualitative findings 'illustrate' quantitative findings.

Using the 3-dimensional Mixed Methods typology framework proposed by Leech & Onwuegbuzie (2009), a **Partially Mixed Sequential Equal Status design** was adopted. The sequential design allowed the quantitative data (Phase 1 - QUANT) to provide an epidemiological context to the qualitative data (Phase 2 - QUAL) of this study; in other words, the quantitative data identified how many women continued to suffer from persistent PPGP postpartum, which were then explored in the qualitative phase in terms of their 'meaning' from the women's perspective. The qualitative data

therefore provide information that add 'depth' to, and thus complement, the quantitative data.

Along the continuum of mono-method to fully mixed methods research, this study adopted a partially mixed design (Leech & Onwuegbuzie 2009). Recruitment of participants for phase 2 was guided by the data from phase 1, but findings were analysed separately and integrated in the overall discussion where appropriate (Chapter 8). Emerging from a pragmatic paradigm (Section 5.2), this Partially Mixed Sequential Equal Status design allowed the collection of data to best address the research objectives and subsequently present greater utility for practice.

In terms of the 'status' of the two phases (Greene 2007), also referred to as 'dominance' or 'priority' (Creswell 2011), equal weight was given to the quantitative and qualitative phase. While it is usual in a sequential design for one phase to carry more weight (Padgett 2012), the innovative nature of phase 2 of this study, since the experiences of women with persistent PPGP had not been explored before internationally, granted it equal weight.

Although one could argue that the qualitative phase was 'embedded' in the quantitative phase (Creswell 2011), as the longitudinal quantitative data collection sometimes continued beyond the qualitative data collection, the fact that recruitment for the qualitative phase (2) was guided by quantitative data made this a sequential design and not truly an embedded design (Nastasi *et al.* 2010).

Figure 5-2 gives an overview of the design of this study.

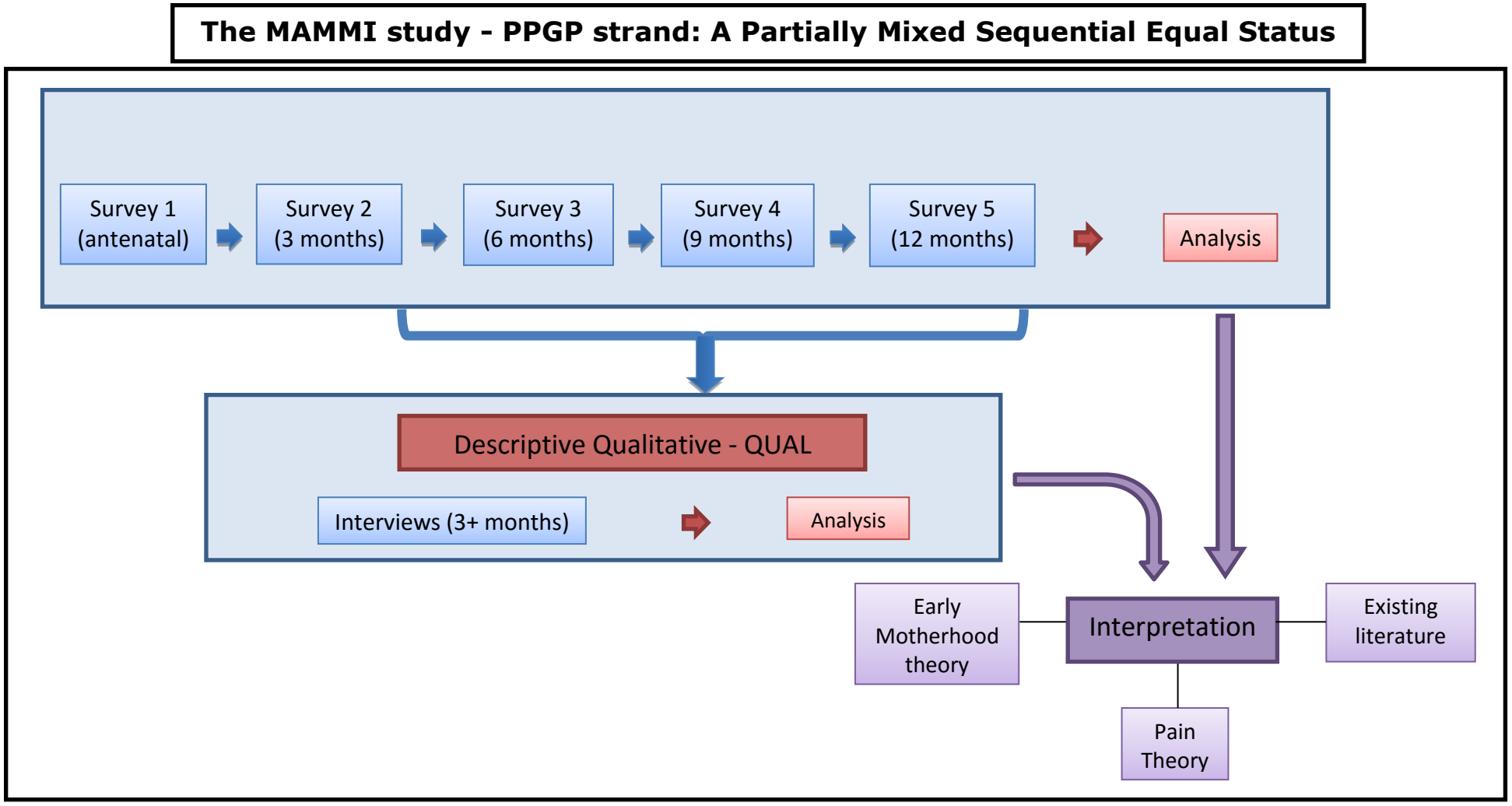

Figure 5-2 Overview of the design of this study

5.3.1 Phase 1 (QUANT) - Longitudinal survey-based cohort study

A longitudinal cohort design was used for phase 1, in which a group of participants was followed for a period of time to identify any changes (Lodico *et al.* 2010). This study followed a group of nulliparous women from early pregnancy to a year after childbirth using the MAMMI surveys. Advantages of a cohort design include the ability to measure the incidence of an outcome, and any change in exposure and outcome over time, while challenges include getting an appropriate sample size, drop-out and selection bias (Levin 2003, Castillo *et al.* 2012). Phase 1 had a prospective cohort design as it was carried out from the present time (start of the study) into the future (Levin 2003); however, in the surveys some questions enquired about symptoms they had experienced before becoming pregnant or in the past three months, which were retrospective questions.

5.3.2 Phase 2 (QUAL) - Descriptive qualitative

A Descriptive Qualitative design was adopted for phase 2, which is an alternative qualitative design that aims to provide a rich straight description of a phenomenon (Neergaard *et al.* 2009). It is not theory-driven and stays as close as possible to the participants' descriptions of their experiences. While quantitative description is limited in learning about the meaning that participants give to events, qualitative description allows for unanticipated themes to emerge (Sandelowski 2000). On the other hand, a descriptive qualitative design involves minimal interpretation and stays closer to the data compared to other qualitative approaches, nevertheless it is still interpretative (Sandelowski 2010). Subsequently, a descriptive qualitative design was particularly appropriate to obtain straight answers to questions that may be important to healthcare practitioners and policy makers (Sandelowski 2000), but the qualitative nature of the design allowed for the participants' views to be explored in depth. A descriptive qualitative methodology was congruent with the pragmatic paradigm and mixed methods design of the study given that descriptive findings from phase 2 were interpreted in the discussion in terms of their practical implications.

5.3.3 Integration of Phase 1 (QUANT) & Phase 2 (QUAL)

A mixed-methods design requires integration of the quantitative and qualitative findings. In this study integration occurred at three levels:

1. At the design level, as the research objectives required quantitative and qualitative methodologies;
2. At the methods level: Quantitative and qualitative data were integrated by '*connecting*' (Fetters *et al.* 2013) as the sample of interview participants were selected from the survey participants;
3. At the reporting level a *contiguous approach* was employed (Fetters *et al.* 2013): The results of the quantitative and qualitative data are reported separately, but then meta-interferences, integrating understandings from both phases, form the coherent discussion to address the research aim (Tashakkori 2010).

5.4 Methods

5.4.1 Sampling, Selection criteria & Sample size

5.4.1.1 Sample frame, sampling design & sampling schemes

Sample frames are formal or informal lists of sample units or participants from which the sample is drawn, and in mixed methods research both formal and informal sampling frames tend to be used (Teddlie & Yu (2007). The formal sample frame, defined as the entire population of interest, for phase 1 of this study included all nulliparous women attending one maternity hospital in Ireland during the recruitment period of the study. The sample frame of phase 2 consisted of all phase 1 participants with persistent PPGP of at least three months after the birth during the recruitment period of phase 2 (see selection criteria in section 5.4.1.2). Although Teddlie & Yu (2007) suggest that qualitative parts of mixed methods studies mostly have an informal sample frame that represents a resource from which to select a sample, in this study the quantitative phase (1) did formally lay out the sample frame for phase 2 by presenting the prevalence of persistent PPGP.

Onwuegbuzie & Collins (2007) proposed a sampling typology for mixed methods research. They differentiated between the sampling schemes and sample design of a study. Sampling schemes are defined as the strategies used to select sample units (participants), while sample design refers to the framework in which sampling takes place, including the number and types of sampling schemes as well as the sample size.

Sampling design

A Sequential Mixed Methods sampling design was used (Onwuegbuzie & Collins 2007, Teddlie & Yu 2007) in which participants for phase 2 were recruited from the sample of phase 1. Onwuegbuzie & Collins (2007) describe an additional dimension to the relationship between samples in mixed methods studies, which can be identical, parallel, nested or multilevel. In this study, the sample of phase 2 was 'nested' in the sample of phase 1, because the sample members selected for phase 2 represent a subset of the participants chosen for phase 1.

Sampling Scheme

Onwuegbuzie & Collins (2007) describe four types of sampling scheme combinations in mixed methods research. This study used the Type 4 combination, which involved non-probability (non-random) sampling schemes in both the quantitative and qualitative phase.

In phase 1 a convenience sampling scheme was used whereby the sampling site, i.e. the maternity hospital where recruitment took place, was conveniently chosen. However, all nulliparous women booking at this maternity hospital during the time of recruitment (February 2012 – July 2014) and who fitted the below described selection criteria, were asked to take part in the study. This could be interpreted as census sampling at the sampling site; however, it is not true census sampling because the whole population of interest about which we wished to make inferences (nulliparous women in Ireland) was not asked to participate (Lodico *et al.* 2010).

Phase 2 involved a purposive sampling scheme, which selects a small number of cases that will yield the most information about a particular phenomenon (Teddlie & Yu 2007). More specifically, homogeneous purposive sampling was adopted, whereby individuals with similar attributes or experiences (Section 5.4.1.2; phase 2) were selected for the sample (Lodico *et al.* 2010). In this study, the purposive sample for phase 2 was recruited from the sample of participants in phase 1. Since participants for phase 2 were recruited consecutively, whilst phase 1 was still ongoing, not all potentially eligible women were contacted. Instead, sampling took place until the point of data saturation, after which the recruitment period for phase 2 ended. This equated to 69 women being contacted consecutively of whom 23 participated this phase (2) (Section 5.4.1.3, Figure 5.4). Figure 5-3 presents an overview of the sampling design and schemes of this study.

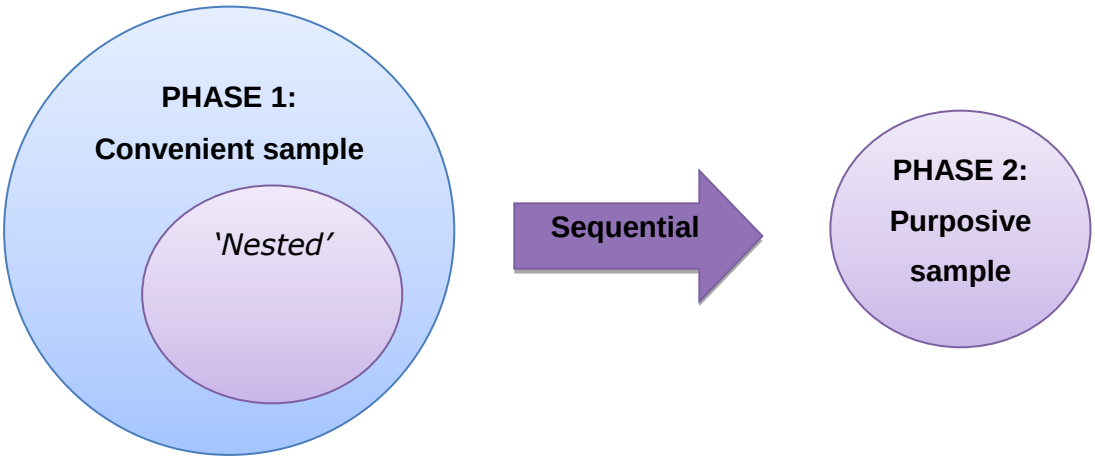

Figure 5-3 Sampling design and schemes (the circle sizes are NOT exactly proportional to the sample sizes)

5.4.1.2 Selection criteria

Phase 1 (QUANT)

Inclusion criteria

- Participants had to be pregnant nulliparous women
- Participants had to be aged 18 or more
- Participants had to agree to take part in the study

Exclusion criteria

- Participants who did not read and understand English

- Participants who experienced miscarriage, stillbirth or death of their baby following recruitment to the study were excluded from further participation in the study

Phase 2 (QUAL)

Inclusion criteria

- Participants had completed at least surveys 1 (antenatal) and 2 (3 months postpartum) of the MAMMI study and reported pain in any of the pelvic girdle areas during pregnancy that persisted for at least 3 months postpartum and was still present at the time of the interview
- Participants had given written consent to take part in the interview and consented to the interview being audio-recorded

Exclusion criteria

- Participants with a history of low back or pelvic girdle pain before pregnancy
- Participants with suspected serious pathology (infection, malignancy, fracture) or nerve involvement (e.g. lumbar radiculopathy)

5.4.1.3 Sample size & power calculations

Generalisability i.e. being able to generalise the findings from the sample to the whole population of interest with confidence, is a key issue. For quantitative strands of a mixed methods study, there is a focus on external validity issues and the aim of sampling is to achieve representativeness, while for qualitative strands, the focus is on seeking rich information and transferability issues (Teddlie & Yu 2007).

Phase 1 (QUANT)

The original sample size of the MAMMI study was estimated for the urinary incontinence strand of the MAMMI study by power calculations based on the prevalence of urinary incontinence at 6 months (10-20%) with a power 0.80, α=0.05. Previous studies internationally estimated a prevalence of PPGP of 22% three months postpartum (Gutke *et al.* 2011) and at 8.6% at two years (Albert *et al.* 2002). Moreover, these studies included positive clinical provocation tests in their inclusion criteria, while in this study any

self-reported PPGP was examined for which an even higher prevalence would be expected, hence this sample size would be sufficient. To confirm this, power calculation for persistent PPGP 12 months postpartum were conducted for this study (Appendix 63).

Phase 2 (QUAL)

A purposive sample of 23 mothers was recruited for phase 2. When open coding the transcripts, no new codes emerged after 20 interviews. This could be interpreted as the point at which data saturation was reached, which has been described as the point when no new information is apparent (Green & Thorogood 2004). Although the concept of data saturation is an area of debate and one cannot with certainty know whether additional codes would arise if data collection was continued, data saturation is a logical approach to deciding on the sample size, considering the aim of the qualitative phase was to gather sufficient in-depth information as a way of describing the phenomenon being studied (Fossey *et al.* 2002). It is also important to avoid data redundancy in terms of ethical issues, cost and time efforts, related to continuing data collection unnecessarily. Nevertheless, the decision of when saturation is reached is subjective (Lodico *et al.* 2010); subsequently, a key recommendation emerging from the data saturation debate is the need for transparency of how data saturation was achieved (Bowen 2008, O'Reilly & Parker 2012). For phase 2 of this study, data saturation was defined as the point at which no new codes were added during open coding of the transcripts. Section 5.4.4 further outlines the open coding process as part of the analysis. Data saturation was reached after 20 interviews, but three more interviews were conducted and no further new codes emerged. Recruitment of women for phase 2 is presented in Figure 5-4.

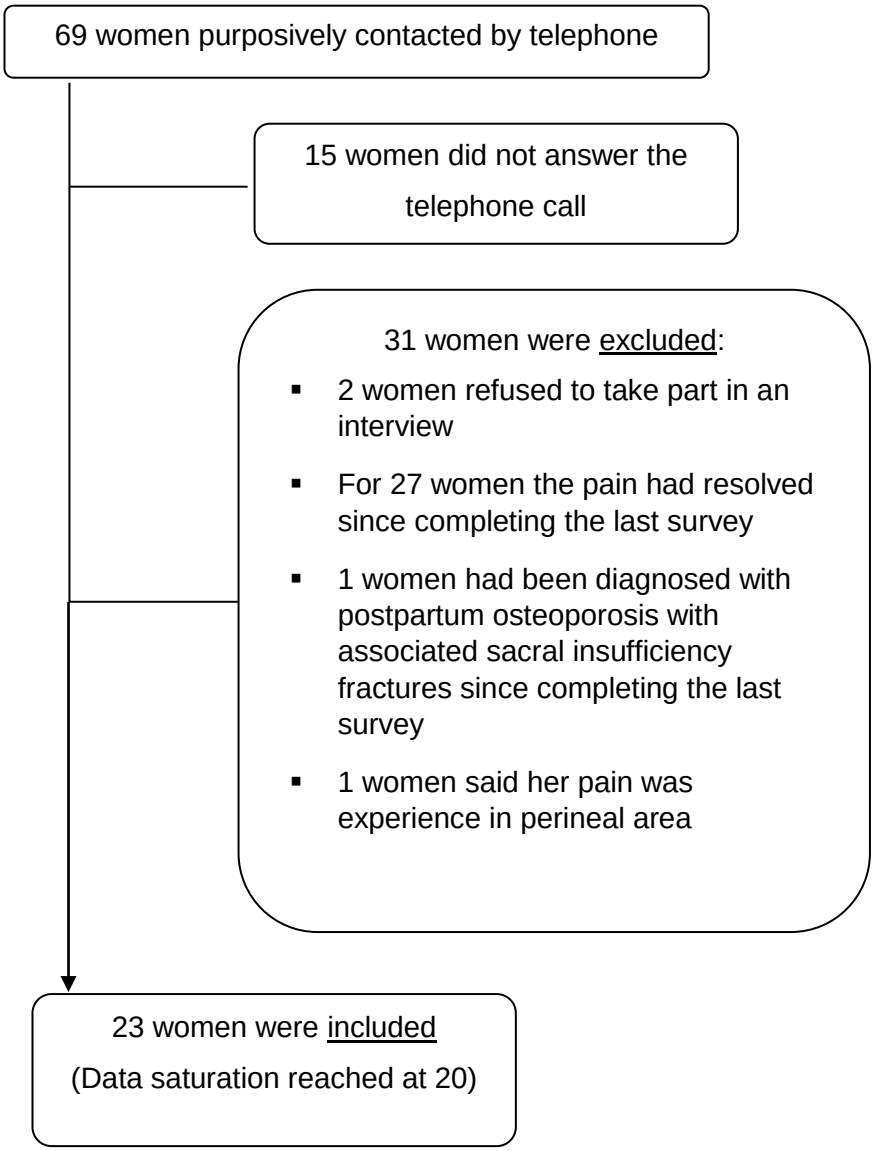

Figure 5-4 Sampling of participants for Phase 2

5.4.2 Recruitment & follow-up

5.4.2.1 Phase 1 (QUANT) recruitment & follow-up

Figure 5-5 presents an overview of the recruitment process and management of follow-up.

Recruitment site

Recruitment of study participants took place in one large maternity hospital in Dublin. All women attending public, semi-private, private, and DOMINO (community midwifery) services were asked to participate. The characteristics of all women attending the hospital in 2014 (The Rotunda

Hospital 2014) and data from the national perinatal statistics report 2013 (Healthcare Pricing Office; Health Service Executive 2013) were compared with the characteristics of the study sample in Chapter 6 (section 6.2.2).

Recruitment process & antenatal follow-up

Training sessions for the midwives at the hospital had been held by Dr Deirdre Daly in 2012, prior to the commencement of recruitment. Women that fit the selection criteria described above in section 5.4.1.2 were approached about the study by the midwife during their first (booking) visit in the maternity hospital between 31 January 2012 and 3 October 2014. If an interest to take part was expressed a pack containing the first survey, a freepost envelope, two copies of the consent form and an information leaflet was given to the woman, and verbal consent was sought to receive a phone call from one of the researchers of the MAMMI study team approximately two weeks later. The list of women recruited was collected by a member of the MAMMI study team on a weekly basis.

During the telephone follow-up call, conducted by one of the members of the research team, further verbal information about the study was provided to the women including what taking part involved, the estimated time commitment, the purpose of the study, and the rights of the participants. Women who refused to take part at this point were not further contacted. Women who expressed willingness to participate were sent a webtext reminder 3-4 weeks following this telephone conversation if the survey had not been returned in the meantime.

Postnatal follow-up

Surveys 2, 3, 4 and 5 were posted at approximately 3, 6, 9 and 12 months postpartum to women who had completed survey 1. If the woman had not returned a postnatal survey and had not withdrawn from the study in the meantime, four weeks after a postnatal survey was sent out, a reminder telephone call was made. In February 2014 ethical approval was granted to increase the number of postnatal reminders. Subsequently, since February 2014 up to three postnatal reminders took place if a postnatal survey was not returned. Two weeks after the telephone reminder, a webtext was sent

to remind the woman to return the survey if it had not yet been returned. Finally, the survey was resent to the women two weeks after the webtext as a last reminder. This procedure of postnatal reminders was the same for all four postnatal surveys. Figure 5-5 illustrates the recruitment and follow-up process of phase 1.

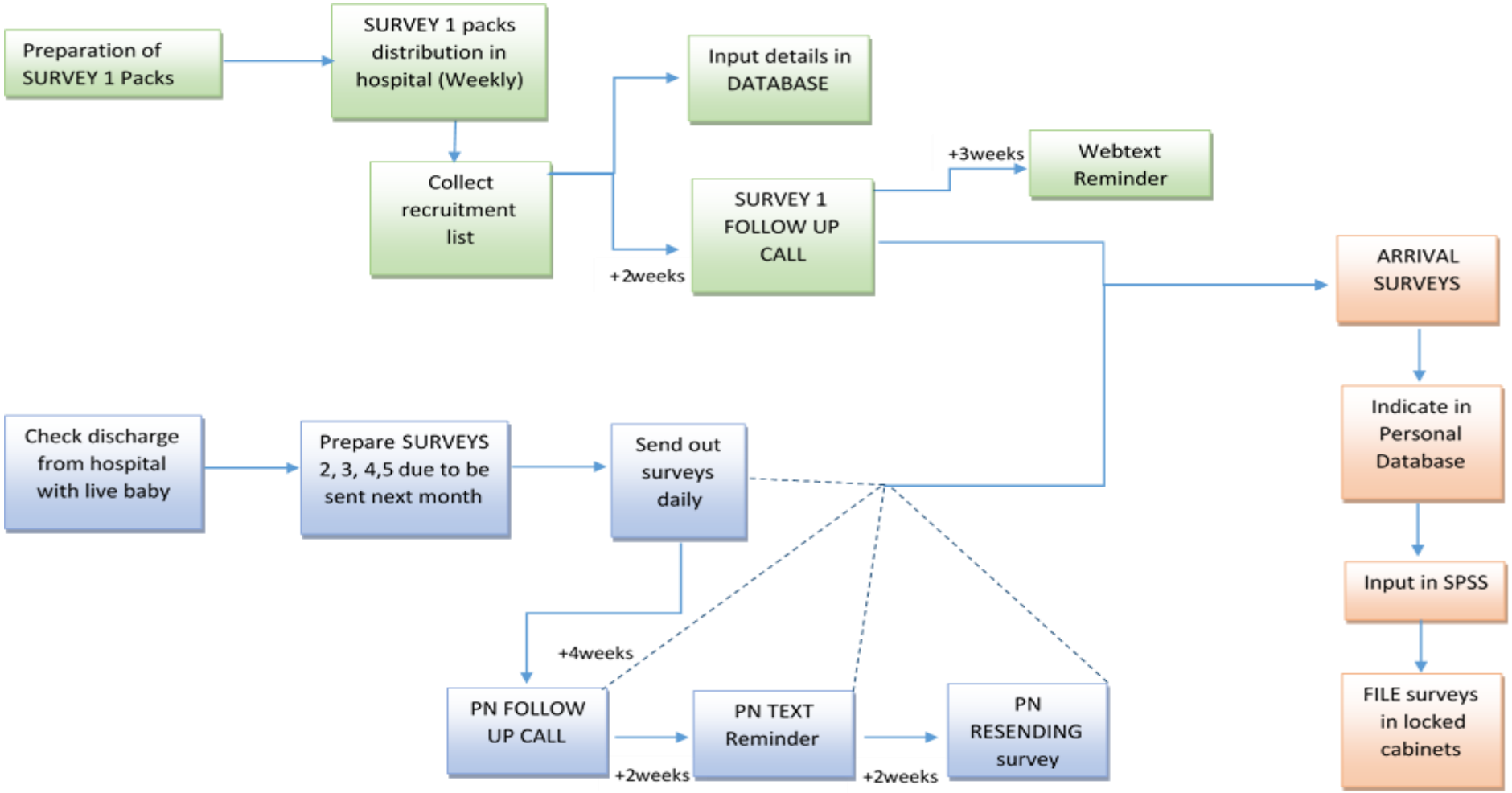

Figure 5-5 Overview of recruitment and follow-up of Phase 1

5.4.2.2 Phase 2 (QUAL) recruitment

Participants for phase 2 were recruited between June and October 2013. Women reporting pain in survey 2 (three months postpartum) on the pain diagram in any the following areas; 'bone at front of pelvis', 'left and/or right hip', 'sacral area or coccyx', 'sacroiliac joint' and/or any other areas reported in the open ended question that fitted within the definition of PPGP described in section 1.5, and who did not report a history of low back and/or pelvic girdle pain before the start of pregnancy in survey 1, were contacted by telephone. This only involved women who had consented to be contacted for future related research. Firstly, the woman was asked whether she was still having PPGP, as well as additional questions to triage the woman and screen for pathology and nerve root problems. As I am a qualified chiropractor, I was able to use my clinical expertise to develop these questions. A participants' selection flowchart was used to guide this recruitment process (Appendix 64). This had been constructed prior to the study and was sent to a consultant obstetrician and anaesthesiologist for feedback.

A minimum of three months persistent PPGP postpartum was chosen as a criterion for women to take part in an interview because persistence beyond 12 weeks is considered 'chronic' (Airaksinen *et al.* 2006). However, no maximum period of persistent PPGP symptoms was set; hence, women reporting persistent PPGP up to 12 months postpartum (end of phase 1) were candidates to take part in an interview, as long as they fitted the above described selection criteria.

5.4.3 Data collection

5.4.3.1 Phase 1 (QUANT) data collection

MAMMI surveys

Five hard copy surveys were administered at different points in time: one during pregnancy, then at 3, 6, 9, and 12 months postpartum (Surveys 1 to 5). All surveys were similar in content and contained questions regarding women's physical and mental health and wellbeing. The sections of all surveys are outlined in Table 5-2. A copy of survey 5 is provided in appendix 65 as example. The MAMMI surveys were adapted by Dr Deirdre

Daly[2], as part of her PhD study, based on a survey conducted in Australia (Brown *et al.* 2006). Issues of validity and reliability of the surveys are addressed in section 5.4.5. Data on the potential risk and prognostic factors that were examined in phase 1 of this study were collected from various sections of the surveys. A full list of the variables assessed in this study is presented in section 5.4.4.

Survey 1 (antenatal): A. Your general health and well-being B. Your health before pregnancy C. Your health since the start of pregnancy D. Your emotional health and well-being now E. About you and your household
Survey 2 (3 months postpartum): A. Questions about you and your baby B. Your labour and baby's birth C. Life with a new baby D. Your health since the birth of your baby E. Sex after childbirth F. Your emotional health and well-being now G. Contacts with health services H. About you and your household I. You and your relationships
Survey 3 (6 months postpartum) A. Questions about you, your baby and contact with the health services B. Life with a new baby C. Your health over the past three months D. Sex after childbirth E. Your emotional health and well-being now F. About you and your household G. About you and your relationships
Survey 4 (9 months postpartum) A. Questions about you, your baby and contact with the health services B. Life with a new baby C. Your health over the past three months D. Sex after childbirth E. Your emotional health and well-being now F. About you and your household G. About you and your relationships
Survey 5 (12 months postpartum) A. Questions about you, your baby and contact with the health services B. Life with a 12 month old baby C. Your health over the past three months D. Sex after childbirth E. Your emotional health and well-being now F. About you and your household G. About you and your relationships

Table 5-2 Sections of the five MAMMI surveys

[2] Assistant Professor of Midwifery/Director of International Initiatives, School of Nursing & Midwifery, Trinity College Dublin (Ireland)

Assessment of PPGP

A labelled pain diagram was included in each of the five surveys, which is an accurate way to assess pain location (Ohlund *et al.* 1996) (Appendix 65, pp865-866). Any woman who marked to have had pain in any of the pelvic girdle areas (front of pelvis, lateral hip(s), sacrum/coccyx, sacroiliac areas) on a pain diagram, was classified as having PPGP. Additionally, in Survey 4 and 5, women who reported PPGP on the pain diagram were asked to complete the Pelvic Girdle Questionnaire (Stuge *et al.* 2011) and questions regarding any pain medication they had taken and whether they had discussed their persistent PPGP with anyone (Appendix 65, pp867-869). This was an additional section that was added to Survey 4 and 5 for the purpose of this PPGP strand of the MAMMI study. The Pelvic Girdle Questionnaire is a recently developed valid and reliable 25-item condition-specific questionnaire that assesses symptoms and activity limitation related to pelvic girdle pain, adding up to a 0-75 score, with 75 indicating most severe symptoms and activity limitations. For the present study, the face and content validity, internal consistency and test-retest reliability of the Pelvic Girdle Questionnaire was assessed in the Irish context (Section 5.4.5).

5.4.3.2 Phase 2 (QUAL) data collection

A face-to-face interview was arranged at a time and in a place convenient for the mother. Prior to the interview, the mother was asked to complete a short questionnaire (Appendix 66) that included a pain diagram (without labels) and questions concerning the pain pattern and pain severity (10-point Numerical Pain Rating scale). Subsequently, a semi-structured audio-recorded interview was conducted.

A topic guide (Appendix 67) was used to guide the interview which included open-ended questions. This topic guide was constructed based on the objectives of this study and guided by the biopsychosocial model of pain (Chapter 4, section 4.2.1) including questions regarding how they felt (emotional) and what they did (behavioural) when they were in pain, thoughts (cognitive) about their symptoms, and any interactions with other people (social).

Description of main topics of the interviews (these were broad topics and the women could expand on areas they found relevant):
(a) The experiences of how their persistent PPGP impacted on their life were explored. The opening question (Appendix 67) allowed the woman to share the experiences of importance to her. Possible prompt questions included open questions regarding their experiences of how their persistent PPGP affected their life as a new mother and taking care of their child.

(b) The second broad topic that was explored in the interviews was their health-seeking behaviours. For the purpose of this study, health-seeking behaviours were defined as any remedial actions that individuals undertake to rectify a perceived health problem (Ward *et al.* 1997). This is different from 'health behaviour', which is related to preventing health problem/disease (Kasl & Cobb 1966), and sometimes referred to as 'health-promoting behaviour' (Lo *et al.* 2015). It is also different from 'help seeking behaviour' which Cornally and McCarthy (Cornally & McCarthy 2011b), in a concept analysis, defined as a problem-focused, planned behaviour, involving interpersonal interaction with a selected health-care professional; also often referred to as 'healthcare-seeking behaviour' (Chowdhury *et al.* 2007). However, 'health-seeking behaviours', of interest in this study, may or may not involve a healthcare professional, and can include other 'informal' actions aimed at improving or resolving the health problem they experience (El Kahi *et al.* 2012).

5.4.4 Data analysis

5.4.4.1 Phase 1 (QUANT) data analysis

Data were stored and analysed in the School of Nursing & Midwifery (Trinity College Dublin) using the IBM statistical software SPSS (IBM Corp. 2013). Following data coding, data were entered into SPSS. The relevant sections for this study of five percent of all surveys were checked for accuracy. The data entry error rate was very low (0.003% for survey 1, 0.001% for survey 2, 0.0009% for survey 3, 0.001% for survey 4, and 0.0008% for survey 5). In addition, the data were visually checked for discrepancies and further data cleaning was done by running descriptive statistics for all

variables of interest. This included assessing frequencies and the range of any categorical variables, and examining the mean, standard deviation, minimum and maximum scores of any continuous variables for potential errors (Palant 2005).

Descriptive statistics

Participant characteristics of the sample were assessed, including age, country of birth, level of education, number of weeks of gestation. Participants' characteristics were compared to clinical report data of primiparous women who gave birth at the site hospital and to national data to assess representativeness of the sample (Chapter 6, section 6.2.2).

The prevalence of PPGP and persistent PPGP, as well as the symptoms and activity limitations related to persistent PPGP (measured on the Pelvic Girdle Questionnaire), the use of pain medication and any advice sought 6 to 12 months postpartum, were described using frequency distributions and percentages (Chapter 6, sections 6.3, 6.7 and 6.8).

Assessment of risk and prognostic factors for PPGP

The chi-square test was used to compare categorical factors between women with and without (persistent) PPGP. Univariate and multivariable logistic regression analyses were conducted to assess potential risk factors for PPGP in early/mid pregnancy and in the last month of pregnancy. Similarly, prognostic factors for persistent PPGP postpartum were assessed using logistic regression for all four follow-up periods (0-3, 3-6, 6-9 and 9-12 months postpartum).

The assumptions of the Chi-square test and of logistic regression analysis were checked prior to the analyses. The chi-square test assumes that the levels (or categories) of the variables are mutually exclusive, each subject contributes data to one cell only, the study groups are independent, the value of the cell expected count is five or more in at least 80% of the cells, and no cell has an expected cell count of less than one (McHugh 2013) (pp144). The assumptions for using logistic regression are that; the sample is representative of the population to which interference are made, the sample size is sufficient to support the model, the data have been collected

in a period when the relationship between the outcome and the explanatory variable(s) remains constant, all important explanatory variables are included, and the explanatory variables do not have a high degree of collinearity with one another (Peat & Barton 2005) (pp253). Multicollinearity was assessed by running the multivariable analysis with and without the variable that was thought to have high collinearity with another variable in the model. If standard errors increased by 10% or more by the addition of the variable, then collinearity was considered to be present, making the model less precise (Peat & Barton 2005).

The variables that were explored as potential risk and prognostic factors for PPGP are listed in Table 5-3 to Table 5-5. These variables were chosen based on the systematic review of existing literature on risk and prognostic factors (Chapter 3).

The association with each variable and the outcome (PPGP for risk factors or persistent PPGP for prognostic factors) was first examined using univariate logistic regression. All variables that were statistically significant in univariate analysis ($p \leq 0.05$) were then included in the multivariable model. For each multivariable model, variables were entered simultaneously into the model, selecting the 'enter' option in the SPSS software package (Patton 2010). Multivariable models were interpreted with the insignificant variables included in the model. Two tests were used to assess 'goodness of fit' of multivariable models. The Omnibus Test of Model Coefficients gives an overall indication of how well the model performs, over and above the results with none of the predictors entered into the model; hence a highly significant value is required. The Hosmer and Lemeshow Test is a 'test for poor fit', with a non-significant result ($p > 0.05$) indicating good fit (Pallant 2010).

Potential risk factors for PPGP assessed (obtained from survey 1):
Age (converted to a categorical variable)
Body Mass Index pre-pregnancy
History of any Low Back Pain the year before becoming pregnant as marked on a pain diagram (binary)
History of any Pelvic Girdle Pain the year before becoming pregnant as marked on a pain diagram (binary)
History of feeling depressed, low mood or sad (lasting two weeks or more) before pregnancy (converted to binary variable: no ('never' and 'rarely') and yes ('occasionally' and 'often'))
History of intense anxiety (such as panic attacks) before pregnancy (converted to binary variable: no ('never' and 'rarely') and yes ('occasionally' and 'often'))
History of any surgery 'on the bones in your back' (converted to binary variable: no ('no' and 'not sure') and yes ('as child' and 'as adult'))
History of any injury 'to the bones in your back' (converted to binary variable: no ('no' and 'not sure') and yes ('as child' and 'as adult'))
Diabetes (converted to binary variable: no ('no' and 'not sure') and yes ('as child' and 'as adult'))
History of severe period pain (converted to binary variable: no ('never' and 'rarely') and yes ('occasionally' and 'often'))
History of heavy periods or vaginal bleeding that was worrying (converted to binary variable: no ('never' and 'rarely') and yes ('occasionally' and 'often'))
Smoking before pregnancy (Categorical: Never smoked; stopped smoking when found out being pregnant or before, smoking)
Marital status (Categorical: married, living with partner, single/divorced/widowed, in a relationship – not living together)
Level of education (Categorical: no formal qualification/primary or lower secondary, upper secondary, university degree or equivalent, postgraduate qualification)
Employment status (Categorical: full-time paid work, part-time/casual paid work, unemployed, student/pupil, looking after home/family, unable to work due to sickness/disability)
Ethnic background (Categorical: white, black/African, Asian, mixed)

Table 5-3 Potential risk factors for PPGP explored in this study

Potential prognostic factors for PPGP assessed (obtained from survey 1):
Age (converted to a categorical variable)
Body Mass Index pre-pregnancy
History of any Low Back Pain the year before becoming pregnant as marked on a pain diagram (binary)
History of any Pelvic Girdle Pain the year before becoming pregnant as marked on a pain diagram (binary)
Depression during pregnancy, assessed using (1) the Depression, Anxiety, Stress Scale (DASS-21) scale (Antony *et al.* 1998), of which 7 of the 21 items relate to depression, and (2) the Edinburgh Postnatal Depression Scale (EPDS) (Cox *et al.* 1987)
Anxiety during pregnancy, assessed using (1) the Depression, Anxiety, Stress Scale (DASS-21) scale, of which 7 of the 21 items relate to anxiety
Stress during pregnancy, assessed using (1) the Depression, Anxiety, Stress Scale (DASS-21) scale, of which 7 of the 21 items relate to stress
History of any surgery 'on the bones in your back' (converted to binary variable: no ('no' and 'not sure') and yes ('as child' and 'as adult'))
History of any injury 'to the bones in your back' (converted to binary variable: no ('no' and 'not sure') and yes ('as child' and 'as adult'))
Diabetes (converted to binary variable: no ('no' and 'not sure') and yes ('as child' and 'as adult'))
History of severe period pain (converted to binary variable: no ('never' and 'rarely') and yes ('occasionally' and 'often'))
History of heavy periods or vaginal bleeding that was worrying (converted to binary variable: no ('never' and 'rarely') and yes ('occasionally' and 'often'))
Smoking before pregnancy (Categorical: Never smoked; stopped smoking when found out being pregnant or before, smoking)
Marital status (Categorical: married, living with partner, single/divorced/widowed, in a relationship – not living together)
Level of education (Categorical: no formal qualification/primary or lower secondary, upper secondary, university degree or equivalent, postgraduate qualification)
Ethnic background (Categorical: white, black/African, Asian, mixed)
Pain location of PPGP during pregnancy (categorical; anterior, posterior or combined)

Table 5-4 Potential prognostic factors for PPGP explored in this study

Potential prognostic factors for PPGP assessed (obtained from survey 2, 3, 4 and/or 5, or hospital records):
Employment status (Categorical: full-time paid work, part-time/casual paid work, unemployed/looking for first job/gave up job when my baby was born, student/pupil, looking after home/family, unable to work due to sickness/disability)
Return to work (Categorical: returned to work/study, on paid maternity leave, on unpaid maternity leave, not in paid work or study)
Depression 0-3 months postpartum, assessed using (1) the Depression, Anxiety, Stress Scale (DASS-21) scale (Antony *et al.* 1998), and (2) Edinburgh Postnatal Depression Scale (EPDS) (Cox *et al.* 1987)
Anxiety 0-3 postpartum, assessed using the DASS-21
Stress 0-3 postpartum, assessed using the DASS-21
Breastfeeding (Categorical: never breastfed, initiated breastfeeding but discontinued in the first three months postpartum, still breastfeeding at 3 months postpartum). This variable had additional categories in subsequent follow-ups to indicate when women had discontinued breastfeeding, based on questions survey 3 to 5
Mode of birth obtained from hospital records where available (Categorical: spontaneous birth without epidural, spontaneous birth with epidural, vacuum or kiwi birth, forceps or combined instrumental birth, caesarean section with no labour, caesarean section in 1st stage of labour, caesarean section in 2nd stage of labour)

Table 5-5 Potential prognostic factors for PPGP explored in this study - continued

5.4.4.2 Phase 2 (QUAL) data analysis

The iterative data were transcribed verbatim and were analysed using thematic analysis (Vaismoradi *et al.* 2013). A low-inference approach was adopted; analysis stayed as close as possible to the data (Neergaard *et al.* 2009). Transcripts were checked twice for transcription errors, and imported into NVivo 8 software (2008) for data management and analysis. After familiarisation with the data, all interviews were coded (Vaismoradi *et al.* 2013). First, open coding was used to assign a word or short phrase, 'a code', to all portions of narratives. This was followed by axial coding to identify emerging categories, and broader themes. Figure 5-6 gives an overview of the data analysis process of the interviews and appendix 68 provides an audit trial for the analysis.

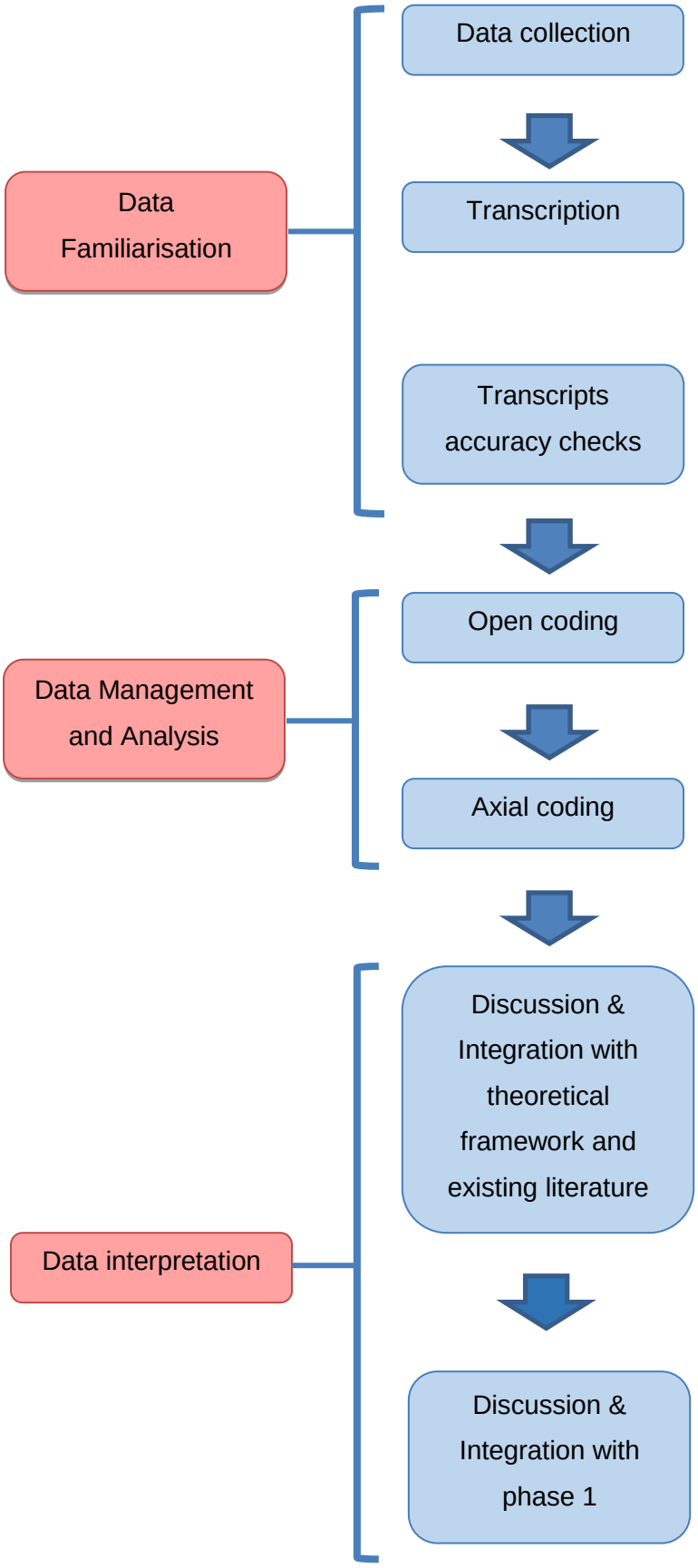

Figure 5-6 Overview of data management and analysis of interview data

Although the purpose of the qualitative phase was primarily to describe women's experiences in accordance with descriptive qualitative design, findings are discussed within the context of the theoretical framework and existing literature in Chapter 7 (Section 7.4). Moreover, interpretations occurred in the final discussion (Chapter 8) where quantitative and qualitative data were integrated in addressing the overall research aim. Finally, in light of the pragmatic paradigm of this study, 'warranted inferences' were made in the discussion chapter. These represent actionable knowledge, i.e. knowledge that is actionable for improving the practical problem being studied (Greene & Hall 2010). The findings from phase 1 and 2 were integrated and meta-inferences were drawn with regards to the impact of PPGP and persistent PPGP on women's lives, and their implications to health and maternity care services and future research.

5.4.5 Quality/Legitimation

The issue of quality in Mixed Methods research is an emerging area and there is no final agreed set of quality criteria available at present. Onwuegbuzie & Johnson (2006) suggested the term 'legitimation' when talking about quality in Mixed Methods research as it can be used by both quantitative and qualitative researchers. They also proposed a new typology of Mixed Methods legitimation types including nine types of issues that become relevant when combining inferences from quantitative and qualitative data to draw meta-inferences. The Handbook of Mixed Methods Research includes a comprehensive 8-domain framework to assess the quality of Mixed Methods studies (O'Cathain 2010). However, the extensive nature of this framework with numerous items in each domain make it impractical to use. Nevertheless, assessing the quality of a Mixed Methods study should involve more than just an assessment of the qualitative and quantitative components individually. It should take into account the 'added value' of combining both methodologies. For assuring quality in the present study, O'Cathain *et al.* (2008)'s quality assessment tool was used. Using this generic tool, the quantitative (Section 5.4.5.2) and qualitative (Section 5.4.5.3) phases of this study were addressed separately, but quality issues related to the Mixed Methods nature of this study were also discussed (Sections 5.4.5.1).

5.4.5.1 Mixed Methods quality/legitimation issues

O'Cathain *et al.* (2008) identified quality criteria for the success of a study, the design, and issues of integration and inferences in Mixed Methods studies based on early work from Creswell (2014). After applying these criteria to existing Mixed Methods studies, they found that it was difficult to judge the quality of these studies due to a lack of transparency. Subsequently, they proposed the 'Good Reporting of A Mixed Methods Study' (GRAMMS) guidelines (Table 5-6). Since the GRAMMS guidelines reflect important questions to be asked when assessing the quality of Mixed Methods studies, these guidelines were used in the present study to guide continuous quality assessment during the different phases of the study and to ensure adequate reporting. Table 5-6 gives an overview of the GRAMMS guidelines and where the different items are addressed in this thesis.

Good Reporting of A Mixed Methods Study (GRAMMS)
(1) Describe the justification for using a mixed methods approach to the research question (Section 5.3)
(2) Describe the design in terms of the purpose, priority and sequence of methods (Section 5.3)
(3) Describe each method in terms of sampling, data collection and analysis (Sections 5.4.1-5.4.4)
(4) Describe where integration has occurred, how it has occurred and who has participated in it (Section 5.3.3)
(5) Describe any limitation of one method associated with the presence of the other method (Section 5.3)
(6) Describe any insights gained from mixing or integrating methods (Chapter 8)

Table 5-6 Good Reporting of A Mixed Methods Study (GRAMMS) (O'Cathain 2008)

5.4.5.2 Phase 1 (QUANT) legitimation

Validity (a)

Face and content validity of the MAMMI surveys

The MAMMI surveys were adapted by Dr Deirdre Daly from an Australian study (Brown *et al.* 2006). Dr Daly also assessed the face and content validity of the MAMMI surveys. Face validity of the surveys was assessed by 15 women who were pregnant or had recently given birth. Content validity of survey 1 (antenatal) and 2 (3 months postnatal) was examined by 18 experts using a 4-point relevance rating scale, and the mean scale content validity index (S-CVI) for individual survey items was 0.97 (range 0.73-1.0) for survey 1 and 0.97 (range 0.80-1.0) for survey 2.

For the present study, the PPGP strand of the MAMMI study, the Pelvic Girdle Questionnaire was added to the MAMMI surveys 4 and 5. The face and content validity, internal consistency, and test-retest reliability of the Pelvic Girdle Questionnaire were examined in the Irish context.

Face validity of the Pelvic Girdle Questionnaire

Face validity refers to the degree to which a measure is clear and the purpose of the test is apparent to those taking it. This is done when a rater(s) who is an "interested individual" rates an instrument as relevant/suitable or not (Nevo 1985). An "absolute" technique was employed in the present study in assessing the face validity of the Pelvic Girdle Questionnaire (Nevo 1985), whereby women were asked to rate seven aspects of the Pelvic Girdle Questionnaire on a 4-point Likert scale and were given the opportunity to comment (Appendix 69). A convenient sample of 13 pregnant women completed the face validity questionnaire when attending antenatal PPGP classes at the site hospital, and 22 women with persistent PPGP postpartum already taking part in the MAMMI study also voluntarily completed the face validity questionnaire. The results of face validity questionnaire are presented in Figure 5-1. Only one woman commented on the Pelvic Girdle Questionnaire and said she had initially reversed the scoring system (which is 0-3 for each item). Subsequently, the labels of the scores were enlarged for clarity.

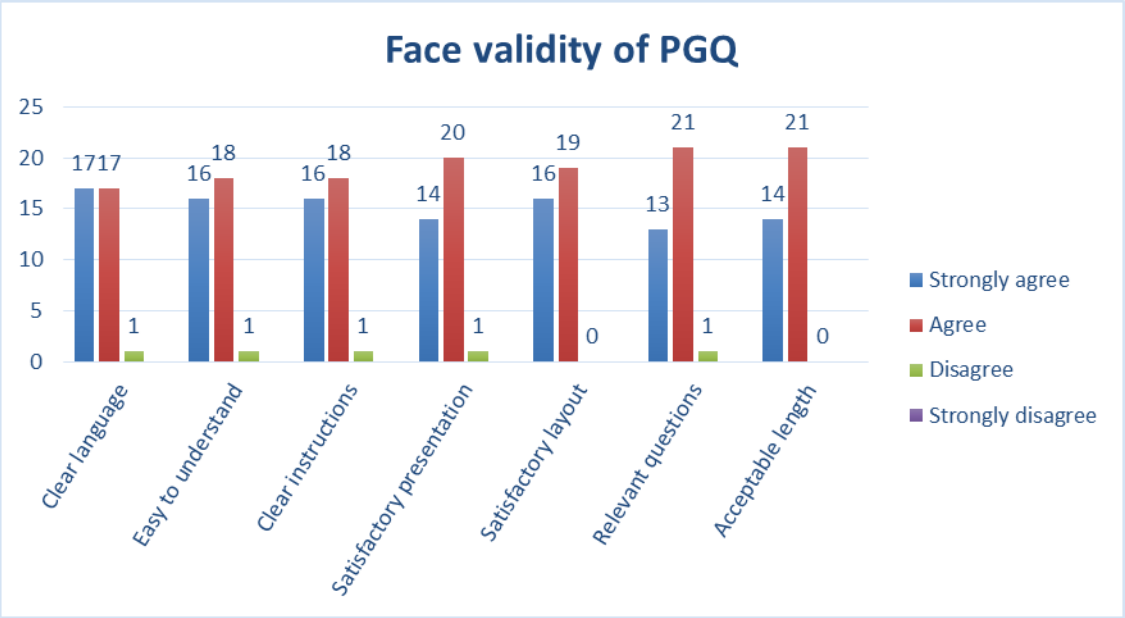

Figure 5-7 Assessment of the face validity of the Pelvic Girdle Questionnaire

Content validity of the Pelvic Girdle Questionnaire

Content validity involves verification that a measurement actually measures what it is expected to measure, covering all areas reasonably and thoroughly (Dorland 2003). Stuge *et al.* (2011) assessed the content validity of the Pelvic Girdle Questionnaire by classifying the items according to the World Health Organization's International Classification of Functioning, Disability and Health. For the present study, nine experts including four physiotherapists (expert number 1-4), one obstetrician (expert number 5), one anaesthesiologist (expert number 6), one midwife (expert number 7), one chiropractor, (expert number 8), and one osteopath (expert number 9), working in Ireland, rated the content of the Pelvic Girdle Questionnaire for relevance. All worked in a maternity hospital setting, except the osteopath and chiropractor who worked in private practice, but specialised in women's health. The content validity tool used was adopted from Lynn (1986)'s *relevance rating scale* (Appendix 70). Content Validity Indices were calculated (Table 5-7). Polit *et al.* (2007) recommend a standard of 0.90 for the average Scale Content Validity Index and an Item Content Validity Index of minimum 0.78 for all items, for excellent content validity. According to these criteria, there was excellent content validity of the Pelvic Girdle Questionnaire (Table 5-7). Only expert 5 rated three items

(sitting, standing and walking for more than 60 minutes) as not relevant and stated that this was because, in her/his opinion, they would not impact women's quality of life.

Expert number	1	2	3	4	5	6	7	8	9	
Proportion rated as relevant (score 3 or 4)	1.0	1.0	1.0	1.0	0.88	1.0	1.0	1.0	1.0	
Item Content Validity Range										88.9 - 1.0
Average Scale Content Validity Index*										0.987
Scale Content Validity Index - universal agreement**										0.88
* 25 items were rated by 9 experts. Of the total of 225 items, 222 were rated as relevant (at 3 or 4 score)										
** Proportion of items rated as relevant by all 9 experts (Polit *et al.* 2007)										

Table 5-7 Content Validity Indices for the 25-time Pelvic Girdle Questionnaire rated by 9 experts

Reliability (b)

Test-retest reliability of the MAMMI surveys

Dr Daly assessed the test-retest reliability of the MAMMI surveys. Ten women completed survey 1 twice, with a 1-2 week period in between, to assess test-retest reliability. This was assessed for 11 items (of which 2 related to pain in any part of the body) that were expected to remain stable, and these showed very strong agreement (Cohen's kappa coefficient ranged from 0.87-1.0).

Internal consistency of the Pelvic Girdle Questionnaire

Internal consistency reflects coherence or redundancy of the components of scale (Polit & Beck 2008). In other words, it assesses the consistency of results across items of a test. Grotle *et al.* (2012) assessed the internal consistency of the Pelvic Girdle Questionnaire in Norway and found a Cronbach alpha of 0.86 for the activity subscale and 0.68 for the symptoms subscale. They considered Cronbach alpha values of less than 0.7, 0.7 to 0.8, and more than 0.8 to indicate low, moderate, and good internal consistency, respectively.

Internal consistency for the present study in Ireland was assessed for the items of the Pelvic Girdle Questionnaire for both the activity and symptom subscale. Seventy-one women completed the Pelvic Girdle Questionnaire; 26 pregnant women, 28 women approximately 9 months postpartum, and 17 women were 12 months postpartum. Cronbach alpha for the complete Pelvic Girdle Questionnaire was 0.93, for the activity subscale 0.92, and 0.80 for the symptom subscale. There was good internal consistency, since Cronbach alpha was greater than 0.7 (Pallant 2010).

Test-retest reliability of the Pelvic Girdle Questionnaire

Test-retest reliability examines the stability of a test over time (Polit & Beck 2008). Previous assessment of the test-retest reliability for the Pelvic Girdle Questionnaire in Norway showed an intra-class correlation coefficient estimate of 0.93 (95% confidence interval (CI) 0.86–0.96) for the Pelvic Girdle Questionnaire activity subscale and 0.91 (95% CI 0.84–0.95) for the symptom subscale (Stuge *et al.* 2011).

For the present study, 67 women completed the Pelvic Girdle Questionnaire twice, with a time interval of approximately two weeks in between (n=60; median 15.5 days; interquartile range 13-21 days). This sample consisted of 22 pregnant women with PPGP, 28 women with persistent PPGP approximately 9 months postpartum, and 17 women with persistent PPGP 12 months postpartum. The total Pelvic Girdle Questionnaire score intra-class correlation coefficient was 0.85 (95% CI 0.76-0.91), for the Activity subscale it was 0.80 (95% CI 0.67-0.88), and for the Symptom subscale 0.91 (95% CI 0.85-0.94). A second analysis was conducted, only including the 34 women who said on the retest form that their pain was about the same as two weeks before. The intra-class correlation coefficients for this subgroup were; 0.93 (0.87-0.97) for the total Pelvic Girdle Questionnaire score, 0.91 (95% CI 0.81-0.96) for the Activity subscale, and 0.94 (95% CI 0.87-0.97) for the Symptom subscale. Intra-class correlation coefficients of greater than 0.7 indicated good test-retest reliability (Terwee *et al.* 2007).

Generalisability (c)

Generalisability is another important aspect to consider in interpreting results from quantitative data. In Chapter 6, the setting of this study is clearly described, and the sample characteristics are compared to national data of pregnant nulliparous women in Ireland. However, the implications of a non-random sample include the potential presence of discrepancies between the sample and population of interest, leading to possible unknown confounders.

5.4.5.3 Phase 2 (QUAL) Trustworthiness & rigour

Rigour, described as a way of demonstrating the legitimacy of the research process to ensure representation of reality, is important in research (McBrien 2008). The concepts of validity and reliability related to quantitative research cannot be addressed in the same way in qualitative research (Shenton 2004). Lincoln & Guba (1985) proposed the term 'trustworthiness' to describe questions of truth value, applicability, consistency and neutrality of qualitative research. Four components were outlined; credibility, transferability, dependability and confirmability. The criterion 'authenticity' was added later (Guba & Lincoln 2005).

Credibility (a)

Credibility relates to the accuracy of descriptions or interpretations of the experiences that are studied (Lincoln & Guba 1985). In phase 2 of this study, the transcripts were checked twice for accuracy and the following other techniques were used to enhance credibility:

Peer debriefing

Peer debriefing involves the process of exposing oneself to a peer in a way paralleling an analytical session to explore aspects of the inquiry that might otherwise remain only implicit within the enquirer's mind (Lincoln & Guba 1985). In this study, peer debriefing took place with two senior researchers (PhD supervisors) to discuss methodological issues; however, discussions concerning the transcripts did not take place until after the coding audit (see (c) and (d)) to ensure independence in the latter, as this was conducted by one of the senior researchers who was also a debriefer.

Member checking

Member checking refers to the testing of data or findings with participants (Cohen & Crabtree 2008). Member checking can be done at different levels; by returning the transcripts to the respective participants, by verifying the interpretation of each account, or by verifying the overall results (Seale 1999). In this study, formal member checking took place in which a summary of the emerging themes and categories was sent to the interviewees for feedback and comments (Appendix 71). The results and interpretation of the member checking are outlined in chapter 7 (Section 7.5).

Negative case analysis

Negative case analysis aims to promote credibility by looking for disconfirming data and continually revising findings until a 'fit' is achieved (Lincoln & Guba 1985). During data analysis of the transcripts of the 23 interviews this process was applied throughout, whereby narratives contradictory to the emerging themes were identified and the thematic framework was adapted accordingly to fit all data.

Audit Trial

An audit trail in qualitative research consists of a thorough collection of documentation regarding all aspects of the research. Records of all steps of the study process provide justification of all actions in the process (Lincoln & Guba 1985, McBrien 2008). Appendix 68 provides a detailed outline of the analysis of the data, including which codes the themes and categories were derived from.

Transferability (b)

Thick descriptions

Transferability relates to the generalisability of the findings, which is a concept inherently impossible based on qualitative data. The best way to address this, is to provide a rich description of the context in which the findings arose. This allows the reader to make a decision whether or not they can be transferred to another context of interest. Chapter 7 provides such a rich description of the interviewees and interview findings.

Dependability (c) & Confirmability (d)

Dependability refers to the extent to which the research process is logical. This also requires reflexivity, in which the author keeps a critical account of the process (Tobin & Begley 2004). Confirmability is concerned with examining whether or not the findings are clearly derived from the data. A well-conducted audit can thus be used to determine dependability and confirmability simultaneously (Lincoln & Guba 1985).

Audit Trail

An audit trial (Appendix 68) was kept to account for decisions made in the analysis process to ensure transparency (McBrien 2008).

Coding audit

A random sample of three of the 23 transcripts were independently coded by another researcher, following which the findings were discussed. The two researchers involved had not discussed the transcripts of the interviews prior to this meeting. There was agreement as to the codes and emerging themes, hence no further transcripts were coded by a second researcher; however, further peer-debriefing sessions were held to discuss the final thematic framework and reporting of the findings.

Reflective journal

Throughout the research study the researcher maintained a reflective journal to record any internal or external dialogue and reflections concerning the process, the findings or the researcher's role (McBrien 2008). Examples of some reflective diary entries are presented in appendix 72.

Authenticity (d)

Authenticity examines the wider context of research, ensuring the research is worthwhile and has a noticeable impact on the members being studied. It also focuses on whether researchers faithfully and fairly describe participants' experiences; fairness being thought of as a quality of balance with all stakeholders' views, perspectives, claims, and concerns being apparent in the text (Guba & Lincoln 2005). Authenticity has five

components (Tobin & Begley 2004): (1) Fairness and balance involves representing all views, differences and conflicts. The views of all interview participants are clearly described in Chapter 7 of this study and any differences are highlighted. Moreover, to participate in an interview, women did not have to have been in contact with the health services, allowing for a wider set of views to be represented. (2) Ontological authenticity refers to demonstrating more sophisticated understanding and enlargement of personal construction of the phenomenon being studied. This study brought a deeper understanding of how persistent PPGP postpartum affects women's lives. (3) Educative authenticity refers to the ability to help people to appreciate the viewpoints and constructions of others. The findings of phase 2 provide insight into the views of women with persistent PPGP that may be difficult to appreciate otherwise for people not having experienced persistent PPGP. (4) Catalytic authenticity is verified by stimulating some form of action. This study hopes to provide data to inform clinical practice. Dissemination strategies are ongoing to promote awareness about and action upon the findings of this study. (5) Tactical authenticity involves empowerment of stakeholders to act on the increased understanding that emerged from a study (Onwuegbuzie *et al.* 2008). Some women said that taking part in the interview or completing the MAMMI surveys had encouraged them to seek help for their persistent PPGP.

5.4.6 Ethical considerations

5.4.6.1 Ethical approval

Ethical approval for the overall MAMMI-study was obtained from the Rotunda Hospital Ethics Committee as well as from the Faculty of Health Sciences Ethics Committee (Trinity College Dublin) in 2011. Ethical approval for this study, the Pregnancy-related Pelvic Girdle Pain Strand of the MAMMI study, was obtained from Faculty of Health Sciences Ethics Committee (Trinity College Dublin) in March 2013 (Appendix 73).

5.4.6.2 Informed consent

Phase 1 (QUANT)

An information leaflet (Appendix 74) was included in the pack given to the woman by the midwife. This leaflet contained a clear outline of the purpose of the study, what the study involved, and the participants' rights (including the right to withdraw at any point). The consent form (Appendix 75) consisted of detailed questions, concerning being contacted for any related research and permission to access hospital records.

Phase 2 (QUAL)

Information regarding phase 2 of this study was given verbally during the telephone recruitment. Verbal consent was sought at the beginning of this conversation to ask additional questions related to their PPGP and health (based on recruitment guidance flow-chart) to confirm eligibility for an interview. Moreover, women were given the opportunity to ask any questions. At the time of the actual interview encounter, the information was repeated verbally and a written information leaflet was given to the woman prior to the interview (Appendix 76). They were given the opportunity to ask any questions before completing the written consent (Appendix 77).

5.4.6.3 Personal information – protecting privacy and confidentiality

Phase 1 (QUANT)

The contact details of women who refused to take part at the time of the antenatal recruitment call, or who did not respond and return the first survey within eight months following recruitment, were permanently removed from the personal information database. If a woman returned survey 1 with an incomplete or no consent form, we continued to send subsequent surveys and included another copy of the consent form; however, her hospital records were not accessed until the consent form was returned, giving permission to do so. All surveys were given a unique identification number rather than using women's names, to ensure confidentiality. None of the reports of the results of the study contain information that would identify any woman.

Phase 2 (QUAL)

Only women who had consented to be contacted regarding taking part in any interview (question 5 on consent form of phase 1 (Appendix 75)) were contacted for phase 2. Audio-recordings and transcripts were given a unique number, different from their case number in phase 1. For member checking, only women who had agreed to this (question 4 on consent form of phase 2 (Appendix 77)) were sent the member checking forms. None of the reports of the results contain information that would identify any woman.

5.4.6.4 Time commitment

Phase 1 (QUANT)

Completing a single MAMMI survey took about 45 minutes. The length of the surveys and time commitment when taking part in the study were clearly communicated within the information leaflet and during the antenatal recruitment telephone conversation. Moreover, the cover letter repeated the approximate time it would take to complete the survey.

Phase 2 (QUAL)

The women who were contacted regarding taking part in an interview were given an estimate of the duration of the interview. Moreover, the location and time of the interview was chosen by the woman for her convenience.

5.4.6.5 Vulnerable women

Phase 1 (QUANT)

Women who had had a miscarriage in between their booking visit and the telephone recruitment were approached with empathy and were given details of support services. Postnatal surveys were not sent to women who had completed survey 1 but had a miscarriage, stillbirth or neonatal death.

Phase 2 (QUAL)

It was made clear to the women verbally and in the information leaflet that the interview could be discontinued at any stage. If a woman would have shown any signs of distress, the interviewer would have discontinued the interview; however, this did not happen in the 23 interviews that were conducted.

5.4.6.6 Multi-participation in interviews

As several members of the MAMMI study team conducted interviews for different strands of the MAMMI study, a woman could potentially be contacted more than once if she experienced multiple morbidities. Whenever a woman was contacted concerning taking part in an interview, she was asked whether she would be happy to be contacted again regarding any other interviews on other topics. All members of the MAMMI study team complied with this strategy to ensure a woman was not contacted twice without her agreement to do so. Within the MAMMI database it was clearly indicated whether a woman had been contacted to take part in an interview and by which strand, her response, whether or not an interview had been conducted, and whether or not she would be happy to be contacted again for another interview.

5.4.6.7 Data storage

Phase 1 (QUANT)

Both the personal details database of all MAMMI study participants and the SPSS survey databases are encrypted. Hard copies are stored in locked cabinets only accessible to members of the MAMMI study team.

Phase 2 (QUAL)

Audio-recordings and transcripts were labelled with a participant number and are stored on an encrypted hard disk.

5.5 Conclusion

Set in a pragmatic paradigm, this study had a Partially Mixed Sequential Equal Status design consisting of a survey-based longitudinal cohort part (Phase 1) and a descriptive qualitative phase (2), which involved semi-structured interviews with women with persistent PPGP postpartum. In the next chapters (Chapter 6 and 7), the findings of this study are presented. Quantitative analysis (Phase 1) involved descriptive and inferential statistics, presented in chapter 6, and qualitative data (Phase 2) were analysed using thematic analysis and are presented in chapter 7. Integration of the two phases occurred at the study design, recruitment and discussion stage (Chapter 8) of this study.

Chapter 6 Findings & Discussion: Phase 1 Quantitative

6.1 Introduction

This is the first of two chapters that outline the findings of this study. In this chapter, the findings of the quantitative phase (1) are presented, addressing predominantly objectives 1 to 3 of this study:

(1) To identify the existence and prevalence of self-reported PPGP during pregnancy and 0-3, 3-6, 6-9 and 9-12 months postpartum in 1478 nulliparous women in Ireland

(2) To identify pre-pregnancy risk factors for self-reported PPGP in (a) early/mid pregnancy and (b) the last months of pregnancy

(3) To identify pre-pregnancy, pregnancy-related, birth-related and postnatal prognostic factors for self-reported PPGP that persists 0-3, 3-6, 6-9 and 9-12 months postpartum

Section 6.2 includes a description of the sample included in the analysis. The remaining chapter consists of two overarching parts; sections 6.3 to 6.6 concern PPGP and risk factors for PPGP, and sections 6.7 to 6.17 relate to persistent PPGP and prognostic factors. In section 6.3, the prevalence of PPGP is outlined, followed by univariate and multivariable analyses examining risk factors for PPGP for the outcomes PPGP in early/mid pregnancy and PPGP in the last month of pregnancy (Sections 6.4 and 6.5). In section 6.6, these findings are discussed in the context of existing literature on the prevalence of PPGP and the systematic review on risk factors for PPGP (Chapter 3). Next, in section 6.7, the prevalence of persistent PPGP at the four postnatal follow-up periods of this study are presented. The symptoms, activity limitations and health-seeking behaviours of women with persistent PPGP, lasting more than six months postpartum, are described in sections 6.7.2 and 6.8. Finally, univariate and multivariable analyses examining prognostic factors for PPGP, at the four postpartum follow-up periods, are presented in sections 6.9 to 6.16. These findings are discussed in the context of existing literature on the prevalence of persistent PPGP and the systematic review on prognostic factors of PPGP (Chapter 3), before concluding this chapter in section 6.18.

6.2 Sample and participants

The MAMMI study is ongoing, hence retention rates for the cohort that was analysed in this PhD study (not the full cohort) are described in this section.

6.2.1 Recruitment and retention rates

During the recruitment period (31st January 2012 and 3rd October 2014), approximately 10,026 nulliparous women booked at the site hospital (3680 women in the last 11 months of 2012, 3766 women in 2013, and 2580 women in the first eight months of 2014). Of these women, 4809 women (48%) were offered the study information, of whom 38% (n=1841) chose to take part in the MAMMI study. Only women who gave birth on or before 31st July 2014 (n=1478) were included in this PhD study in order for postpartum follow-ups to be completed. Retention rates are presented in Figure 6-1. Women who became pregnant again or who had been, but had a miscarriage or abortion during the postnatal follow-up time of the study, were excluded from subsequent follow-ups.

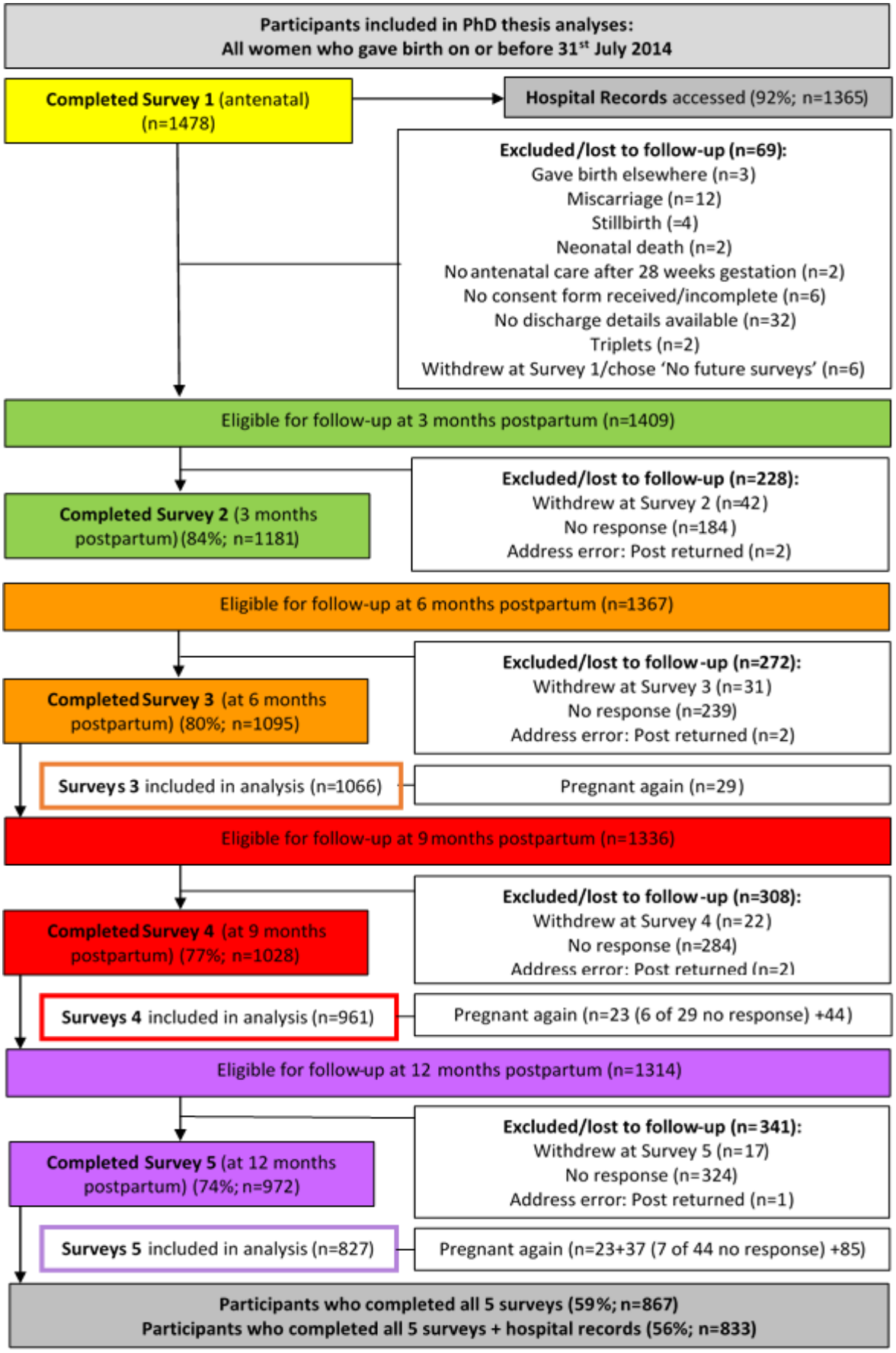

Figure 6-1 Flow chart of retention rate of the 1478 women included in part 1 of this PhD study

6.2.2 Description of sample – participant characteristics

The characteristics of the 1478 participants are described in this section. The representativeness of the sample was assessed by comparing the study sample with the 2014 data from the site hospital and the national perinatal statistics report for the year 2013.

6.2.2.1 Age groups

The study sample included fewer women aged 18-24 and more women aged 30-34 and 35-39 when compared to the data from the site hospital and the national perinatal statistics report (Table 6-1).

	Study participants		Perinatal statistics report 2013*		Site hospital 2014	
Age group	**n**	**%**	**n**	**%**	**n**	**%**
Up to 24	129	8.7	5200**	19.5	746**	19.7
25 to 29	347	23.5	6533	24.5	902	23.8
30 to 34	632	42.8	9679	36.3	1306	34.5
35 to 39	317	21.5	4320	16.2	670	17.7
40 and over	52	3.5	933	3.5	166	4.4
Total	1477	100.0	26665	100.0	3790	100.0
Missing	1					

*Healthcare Pricing Office; Health Service Executive (2013)
**Includes women younger than 18 years: 197 women were less than 20 years of age

Table 6-1 Age groups of participants

6.2.2.2 Country of birth

The 1453 participants who stated their country of birth were born in 66 different countries. Approximately two-thirds were born in Ireland (65.9%; n=957), a quarter (26.2%; n=381) was born in another European country, whilst 7.9% (n=115) of participants stated they were from non-European countries (Table 6-2). The five most common European countries of birth after Ireland were: Poland (8.3%; n=120), United Kingdom (5.0%; n=72), Slovakia (1.7%; n=25), Germany (1.4%; n=20) and Romania (1.4%; n=20). This study included fewer women from non-European countries than the site hospital (7.9% versus 12.6%), which may be, in part, explained by a possible language barrier since the surveys were only available in English. In addition, in the site hospital records, European countries outside of the

European Union were included in the 'non-European' group, which may also contribute to the observed relatively higher percentage of non-Europeans. On the other hand, this was not the case when compared to the national perinatal statistic report data (Healthcare Pricing Office; Health Service Executive 2013). The urban location of the site hospital may contribute to the higher percentage of non-Europeans compared to national data.

Country of birth	Study participants		Site hospital 2014		Perinatal statistics report 2013*	
	n	%	n	%	n	%
Irish	957	65.9	5451	62.0	53383	77.3
EU/other European	381**	26.2	1613	18.36^^	10890	15.8
Non-European^	115	7.9	1106	12.6	4770	6.9
North America/Canada	12	0.8			583	0.8
Latin America/Caribbean	19	1.3				
Africa	30	2.1			1692	2.5
Asia	46	3.2			2357	3.4
Australia	8	0.6			101	0.1
New Zealand	0				37	0.05
Total	1453	100.0	8787	100.0	69043	100.0
Missing	25		617		224	
*Healthcare Pricing Office; Health Service Executive (2013)						
**Includes Iceland						
^Includes Russia						
^^Only includes EU countries						

Table 6-2 Region of birth of participants

6.2.2.3 Ethnicity

Ethnicity was reported by 1469 participants, with 94% (n=1382) being of white background (Table 6-3). No data on ethnicity were available from the site hospital or the national perinatal statistics report for comparison.

Ethnicity	Study participants	
	n	%
Irish	1020	69.4
Irish Traveller	1	0.1
African	20	1.4
Chinese	10	0.7
Any other white background	362	24.6
Any other black background	3	0.2
Any other Asian background	33	2.2
Other, including mixed background	20	1.4
Total	1469	100.0
Missing	9	

Table 6-3 Ethnicity of participants

6.2.2.4 Relationship status

Just under two-thirds of participants (61.1%; n=901) were married and about a quarter (26.6%; n=393) were living with their partner but not married. The categories in the national perinatal statistics report (Healthcare Pricing Office; Health Service Executive 2013) were different, but data are comparable since the 'single' category in the report refers to 'never being married' (Table 6-4). Data on relationship status was not available from the site hospital.

	Study participants		Perinatal statistics report 2013	
Relationship status	**n**	**%**	**n**	**%**
Married	901	61.1	44176	63.8
Divorced or separated	2	0.1	978	1.4
Widowed	1	0.1	68	0.1
Single	52	3.5	24028	34.7
Living with partner	393	26.6		
In a relationship - not living together	117	7.9		
Other	9	0.6	17	0.02
Total	1475	100.0	69267	100.0
Missing	3			

*Healthcare Pricing Office; Health Service Executive (2013)

Table 6-4 Relationship status of participants

6.2.2.5 Accommodation

Half of the participants (50.6%; n=745) lived in a house or apartment with a mortgage. Of the participants who ticked 'other', 16 were living with their parents or partner's parents, four women were renting rooms, one woman was living with her boyfriend who had a mortgaged property, one woman had both a mortgaged and non-mortgaged property, three women lived in accommodation provided by their employer, and one women was living in temporary accommodation of Dublin City Council whilst waiting to be rehoused. The remaining two women did not provided details of what 'other' accommodation they were staying in. No data on accommodation status was available from the site hospital and national perinatal statistics report. One woman who ticked 'no fixed accommodation' said she was moving to a house with a smaller mortgage soon, the other women did not provide additional information (Table 6-5).

Accommodation status	Study participants	
	n	%
House - with a mortgage	582	39.5
House - without mortgage	80	5.4
Apartment - with a mortgage	163	11.1
Apartment - without mortgage	24	1.6
Rented house - privately rented	215	14.6
Rented house - local authority	27	1.8
Rented apartment - privately rented	325	22.0
Rented apartment - from local authority	23	1.6
Caravan / mobile home	4	0.3
Hostel accommodation	2	0.1
No fixed accommodation	2	0.1
Other	27	1.8
Total	1474	100.0
Missing	4	

Table 6-5 Accommodation status of participants in early pregnancy

6.2.2.6 Educational level

About two-thirds of participants had a university degree or higher qualification (63.9%; n=939) (Table 6-6). No data were available from the site hospital and national perinatal statistics report. The national rate of women aged 25-34 with third level qualification was 55.3% in 2013 (Central Statistics Office 2011).

Highest qualification	Study participants	
	n	%
No formal qualifications	2	0.1
Primary or first school	4	0.3
Lower secondary	5	0.3
Junior/Inter/Group Cert/ O levels/ GCSE, NCVA Foundation cert etc	28	1.9
Upper secondary Leaving Cert - applied and vocation progs., A Levels, NCVA level 1 etc.	184	12.5
Completed apprenticeship, NCVA level 2/3, Teagasc cert, dip or equivalent	100	6.8
Both upper secondary and technical or vocational qualification	68	4.6
National certificate, diploma NCEA/ Institute of Technology or equivalent, Nursing Diploma	141	9.6
Primary degree	275	18.7
Professional qualification of degree status	153	10.4
Postgraduate certificate or diploma	203	13.8
Postgraduate degree Masters	288	19.6
Doctorate/PhD	20	1.4
Total	1471	100.0
Missing	7	

Table 6-6 Highest qualification of participants

6.2.2.7 Employment status in early pregnancy

The majority of women were in full-time paid employment (78.5%; n=1154) (Table 6-7). The category 'other' mostly included women who were self-employed.

Employment status	Study participants	
	n	%
Full-time paid work	1154	78.5
Part-time paid work	92	6.3
Casual paid work	18	1.2
Looking for first job	8	0.5
Unemployed	116	7.9
Student or pupil	29	2.0
Looking after home/family	14	1.0
Unable to work due to sickness/disability	9	0.6
Unpaid voluntary work	5	0.3
Other	26	1.8
Total	1471	100.0
Missing	7	

Table 6-7 Employment status of participants in early pregnancy

6.2.2.8 Pre-pregnancy Body Mass Index (BMI)

Just over a quarter of women were overweight or obese (27.8%; n= 378) (Table 6-8). Pre-pregnancy BMI was not reported in the site hospital annual report and the national perinatal statistics report.

Pre-pregnancy BMI	Study participants	
	n	%
Underweight (≤18.49 kg/m2)	57	4.2
Ideal (18.5-24.99 kg/m2)	926	68.0
Overweight (25-29.99 kg/m2)	248	18.2
Obese (30-34.99 kg/m2)	114	8.4
Very obese (≥35 kg/m^2)	16	1.2
Total	1361	100.0
Missing	117	

Table 6-8 Pre-pregnancy Body Mass Index of participants

6.2.2.9 Gestational age when completing survey one

The number of days of gestation was calculated by subtracting the date of completing survey 1 from the due date of the baby. The majority of women (87.0%; n=1332) were between 12 and 24 weeks pregnant when completing the antenatal survey (Table 6-9). For 146 participants, their gestational age could not be calculated because the due date or survey 1 completion date was not reported or reported with error.

Weeks of gestations when completing survey 1	Study participants	
	n	%
0 to 12 weeks (<84 days) gestation	56	4.2
12 to 24 weeks (84-167 days) gestation	1159	87.0
25 to 28 weeks (168-195 days) gestation	64	4.8
29 to 40 weeks (196-280 days) gestation	53	4.0
Total	1332	100.0
Missing (Baby's due date and/or completion data of survey 1)	146	

Table 6-9 Gestational age of participants when completing survey 1

6.3 Prevalence of PPGP

This section outlines the prevalence of PPGP in early/mid pregnancy and in the last month of pregnancy. The period prevalence of PPGP in early/mid pregnancy (from the start of pregnancy to time of completing survey 1 (mean gestational age 123 days, SD 33 days)) was obtained from a pain diagram in survey 1. Data from late pregnancy (last month of pregnancy) were obtained from survey 2 and was collected retrospectively. The prevalence of any PPGP is presented, but data have also been stratified by sub-outcomes according to pain location (anterior, posterior, or combined anterior and posterior). In addition, the prevalence of PPGP is reported for women without a history of any low back and/or pelvic girdle pain in the year before becoming pregnant, which was collected retrospectively on a pain diagram in survey 1. In section 6.3.2, the prevalence of PPGP, as reported in the site hospital records, is presented.

6.3.1 Self-reported prevalence of PPGP

6.3.1.1 Self-reported prevalence of PPGP in early/mid pregnancy

The period prevalence of PPGP (from the start of pregnancy to the time of completing survey 1) was 60.1% (n=886). Posterior PPGP (48.9%; n=722) was more prevalent than anterior PPGP (2.3%; n=34) or combined anterior and posterior PPGP (8.8%; n=130). In women with a history of low back and/or pelvic girdle pain in the year before becoming pregnant (n=680), the prevalence of PPGP was higher (80.1%; n=545) than in women without a history of low back and/or pelvic girdle pain (42.7%; n=337) (Table 6-10).

Prevalence of PPGP in early pregnancy (mean=123, SD=33 days gestation) (n=1478)									
	Any PPGP		Anterior PPGP		Posterior PPGP		Combined anterior & posterior PPGP		Missing
	n	%	n	%	n	%	n	%	
All women (n=1475)	886	60.1	34	2.3	722	48.9	130	8.8	3
Low back and/or pelvic girdle pain in the year before pregnancy									
No (n=790)	337	42.7	23	2.9	263	33.3	51	6.5	1
Yes (n=680)	545	80.1	11	1.6	456	67.1	78	11.5	0
Missing (n=7)	4		0		3		1		2

Table 6-10 Prevalence of PPGP in early/mid pregnancy

6.3.1.2 Self-reported prevalence of PPGP in late pregnancy

The prevalence of PPGP in the last month of pregnancy was 69.7% (n=821). Posterior PPGP was most prevalent (43.7%; n=517), but anterior PPGP and combined anterior and posterior PPGP were more common in late (4.5%; n= 53 and 21.3%; n=251) compared to early/mid pregnancy (2.3%; n= 34 and 8.8%; n=130). The prevalence of PPGP was higher (80.5%; n=442) in women with a history of low back and/or pelvic girdle pain in the year before becoming pregnant (n=549) than in women who did not (60.2%; n=373) (Table 6-11).

Prevalence of PPGP in the last month of pregnancy (n=1181)									
	Any PPGP		Anterior PPGP		Posterior PPGP		Combined anterior & posterior PPGP		Missing
	n	%	n	%	n	%	n	%	
All women (n=1178)	821	69.7	53	4.5	517	43.7	251	21.3	3
Low back and/or pelvic girdle pain in the year before pregnancy									
No (n=620)	373	60.2	38	6.1	222	35.8	113	18.2	1
Yes (n=549)	442	80.5	15	2.7	290	52.8	137	25.0	2
Missing (n=9)	6		0		5		1		0

Table 6-11 Prevalence of PPGP in late pregnancy

6.3.2 Prevalence of PPGP reported in hospital records

The prevalence of PPGP reported in the hospital records of the 1365 women that were accessed was 5.8% (n=78) (Table 6-12).

Pelvic girdle pain reported in hospital records	Study participants	
	n	%
No	1278	94.2
Yes	78	5.8
Total	1356	100.0
Missing	9	

Table 6-12 Prevalence of PPGP reported in hospital records

6.4 Univariate analysis assessing risk factors for PPGP

Sixteen potential risk factors were assessed and the findings of the univariate analysis are presented in tabular format in sections 6.4.1-6.4.4). Each factor examined was assessed in association with two outcomes: (1) PPGP in early/mid pregnancy, which was defined as any pain in the pelvic girdle area since the start of pregnancy at the time of completing survey 1 (between 12 and 24 weeks gestation for 87% (n=1159) of participants (section 6.2.2.9)), and (2) PPGP in the last month of pregnancy, collected retrospectively in survey 2. Subgroup analyses were conducted for the sub-outcomes (1) anterior PPGP, (2) posterior PPGP and (3) combined anterior and posterior PPGP.

For some variables, several analyses were carried out with categories merged where appropriate. The additional data are, in such case, provided in appendices and references are provided where applicable. For the factor age, the age of participants at the start of the study was used and univariate logistic regression was conducted twice, with the age category 25 to 29 years and the 18 to 24 age group as the reference group, in accordance with studies identified in the systematic review (Chapter 3). Moreover, the age groups 35 to 39 and over 40 merged, because of smaller numbers in the latter (Appendix 78, a). For BMI, the categories 'obese' (BMI 30-34.99 kg/m^2) and 'very obese' (BMI≥35 kg/m^2) were combined in the

analysis due to the small number of women in the 'very obese' group (Appendix 78, b).
Women's educational level was categorised in one of four categories and analysis was conducted with the highest level of qualification (postgraduate) as reference in line with the majority of existing studies examining this potential risk factor (Chapter 3). Subsequently, categories were merged into a binary variable based on whether or not a women had a university degree or equivalent (Appendix 78, c).

The nine categories of employment status (Section 6.2.2.7) were recoded into six categories whereby 'part-time paid work' and 'casual work' were merged, and 'looking for first job' and 'unpaid voluntary work' were included in 'unemployed'. In the category 'Other', one woman who stated she was an asylum seeker was included in the 'unemployed' category. Eighteen self-employed women were included in the 'Full-time paid work' category. One freelance worker was included in the 'casual work' category. One woman who worked part-time and studied part-time was included in the 'part-time paid work' category. Categories were further merged into a binary variable (working versus not working) based on categorisation in existing studies (Chapter 3). 'Not working' is intended to mean 'not working outside the home', but is abbreviated to 'not working' in all tables. Being a student was included in the 'working' category.

For the factor marital status, only one woman was widowed and two women were divorced or separated. These women were included in the 'single' category. Six women stated that they were engaged to be married and were included in the 'married' category. The eight categories of ethnic background (Irish, Irish traveller, African, Chinese, any other white background, any other black background, any other Asian background, mixed background) were merged into four categories (white, black/African, Asian, mixed).

Women who ticked on the pain diagram that they had experienced any pain in the lumbar area in the 12 months before becoming pregnant were categorised as having a history of low back pain. Similarly, women who

ticked on the pain diagram that they had experienced any pain in the pelvic girdle areas in the 12 months before becoming pregnant where categorised as having a history of pelvic girdle pain. The seven categories of the factor smoking (smoke regularly – same as before pregnancy, smoke regularly but cut down since pregnancy, smoke more than before pregnancy, smoke once in a while, stopped smoking when pregnant, stopped smoking before pregnancy, never smoked) were recoded into three categories (smoking during pregnancy, stopped before pregnancy or when finding out being pregnant, never smoked).

Only 12 women reported having had surgery to the back, of whom six experienced PPGP in early/mid pregnancy and in the last month of pregnancy and they all reported only posterior PPGP. Five women had diabetes, all of whom reported PPGP in early/mid pregnancy and three of whom had PPGP in the last month of pregnancy. All five women experienced posterior PPGP in early/mid pregnancy, and, in the last month of pregnancy, one woman had posterior PPGP and two women reported combined anterior and posterior PPGP. The small number of women reporting back surgery or had diabetes made further analysis not appropriate for these two factors. This applies to all further postpartum follow-up periods as well.

6.4.1 Risk factors for PPGP in early/mid pregnancy – Univariate analysis

The findings of the univariate analysis for risk factors for PPGP in early/mid pregnancy are presented in Table 6.13.

Factor	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference						
	n=1474	**n=589**	**n=885**	**%**		
18-24	129	50	79	61.2	0.3	0.8 (0.5-1.2)
25-29	346	118	228	65.9		1.0 (ref.)
30-34	631	259	372	59.0	0.03	0.7 (0.6-1.0)
≥35	368	162	206	56.0	0.007	0.7 (0.5-0.9)
Missing	4					

Factor	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)
Age (years) 18-24 reference						
	n=1474	**n=589**	**n=885**	**%**		
18-24	129	50	79	61.2		1.0 (ref.)
25-29	346	118	228	65.9	0.3	1.2 (0.8-1.9)
30-34	631	259	372	59.0	0.6	0.9 (0.6-1.3)
≥35	368	162	206	56.0	0.3	0.8 (0.5-1.2)
Missing	4					
BMI						
	n=1358	**n=548**	**n=810**	**%**		
Underweight	57	21	36	63.2	0.4	1.3 (0.7-2.2)
Ideal	924	397	527	57.0		1.0 (ref.)
Overweight	247	97	150	60.7	0.3	1.2 (0.9-1.6)
(Very) Obese	130	33	97	74.6	<0.001	2.2 (1.5-3.4)
Missing	120					
Educational level						
	n=1468	n=587	n=881	%		
No formal education/primary/ lower secondary	39	13	26	66.7	0.3	1.4 (0.7-2.9)
Upper secondary	351	128	223	63.5	0.1	1.3 (1.0-1.7)
University degree or equivalent	568	232	336	59.2	0.7	1.0 (0.8-1.3)
Postgraduate qualification	510	214	296	58		1.0 (ref.)
Missing	10					
Employment status						
	n=1470	**n=587**	**n=883**	**%**		
Full-time paid work	1171	493	678	57.9		1.0 (ref.)
Part-time paid work/casual work	114	37	77	67.5	0.05	1.5 (1.0-2.3)
Unemployed	131	40	91	69.5	0.01	1.7 (1.1-2.4)
Student/pupil	30	10	20	66.7	0.3	1.5 (0.7-3.1)
Looking after home/family	15	7	8	53.3	0.7	0.8 (0.3-2.3)
Unable to work due to sickness/disability	9	0	9	100	x	x
Missing	8					

Factor	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)
Marital status						
	n=1472	**n=587**	**n=885**	**%**		
Married	906	378	528	58.3		1.0 (ref.)
Single	58	25	31	55.4	0.7	0.9 (0.5-1.5)
Living with partner	393	139	254	64.6	0.03	1.3 (1.0-1.7)
In a relationship - not living together	117	45	72	61.5	0.5	1.1 (0.8-1.7)
Missing	6					
Ethnicity						
	n=1466	**n=585**	**n=881**	**%**		
White background	1381	559	822	59.5		1.0 (ref.)
Black or African background	23	9	14	60.9	0.9	1.0 (0.5-2.5)
Asian background	43	13	30	59.8	0.2	1.6 (0.8-3.0)
Mixed background	19	4	15	78.9	0.1	2.6 (0.8-7.7)
Missing	12					
Low back pain in the 12 months before pregnancy						
	n=1470	**n=588**	**n=882**	**%**		
No	1200	519	681	68.4		1.0 (ref.)
Yes	270	69	201	82.1	<0.001	2.2 (1.6-3.0)
Missing	8					
Pelvic girdle pain in the 12 months before pregnancy						
	n=1472	**n=588**	**n=884**	**%**		
No	862	500	362	42.0		1.0 (ref.)
Yes	610	88	522	85.6	<0.001	8.2 (6.3-10.7)
Missing	6					
History of heavy periods						
	n=1471	**n=587**	**n=884**	**%**		
No	1286	529	757	58.9		1.0 (ref.)
Yes	185	58	127	68.6	0.01	1.5 (1.1-2.1)
Missing	7					

Factor	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)
History of severe period pain						
	n=1473	n=588	n=885	%		
No	989	434	555	56.1		1.0 (ref.)
Yes	484	154	330	68.2	<0.001	1.7 (1.3-2.1)
Missing	5					
History of anxiety before pregnancy						
	n=1468	**n=586**	**n=882**	**%**		
No	1344	543	801	59.6		1.0 (ref.)
Yes	124	43	81	65.3	0.2	1.3 (0.9-1.9)
Missing	10					
History of low mood/feeling depressed before pregnancy						
	n=1472	**n=587**	**n=885**	**%**		
No	1250	505	745	59.6		1.0 (ref.)
Yes	222	82	140	63.1	0.3	1.2 (0.9-1.6)
Missing	6					
Smoking						
	n=1458	**n=583**	**n=875**	**%**		
Smoking	106	39	67	53.2	0.6	1.1 (0.7-1.7)
Stopped smoking before pregnancy or when found out being pregnant	555	230	325	58.6	0.5	0.9 (0.7-1.1)
Not smoking	797	314	483	60.6		1.0 (ref.)
Missing	20					
History of injury to the back						
	n=1445	**n=578**	**n=867**	**%**		
No	1385	563	822	59.4		1.0 (ref.)
Yes	60	15	45	75.0	0.02	2.1 (1.1-3.7)
Missing	33					

Table 6-13 Risk factors for PPGP in early/mid pregnancy – Univariate analysis

6.4.2 Risk factors for anterior and/or posterior PPGP in early/mid pregnancy – Univariate analysis

The findings of the univariate analysis for risk factors for sub-outcomes for PPGP in early/mid pregnancy are presented in Table 6.14.

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference													
	n=1474	**n=34**	**%**			**n=722**	**%**			**n=129**	**%**		
18-24	129	1	0.8	0.9	0.9 (0.9-8.7)	62	48.1	0.2	0.8 (0.5-1.2)	16	12.4	0.7	1.1(0.6-2.1)
25-29	346	3	0.9		1.0 (ref.)	187	54.0		1.0 (ref.)	38	11.0		1.0 (ref.)
30-34	631	17	2.7	0.07	3.1(0.9-10.9)	304	48.2	0.08	0.8 (0.6-1.0)	51	8.1	0.1	0.7 (0.5-1.1)
35-39	317	13	3.5	0.03	4.2(1.2-14.8)	169	45.9	0.03	0.7 (0.5-1.0)	24	6.5	0.04	0.6 (0.3-1.0)
Missing	4												
Age (years) 18-25 reference													
	n=1474	**n=34**	**%**			**n=722**	**%**			**n=129**	**%**		
18-24	129	1	0.8		1.0 (ref.)	62	48.1		1.0 (ref.)	16	12.4		1.0 (ref.)
25-29	346	3	0.9	0.9	1.1 (0.1-10.9)	187	54.0	0.2	1.3 (0.8-1.9)	38	11.0	0.7	0.9 (0.5-1.6)
30-34	631	17	2.7	0.2	3.5 (0.5-26.9)	304	48.2	1.0	1.0 (0.7-1.5)	51	8.1	0.1	0.6 (0.3-1.1)
35-39	317	13	3.5	0.1	4.7 (0.6-36.1)	169	45.9	0.7	0.9 (0.6-1.4)	24	6.5	0.04	0.5 (0.3-1.0)
Missing	4												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
BMI													
	n=1358	**n=31***	**%**			**n=658**	**%**			**n=121**	**%**		
Underweight	57	1	1.8	0.9	0.9 (0.1-6.5)	31	54.4	0.3	1.3 (0.8-2.3)	4	7.0	0.8	0.9 (0.3-2.5)
Ideal	924	19	2.1		1.0 (ref.)	435	47.1		1.0 (ref.)	73	7.9		1.0 (ref.)
Overweight	247	7	2.8	0.5	1.4 (0.6-3.3)	124	50.2	0.4	1.1 (0.9-1.5)	19	7.7	0.9	1.0 (0.6-1.6)
Obese/very obese	130	4	3.1	0.5	1.5 (0.5-4.5)	68	52.3	0.3	1.2 (0.9-1.8)	25	19.2	<0.001	2.8 (1.7-4.6)
Missing	120												
Educational level													
	n=1468	**n=34**	**%**			**n=718**	**%**			**n=129**	**%**		
No formal education/ primary/lower secondary	39	1	2.6	0.9	0.9 (0.1-7.3)	18	46.2	0.7	0.9 (0.5-1.7)	7	17.9	0.01	3.2 (1.3-7.7)
Upper secondary	351	6	1.7	0.3	0.6 (0.2-1.6)	183	52.1	0.3	1.1 (0.9-1.5)	34	9.7	0.08	1.6 (0.9-2.6)
University degree or equivalent	568	13	2.3	0.6	0.8 (0.4-1.8)	268	47.2	0.6	0.9 (0.7-1.2)	55	9.7	0.06	1.6 (1.0-2.4)
Postgraduate qualification	510	14	2.7		1.0 (ref.)	249	48.8		1.0 (ref.)	33	6.5		1.0 (ref.)
Missing	10												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Employment status													
	n=1470	**n=34**	**%**			**n=718**	**%**			**n=129***	**%**		
Full-time paid work	1171	31	2.6		1.0 (ref.)	557	47.6		1.0 (ref.)	90	7.7		1.0 (ref.)
Part-time paid work/casual work	114	2	1.8	0.6	0.7 (0.2-2.8)	61	53.5	0.2	1.3 (0.9-1.9)	14	12.3	0.9	1.7 (0.9-3.1)
Unemployed	131	1	0.8	0.2	0.3 (0.04-2.1)	69	52.7	0.3	1.2 (0.9-1.8)	21	16.0	0.002	2.3 (1.4-3.9)
Student/pupil	30	0	0.0	1	0	16	53.3	0.5	1.3 (0.6-2.6)	4	13.3	0.3	1.8 (0.6-5.4)
Looking after home/family	15	0	0.0	x	x	7	46.7	0.9	1.0 (0.3-2.7)	1	6.7	0.9	0.9 (0.1-6.6)
Unable to work: sickness/disability	9	0	0.0	x	x	9	100	1.0	x	0	0.0	x	x
Missing	8												
Marital status													
	n=1472	**n=34***	**%**			**n=721**	**%**			**n=130**	**%**		
Married	906	25	2.8		1.0 (ref.)	430	47.5		1.0 (ref.)	73	8.1		1.0 (ref.)
Single	58	1	1.8	0.7	0.6 (0.1-4.8)	23	41.1	0.4	0.8 (0.5-1.3)	7	12.5	0.2	1.6 (0.7-3.7)
Living with partner	393	7	1.8	0.3	0.6 (0.3-1.5)	208	52.9	0.1	1.2 (1.0-1.6)	39	9.9	0.3	1.3 (0.8-1.9)
In a relationship - not living together	117	1	0.9	0.2	0.3 (0.04-2.7)	60	51.3	0.4	1.2 (0.8-1.7)	11	9.4	0.6	1.2 (0.6-2.3)
Missing	6												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Ethnicity													
	n=1466	**n=34***	**%**			**n=718**	**%**			**n=129***	**%**		
White background	1381	32	2.3		1.0 (ref.)	674	48.8		1.0 (ref.)	116	8.4		1.0 (ref.)
Black or African background	23	0	0.0	x	X	9	39.1	0.4	0.7 (0.3-1.6)	5	21.7	0.03	3.0 (1.1-8.3)
Asian background	43	0	0.0	x	X	25	58.1	0.2	1.5 (0.8-2.7)	5	11.6	0.5	1.4 (0.6-3.7)
Mixed background	19	2	50.0	0.04	5.0 (1.1-22.4)	10	52.6	0.7	1.2 (0.5-2.9)	3	15.8	0.3	2.0 (0.6-7.1)
Missing	12												
Low back pain in the 12 months before pregnancy													
	n=1470	**n=34**	**%**			**n=719**	%			**n=129**	**%**		
No	1200	30	2.5		1.0 (ref.)	557	56.7		1.0 (ref.)	94	7.8		1.0 (ref.)
Yes	270	4	1.5	0.3	0.6 (0.2-1.7)	162	64.7	<0.001	1.7 (1.3-2.3)	35	13.0	0.008	1.8 (1.2-2.6)
Missing	8												
Pelvic girdle pain in the 12 months before pregnancy													
	n=1472	**n=34**	**%**			**n=701**	**%**			**n=129**	**%**		
No	862	25	2.9		1.0 (ref.)	261	32.6		1.0 (ref.)	56	6.5		1.0 (ref.)
Yes	610	9	1.5	0.08	0.5 (0.2-1.1)	440	72.1	<0.001	5.4 (4.3-6.7)	73	12.0	<0.001	2.0 (1.4-2.8)

Missing	6												
Factor	**Number of participants**	**Anterior PPGP**		**p**	**Unadjusted OR (95% CI)**	**Posterior PPGP**		**p**	**Unadjusted OR (95% CI)**	**Combined anterior & posterior PPGP**		**p**	**Unadjusted OR (95% CI)**
History of heavy periods													
	n=1471	**n=34***	**%**			**n=721**	**%**			**n=129**	**%**		
No	1286	28	2.2		1.0 (ref.)	630	49.0		1.0 (ref.)	99	7.7		1.0 (ref.)
Yes	185	6	3.2	0.4	1.5 (0.6-3.7)	91	49.2	1.0	1.0 (0.7-1.4)	30	16.2	<0.001	2.3 (1.5-3.6)
Missing	7												
History of severe period pain													
	n=1473	n=34	%			n=722	%			n=129	%		
No	989	21	2.1		1.0 (ref.)	462	46.7		1.0 (ref.)	72	7.3		1.0 (ref.)
Yes	484	13	2.7	0.5	1.3 (0.6-2.6)	260	53.7	0.01	1.3 (1.1-1.6)	57	11.8	0.004	1.7 (1.2-2.5)
Missing	5												
History of anxiety before pregnancy													
	n=1468	**n=34***	**%**			**n=722**	**%**			**n=126**	**%**		
No	1344	30	2.2		1.0 (ref.)	662	49.3		1.0 (ref.)	109	8.1		1.0 (ref.)
Yes	124	4	3.2	0.5	1.5 (0.5-4.2)	60	48.4	0.9	1.0 (0.7-1.4)	17	13.7	0.04	1.8 (1.0-3.1)
Missing	10												
History of low mood/feeling depressed before pregnancy													
	n=1472	**n=34**	**%**			**n=722**	**%**			**n=129**	**%**		
No	1250	28	2.2		1.0 (ref.)	610	48.8		1.0 (ref.)	107	8.6		1.0 (ref.)
Yes	222	6	2.7	0.7	1.2 (0.5-3.0)	112	50.5	0.7	1.1 (0.8-1.2)	22	9.9	0.5	1.2 (0.7-2.0)
Missing	6												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Smoking													
	n=1458	**n=34**	**%**			**n=711**	**%**			**n=130**	**%**		
Smoking	106	3	2.8	0.9	1.0 (0.3-3.7)	50	47.2	0.8	0.9 (0.6-1.4)	14	13.2	0.2	1.5 (0.8-2.7)
Stopped smoking before pregnancy or when found out being pregnant	555	10	1.8	0.3	0.7 (0.3-1.5)	274	49.4	0.8	1.0 (0.8-1.3)	41	7.4	0.2	0.8 (0.5-1.1)
Not smoking	797	21	2.6		1.0 (ref.)	387	48.6		1.0 (ref.)	75	9.4		1.0 (ref.)
Missing	20												
History of injury to the back													
	n=1445	**n=33***	**%**			**n=704**	**%**			**n=130***	**%**		
No	1385	31	2.2		1.0 (ref.)	664	47.9		1.0 (ref.)	127	8.2		1.0 (ref.)
Yes	60	2	3.3	0.6	1.5 (0.4-6.4)	40	66.7	0.005	2.2 (1.3-3.8)	3	5.0	0.3	0.5 (0.2-1.7)
Missing	33												

*Chi square assumption was violated with >20% of cells having an expected count of less than 5

Table 6-14 Risk factor for anterior and/or posterior PPGP in early/mid pregnancy – Univariate analysis

6.4.3 Risk factors for PPGP in the last month of pregnancy – Univariate analysis

The findings of the univariate analysis for risk factors for sub-outcomes for PPGP in the last months of pregnancy are presented in Table 6.15.

Factor	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference						
	n=1175	**n=357**	**n=818**	**%**		
18-24	78	13	65	83.3	0.7	1.8 (1.0-3.5)
25-29	272	73	199	73.2		1.0 (ref.)
30-34	516	157	359	69.6	0.3	0.8 (0.6-1.2)
≥35	309	114	195	63.1	0.01	0.6 (0.4-0.9)
Missing	6					
Age (years) 18-24 reference						
	n=1175	**n=357**	**n=818**	**%**		
18-24	78	13	65	83.3		1.0 (ref.)
25-29	282	73	199	73.2	0.07	0.5 (0.3-1.0)
30-34	516	157	359	39.6	0.01	0.5 (0.2-0.9)
≥35	309	114	195	63.1	0.001	0.3 (0.2-0.6)
Missing	6					
BMI						
	n=1094	**n=333**	**n=761**	**%**		
Underweight	44	17	27	61.4	0.3	0.7 (0.4-1.3)
Ideal	740	228	512	59.2		1.0 (ref.)
Overweight	196	62	134	68.4	0.8	1.0 (0.7-1.4)
Obese/very obese	114	26	88	77.2	0.08	1.5 (0.9-2.4)
Missing	87					
Educational level						
	n=1172	**n=356**	**n=816**	**%**		
No formal education/ primary/lower secondary	18	3	15	83.3	0.2	2.5 (0.7-8.8)
Upper secondary	259	65	194	74.9	0.02	1.5 (1.1-2.1)
University degree or equivalent	458	142	316	69.0	0.5	1.1 (0.8-1.5)
Postgraduate qualification	437	146	291	66.6		1.0 (ref.)
Missing	9					

Employment status						
	n=1172	**n=356**	**n=816**	**%**		
Full-time paid work	966	300	666	68.9		1.0 (ref.)
Part-time paid work/casual work	82	24	58	70.7	0.7	1.1 (0.7-1.8)
Unemployed	86	26	60	69.8	0.9	1.0 (0.6-1.7)
Student/pupil	22	4	18	81.8	0.2	2.0 (0.7-6.0)
Looking after home/family	10	2	8	80.0	0.5	1.8 (0.4-8.5)
Unable to work due to sickness/ disability	6	0	6	100	x	x
missing	9					
Marital status						
	n=1173	**n=356**	**n=817**	**%**		
Married	748	240	508	67.9		1.0 (ref.)
Single	37	9	28	75.7	0.3	1.5 (0.7-3.2)
Living with partner	310	87	223	71.9	0.2	1.2 (0.9-1.6)
In a relationship - not living together	78	20	58	74.4	0.2	1.4 (0.8-2.3)
Missing	8					
Ethnicity						
	n=1170	**n=355**	**n=815***	**%**		
White background	1121	341	780	69.6		1.0 (ref.)
Black or African background	7	2	5	71.4	0.9	1.1 (0.2-5.7)
Asian background	27	7	20	74.1	0.6	1.2 (0.5-3.0)
Mixed background	15	5	10	66.7	0.8	0.9 (0.3-2.6)
Missing	11					
Low back pain in the 12 months before pregnancy						
	n=1169	**n=354**	**n=815**	**%**		
No	985	323	635	66.3		1.0 (ref.)
Yes	211	31	180	85.3	<0.001	3.0 (2.0-4.4)
Missing	12					
Pelvic girdle pain in the 12 months before pregnancy						
	n=1171	**n=354**	**n=817**	**%**		
No	680	267	413	60.7		1.0 (ref.)
Yes	491	87	404	82.3	<0.001	3.0 (2.3-4.0)
Missing	10					

Factor	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)
History of heavy periods						
	n=1171	**n=354**	**n=817**	**%**		
No	1025	319	706	68.9		1.0 (ref.)
Yes	146	35	111	76.0	0.08	1.4 (1.0-2.1)
Missing	10					
History of severe period pain						
	n=1173	**n=356**	**n=817**	**%**		
No	799	261	538	67.3		1.0 (ref.)
Yes	374	95	279	74.6	0.01	1.4 (1.1-1.9)
Missing	8					
History of anxiety before pregnancy						
	n=1169	**n=354**	**n=815**	**%**		
No	1068	337	731	68.4		1.0 (ref.)
Yes	101	17	84	83.2	0.003	2.3 (1.3-3.9)
Missing	12					
History of low mood/feeling depressed before pregnancy						
	n=1172	**n=355**	**n=817**	**%**		
No	1000	321	679	67.6		1.0 (ref.)
Yes	172	34	138	80.2	0.001	1.9 (1.3-2.9)
Missing	9					
Smoking						
	n=1161	n=352	n=809	%		
Smoking	69	14	55	79.7	0.04	1.9 (1.0-3.5)
Stopped smoking before pregnancy or when found out being pregnant	436	122	314	72.0	0.08	1.3 (1.0-1.6)
Not smoking	656	216	440	67.1		1.0 (ref.)
Missing	20					
History of injury to the back						
	n=1145	**n=347**	**n=798**	**%**		
No	1096	336	760	69.3		1.0 (ref.)
Yes	49	11	38	77.6	0.2	1.5 (0.8-3.0)
Missing	36					

*Chi square assumptions were violated with >20% of cells having an expected count of less than five

Table 6-15 Risk factors for PPGP in the last month of pregnancy – Univariate analysis

6.4.4 Risk factors for anterior and/or posterior PPGP in the last month of pregnancy – Univariate analysis

The findings of the univariate analysis for risk factors for sub-outcomes for PPGP in the last month of pregnancy are presented in Table 6.16.

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference													
	n=1175	**n=53**	**%**			**n=514**	**%**			**n=251**	**%**		
18-24	78	2	2.6	0.7	0.8 (0.2-3.6)	34	43.6	0.8	0.9 (0.6-1.5)	29	37.2	0.03	1.8 (1.1-3.2)
25-29	272	9	3.3		1.0 (ref.)	124	45.6		1.0 (ref.)	66	24.3		1.0 (ref.)
30-34	516	28	5.4	0.2	1.7 (0.8-3.6)	231	44.8	0.8	1.0 (0.7-1.3)	100	19.4	0.1	0.8 (0.5-1.1)
≥35	309	14	4.5	0.5	1.4 (0.6-3.3)	125	40.5	0.2	0.8 (0.6-1.1)	56	18.1	0.07	0.7 (0.5-1.0)
Missing	6												
Age (years) 18-24 reference													
	n=1175	**n=53**	**%**			**n=514**	**%**			**n=251**	**%**		
18-24	78	2	2.6		1.0 (ref.)	34	43.6		1.0 (ref.)	29	37.2		1.0 (ref.)
25-29	272	9	3.3	0.7	1.3 (0.3-6.1)	124	45.6	0.8	1.1 (0.7-1.8)	66	24.3	0.03	0.5 (0.3-0.9)
30-34	516	28	5.4	0.3	2.2 (0.5-9.3)	231	44.8	0.8	1.0 (0.6-1.7)	100	19.4	0.001	0.4 (0.2-0.7)
≥35	309	14	4.5	0.4	1.8 (0.4-8.1)	125	40.5	0.6	0.9 (0.5-1.5)	56	18.1	<0.001	0.4 (0.2-0.6)
Missing	6												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
BMI													
	n=1094	**n=53**	**%**			**n=476**	**%**			**n=232**	**%**		
Underweight	44	1	2.3	0.4	0.4 (0.1-3.0)	12	27.3	0.02	0.5 (0.2-0.9)	14	31.8	0.04	2.0 (1.1-3.9)
Ideal	740	40	5.4		1.0 (ref.)	334	45.1		1.0 (ref.)	139	18.6		1.0 (ref.)
Overweight	196	7	3.6	0.3	0.6 (0.3-1.5)	82	41.8	0.4	0.9 (0.6-1.2)	45	23.0	0.2	1.3 (0.9-1.9)
Obese/very obese	114	5	4.4	0.7	0.8 (0.3-2.1)	48	42.1	0.5	0.9 (0.6-1.3)	35	30.7	0.003	1.9 (1.2-3.0)
Missing	87												
Educational level													
	n=1172	**n=53**	**%**			**n=513**	**%**			**n=250**	**%**		
No formal education/ primary/lower secondary	18	1	5.6	1.0	1.0 (0.1-7.6)	7	38.9	0.9	0.9 (0.4-2.5)	7	38.9	0.07	2.5 (0.9-6.6)
Upper secondary	259	11	4.2	0.4	0.7 (0.4-1.5)	120	46.3	0.1	1.3 (0.9-1.7)	63	24.3	0.2	1.3 (0.9-1.8)
University degree or equivalent	458	16	3.5	0.1	0.6 (0.3-1.1)	209	45.6	0.1	1.2 (0.9-1.6)	91	19.9	0.7	1.0 (0.7-1.3)
Postgraduate qualification	437	25	5.7		1.0 (ref.)	177	40.5		1.0 (ref.)	89	20.4		1.0 (ref.)
Missing	9												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Employment status													
	n=1172*	**n=52**	**%**			**n=514***	**%**			**n=250***	**%**		
Full-time paid work	966	42	4.3		1.0 (ref.)	431	44.6		1.0 (ref.)	193	20.0		1.0 (ref.)
Part-time paid work/casual work	82	4	4.9	0.8	1.1 (0.4-3.2)	33	40.2	0.4	0.8 (0.5-1.3)	21	25.6	0.2	1.4 (0.8-2.3)
Unemployed	86	5	5.8	0.5	1.4 (0.5-3.5)	31	36.0	0.1	0.7 (0.4-1.1)	24	27.9	0.1	1.6 (0.9-2.5)
Student/pupil	22	1	4.5	1.0	1.0 (0.1-8.0)	10	45.5	0.9	1.0 (0.4-2.4)	7	31.8	0.2	1.9 (0.8-4.6)
Looking after home/family	10	0	0.0	x	x	6	60.0	0.3	1.9 (0.5-6.6)	2	20.0	1.0	1.0 (0.2-4.7)
Unable to work: sickness/ disability	6	0	0.0	x	x	3	50.0	0.8	1.2 (0.2-6.1)	3	50.0	0.1	4.0 (0.8-20.0)
Missing	9												
Marital status													
	n=1173	**n=53***	**%**			**n=513**	**%**			**n=251**	**%**		
Married	748	39	5.2		1.0 (ref.)	328	43.9		1.0 (ref.)	141	18.9		1.0 (ref.)
Single	37	3	8.1	0.4	1.6 (0.5-5.5)	16	43.2	0.9	1.0 (0.5-1.9)	9	24.3	0.4	1.4 (0.6-3.0)
Living with partner	310	8	2.6	0.1	0.5 (0.2-1.0)	132	42.6	0.7	1.0 (0.7-1.2)	83	26.8	0.004	1.6 (1.2-2.1)
In a relationship - not living together	78	3	3.8	0.6	0.7 (0.2-2.4)	37	47.4	0.5	1.2 (0.7-1.8)	18	23.1	0.4	1.3 (0.7-2.3)
Missing	8												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Ethnicity													
	n=1170	**n=53 ***	**%**			**n=513 ***	**%**			**n=249 ***	**%**		
White background	1121	50	4.5		1.0 (ref.)	494	44.1		1.0 (ref.)	236	21.1		1.0 (ref.)
Black or African background	7	1	14.3	0.2	3.6 (0.4-30.2)	2	28.6	0.4	0.5 (0.1-2.6)	2	28.6	0.6	1.5 (0.3-7.8)
Asian background	27	2	7.4	0.5	1.7 (0.4-7.4)	9	33.3	0.3	0.6 (0.3-1.4)	9	33.3	0.1	1.9 (0.8-4.2)
Mixed background	15	0	0.0	x	x	8	53.3	0.5	1.5 (0.5-4.0)	2	13.3	0.5	0.6 (0.1-2.6)
Missing	11												
Low back pain in the 12 months before pregnancy													
	n=1169	**n=53**	**%**			**n=512**	**%**			**n=250**	**%**		
No	985	43	4.5		1.0 (ref.)	398	41.5		1.0 (ref.)	194	20.3		1.0 (ref.)
Yes	211	10	4.7	0.9	1.1 (0.5-2.1)	114	54.0	0.001	1.7 (1.2-2.2)	56	26.5	0.04	1.4 (1.0-2.0)
Missing	12												
Pelvic girdle pain in the 12 months before pregnancy													
	n=1171	**n=53**	**%**			**n=513**	**%**			**n=251**	**%**		
No	680	43	6.3		1.0 (ref.)	243	35.7		1.0 (ref.)	127	18.7		1.0 (ref.)
Yes	491	10	2.0	0.001	0.3 (0.2-0.6)	270	55.0	<0.001	2.2 (1.7-2.8)	124	25.3	0.01	1.5 (1.1-1.9)
Missing	10												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
History of heavy periods													
	n=1171	**n=53**	**%**			**n=514**	**%**			**n=250**	**%**		
No	1025	45	4.4		1.0 (ref.)	451	44.0		1.0 (ref.)	210	20.5		1.0 (ref.)
Yes	146	8	5.5	0.6	1.3 (0.6-2.7)	63	43.2	0.8	1.0 (0.7-1.4)	40	27.4	0.06	1.5 (1.0-2.2)
Missing	10												
History of severe period pain													
	n=1173	**n=53**	**%**			**n=514**	**%**			**n=250**	**%**		
No	799	37	4.6		1.0 (ref.)	349	43.7		1.0 (ref.)	152	19.0		1.0 (ref.)
Yes	374	16	4.3	0.8	0.9 (0.5-1.7)	165	44.1	0.9	1.0 (0.8-1.3)	98	26.2	0.01	1.5 (1.1-2.0)
Missing	8												
History of anxiety before pregnancy													
	n=1169	**n=52***	**%**			**n=514**	**%**			**n=249**	**%**		
No	1068	44	4.1		1.0 (ref.)	466	43.6		1.0 (ref.)	221	20.7		1.0 (ref.)
Yes	101	8	7.9	0.08	2.0 (1.0-4.4)	48	47.5	0.5	1.2 (0.8-1.8)	28	27.7	0.1	1.5 (1.0-2.3)
Missing	12												
History of low mood/feeling depressed before pregnancy													
	n=1172	**n=53**	**%**			**n=514**	**%**			**n=250**	**%**		
No	1000	43	4.3		1.0 (ref.)	433	43.3		1.0 (ref.)	203	20.3		1.0 (ref.)
Yes	172	10	5.8	0.4	1.4 (0.7-2.8)	81	47.1	0.4	1.2 (0.8-1.6)	47	27.3	0.04	1.5 (1.0-2.1)
Missing	9												

Factor	Number of participants	Anterior PPGP		p	Unadjusted OR (95% CI)	Posterior PPGP		p	Unadjusted OR (95% CI)	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)
Smoking													
	n=1161	**n=52**	**%**			**n=509**	**%**			**n=248**	**%**		
Smoking	69	3	4.3	0.9	0.9 (0.3-3.2)	30	43.5	0.9	1.0 (0.6-1.6)	22	31.9	0.01	2.1 (1.2-3.6)
Stopped smoking before pregnancy or when found out being pregnant	436	19	4.4	0.9	1.0 (0.5-1.7)	190	43.6	0.9	1.0 (0.8-1.3)	105	24.1	0.03	1.4 (1.0-1.9)
Not smoking	656	30	4.6		1.0 (ref.)	289	44.1		1.0 (ref.)	121	18.4		1.0 (ref.)
Missing	20												
History of injury to the back													
	n=1145	**n=53 ***	**%**			**n=502**	**%**			**n=243**	**%**		
No	1096	48	4.4		1.0 (ref.)	481	43.9		1.0 (ref.)	231	21.1		1.0 (ref.)
Yes	49	5	10.2	0.07	2.5 (0.9-6.5)	21	42.9	0.9	1.0 (0.5-1.7)	12	24.5		1.2 (0.6-2.4)

*Chi square assumption was violated with >20% of cells having an expected count of less than 5

Table 6-16 Risk factor for anterior and/or posterior PPGP in the last month of pregnancy – Univariate analysis

6.5 Multivariable analysis assessing risk factors for PPGP

Multivariable logistic regression analyses were conducted to adjust for confounding variables and obtain a more accurate effect measure of the risk factors for PPGP examined in this study. Multivariable logistic regression models were developed for the outcomes (1) PPGP in early/mid pregnancy and (2) PPGP in the last month of pregnancy. Models were also developed for the sub-outcomes posterior PPGP and combined PPGP. The sub-outcome anterior PPGP was not included in the multivariable analysis because this was a small group and the chi square assumptions were violated in univariate analyses for six factors examined with PPGP in early/mid pregnancy as outcome, and for four factors examined with PPGP in the last month of pregnancy as outcome. Potential risk factors were included in the multivariable model if they were statistically significant in univariate analysis for at least one category compared to the reference group ($p \leq 0.05$). An overview of the factors that were significantly associated with PPGP in univariate analyses, and were included in the multivariable models, is presented in Table 6-17.

Factors examined in univariate analysis	Early/mid pregnancy				Last month of pregnancy			
	Any PPGP	Anterior PPGP	Posterior PPGP	Combined anterior & posterior PPGP	Any PPGP	Anterior PPGP	Posterior PPGP	Combined anterior & posterior PPGP
Age (years)	v	v	v	v	v	x	x	v
Body Mass Index	v	x*	x	v	x	x	v	v
Educational level	x	x	x	v	v	x	x	x
Employment status	v	x	x	v	x	x	x	x
Marital status	v	x*	x	x	x	x*	x	v
Ethnicity	x	x*	x	v*	x*	x*	x*	x*
Any low back pain in the year pre-pregnancy	v	x	v	v	v	x	v	v
Any pelvic girdle pain in the year pre-pregnancy	v	x	v	v	v	v	v	v
History of heavy periods	v	x*	x	v	x	x	x	x
History of severe period pain	v	x	v	v	v	x	x	v
History of anxiety	x	x*	x	v	v	x*	x	x
History of depressive feelings/low mood	x	x	x	x	v	x	x	v
Smoking	x	x	x	x	v	x	x	v
History of injury to the back	v	x*	v	x	x	x*	x	x

v: Statistically significantly associated with PPGP in univariate analysis (highlighted in yellow)
x: Not statistically significantly associated with PPGP in univariate analysis
*: Chi square assumptions were violated

Table 6-17 Overview of statistical significance of examined risk factors for PPGP in univariate analysis

The factor 'ethnicity' was not included in the multivariable model for combined PPGP in early/mid pregnancy, even though it was a significant result in univariate analysis ($p \leq 0.05$), because the chi square assumptions were violated. The factors 'history of any low back pain 12 months pre-pregnancy' and 'history of any pelvic girdle pain 12 months pre-pregnancy' were strongly associated (df=1, n=1471, $X^2=144.9$, $p<0.001$); hence, they were combined into the variable 'history of any lumbopelvic pain 12 months pre-pregnancy' to address the issue of collinearity. For the same reason, the factor 'history of injury to the back' was omitted from the multivariable models for any PPGP and posterior PPGP in early/mid pregnancy, because of its strong association with 'history of any lumbopelvic pain 12 months pre-pregnancy' (df=1, n=1441, $X^2=31.8$, $p<0.001$). The multivariable models for risk factors for PPGP in early/mid pregnancy and in the last month of pregnancy are outlined in section 6.5.1 and 6.5.2. Table 6-18 presents an overview of the factors that were significantly associated with PPGP in multivariable analyses.

FACTORS EXAMINED	Early/mid pregnancy			Last month of pregnancy		
	Any PPGP	Posterior PPGP	Combined anterior & posterior PPGP	Any PPGP	Posterior PPGP	Combined anterior & posterior PPGP
Age (years)	v	v	v	v	x	v
Body Mass Index	v	x	v	x	x	v
Educational level	x	x	x	x	x	X
Employment status	x	x	x	x	x	X
Marital status	x	x	x	x	x	X
Any lumbopelvic pain in the year pre-pregnancy	v	v	v	v	v	V
History of heavy periods	x	x	x	x	x	X
History of severe period pain	x	x	v	x	x	X
History of anxiety	x	x	x	x	x	X
History of depressive feelings/low mood	x	x	x	x	x	X
Smoking	x	x	x	x	x	X

Ethnicity, a history of any injury to the back, a history of any surgery to the back, and diabetes were not included in any of the multivariable models.
v: Statistically significantly associated with PPGP in multivariable analysis (highlighted in yellow)
x: Not statistically significantly associated with PPGP in multivariable analysis

Table 6-18 Overview of statistical significance of examined risk factors for PPGP in multivariable analyses

6.5.1 Multivariable analysis assessing risk factors for PPGP in early/mid pregnancy

6.5.1.1 Multivariable analysis assessing risk factors for any PPGP in early/mid pregnancy

The model contained the variables; age, BMI, employment status, marital status, a history of lumbopelvic pain in the year before pregnancy, a history of severe period pain and a history of heavy periods. The Omnibus Test of Model Coefficients was statistically significant (X^2=243.7, df=13, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=1.9, df=8, p=0.983) (Table 6-19 and Table 6-20).

Women aged 35 or older were less likely to have PPGP in early/mid pregnancy (OR 0.7, 95% CI 0.5-0.9, p=0.02). Women who were obese or very obese were at greater risk of having PPGP (OR 2.1, 95% CI 1.4-3.3, p=0.001). A history of any lumbopelvic pain in the year before becoming pregnant was also strongly associated with PPGP in early/mid pregnancy (OR 5.6, 95% CI 4.3-7.2, p<0.001). There was no association between PPGP in early/mid pregnancy and employment status, marital status, a history of severe period pain and a history of heavy periods, all factors that were significant in univariate analysis.

Factors	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Age (years)	**n=1474**	**n=589**	**n=885**	**%**				
18-24	129	50	79	61.2	0.3	0.8 (0.5-1.2)	0.1	0.7 (0.4-1.1)
25-29	346	118	228	65.9		1.0 (ref.)		1.0 (ref.)
30-34	631	259	372	59.0	0.03	0.7 (0.6-1.0)	0.1	0.7 (0.6-1.1)
≥35	368	162	206	56.0	0.007	0.7 (0.5-0.9)	0.02	0.7 (0.5-0.9)
Missing	4							
BMI	**n=1358**	**n=548**	**n=810**	**%**				
Underweight	57	21	36	63.2	0.4	1.3 (0.7-2.2)	0.2	1.5 (0.8-2.7)
Ideal	924	397	527	57.0		1.0 (ref.)		1.0 (ref.)
Overweight	247	97	150	60.7	0.3	1.2 (0.9-1.6)	0.3	1.2 (0.9-1.6)
Obese/very obese	130	33	97	74.6	<0.001	2.2 (1.5-3.4)	0.001	2.1 (1.4-3.3)
Missing	120							
Employment status	**n=1470**	**n=587**	**n=883**	**%**				
Working	1315	540	775	58.9		1.0 (ref.)		1.0 (ref.)
Not working	155	47	108	69.7	0.01	1.6 (1.1-2.3)	0.08	1.5 (1.0-2.4)
Missing	8							

Table 6-19 Multivariable logistic analysis assessing risk factors for PPGP in early/mid pregnancy

Factors	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Marital status	**n=1472**	**n=587**	**n=885**	**%**				
Married	906	378	528	58.3	0.2	1.0 (ref.)		1.0 (ref.)
Single	58	25	31	55.4	0.7	0.9 (0.5-1.5)	0.2	0.6 (0.3-1.3)
Living with partner	393	139	254	64.6	0.03	1.3 (1.0-1.7)	0.5	1.1 (0.8-1.5)
In a relationship - not living together	117	45	72	61.5	0.5	1.1 (0.8-1.7)	0.6	0.9 (0.5-1.5)
Missing	6							
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=1470**	**n=588**	**n=882**	**%**				
No	790	453	337	42.7		1.0 (ref.)		1.0 (ref.)
Yes	680	135	545	80.1	<0.001	5.4 (4.3-6.9)	<0.001	5.6 (4.3-7.2)
Missing	8							
History of heavy periods	**n=1471**	**n=587**	**n=884**	**%**				
No	1286	529	757	58.9		1.0 (ref.)		1.0 (ref.)
Yes	185	58	127	68.6	0.01	1.5 (1.1-2.1)	0.3	1.3 (0.8-1.9)
Missing	7							
History of severe period pain	**n=1473**	**n=588**	**n=885**	**%**				
No	989	434	555	56.1		1.0 (ref.)		1.0 (ref.)
Yes	484	154	330	68.2	<0.001	1.7 (1.3-2.1)	0.3	1.3 (0.8-1.9)
Missing	5							

Table 6-20 Multivariable logistic analysis assessing risk factors for PPGP in early/mid pregnancy - continued

6.5.1.2 Multivariable analysis assessing risk factors for posterior PPGP in early/mid pregnancy

The model contained the variables; age, a history of any lumbopelvic pain in the year before pregnancy and a history of severe period pain. The Omnibus Test of Model Coefficients was statistically significant (X^2=175.3, df=5, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=3.4, df=8, p=0.910) (Table 6-21).

Women aged 35 or older were significantly less likely to experience posterior PPGP in early/mid pregnancy (OR 0.7, 95% CI 0.5-1.0, p=0.04). Women with a history of any lumbopelvic pain in the year before pregnancy were at a higher risk of having posterior PPGP (OR 4.0, 95% CI 3.2-5.0, p<0.001). There was no association between posterior PPGP in early/mid pregnancy and a history of severe period pain, which was significant in univariate analysis.

Factors	Number of participants	No posterior PPGP	Posterior PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Age	**n=1474**	**n=752**	**n=722**	**%**				
18-24	129	67	62	48.1	0.2	0.8 (0.5-1.2)	0.2	0.8 (0.5-1.2)
25-29	346	159	187	54.0		1.0 (ref.)		1.0 (ref.)
30-34	631	327	304	48.2	0.08	0.8 (0.6-1.0)	0.1	0.8 (0.6-1.1)
≥35	368	199	169	45.9	0.03	0.7 (0.5-1.0)	0.04	0.7 (0.5-1.0)
Missing	4							
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=1470**	**n=751**	**n=719**					
No	790	527	263	33.3		1.0 (ref.)		1.0 (ref.)
Yes	680	224	456	67.1	<0.001	4.1 (3.3-5.1)	<0.001	4.0 (3.2-5.0)
Missing	8							
History of severe period pain	**n=1473**	**n=751**	**n=722**	**%**				
No	989	527	462	46.7		1.0 (ref.)		1.0 (ref.)
Yes	484	224	260	53.7	0.01	1.3 (1.1-1.6)	0.4	1.1 (0.9-1.4)
Missing	5							

Table 6-21 Multivariable logistic analysis assessing risk factors for posterior PPGP in early/mid pregnancy

6.5.1.3 Multivariable analysis assessing risk factors for combined anterior and posterior PPGP in early/mid pregnancy

The model contained the variables; age, BMI, educational level, employment status, a history of any lumbopelvic pain in the year before pregnancy, a history of heavy periods, and a history of severe period pain. The Omnibus Test of Model Coefficients was statistically significant (X^2=48.4, df=14, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=2.7, df=8, p=0.949) (Table 6-22 and Table 6-23).

Women aged 35 or older were less likely to experience combined anterior and posterior PPGP in early/mid pregnancy (OR 0.5, 95% CI 0.3-0.9, p=0.03). Obese and very obese women were more likely to have combined PPGP (OR 2.5, 95% CI 1.5-4.3, p=0.001). A history of any lumbopelvic pain in the year before pregnancy was a strong risk factor for combined PPGP in early/mid pregnancy (OR 1.8, 95% CI 1.2-2.6, p=0.006), and a history of severe period pain before pregnancy was also positively associated with combined PPGP (OR 1.8, 95% CI 1.0-3.2, p=0.04). Educational level, employment status, and a history of heavy periods; factors that were all significant in univariate analysis, were no longer associated with combined PPGP in the multivariable model.

Factors	Number of participants	No combined PPGP	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Age (years)	**n=1474**	**n=1345**	**n=129**					
18-24	129	113	16	12.4	0.7	1.1(0.6-2.1)	0.9	1.1 (0.5-2.1)
25-29	346	308	38	11.0		1.0 (ref.)		1.0 (ref.)
30-34	631	580	51	8.1	0.1	0.7 (0.5-1.1)	0.3	0.8 (0.5-1.3)
≥35	368	344	24	6.5	0.04	0.6 (0.3-1.0)	0.03	0.5 (0.3-0.9)
Missing	4							
BMI	**n=1358**	**n=1237**	**n=121**	**%**				
Underweight	57	53	4	7.0	0.8	0.9 (0.3-2.5)	0.5	0.7 (0.2-2.3)
Ideal	924	851	73	7.9		1.0 (ref.)		1.0 (ref.)
Overweight	247	228	19	7.7	0.9	1.0 (0.6-1.6)	0.7	0.9 (0.5-1.5)
Obese/very obese	130	105	25	19.2	<0.001	2.8 (1.7-4.6)	0.001	2.5 (1.5-4.3)
Missing	120							
Educational level	**n=1468**	**n=1339**	**n=129**	**%**				
No formal education/primary/lower secondary	39	32	7	17.9	0.01	3.2 (1.3-7.7)	0.2	2.2 (0.7-6.5)
Upper secondary	351	317	34	9.7	0.08	1.6 (0.9-2.6)	0.4	1.3 (0.7-2.2)
University degree or equivalent	568	513	55	9.7	0.06	1.6 (1.0-2.4)	0.2	1.3 (0.8-2.2)
Postgraduate qualification	510	477	33	6.5		1.0 (ref.)		1.0 (ref.)
Missing	10							

Table 6-22 Multivariable logistic analysis assessing risk factors for combined anterior and posterior PPGP in early/mid pregnancy

Factors	Number of participants	No combined PPGP	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Employment status	**n=1470**	**n=1340**	**n=130**	**%**				
Working	1315	1207	108	8.2		1.0 (ref.)		1.0 (ref.)
Not working	155	133	22	14.2	0.01	1.8 (1.1-3.0)	0.2	1.5 (0.8-2.8)
Missing	8							
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=1470**	**n=1341**	**n=129**					
No	790	739	51	6.5		1.0 (ref.)		1.0 (ref.)
Yes	680	602	78	11.5	0.001	1.9 (1.3-2.7)	0.006	1.8 (1.2-2.6)
Missing	8							
History of heavy periods	**n=1471**	**n=1342**	**n=129**	**%**				
No	1286	1187	99	7.7		1.0 (ref.)		1.0 (ref.)
Yes	185	155	30	16.2	<0.001	2.3 (1.5-3.6)	0.6	1.1 (0.7-1.8)
Missing	7							
History of severe period pain	**n=1473**	**n=1344**	**n=129**	**%**				
No	989	917	72	7.3		1.0 (ref.)		1.0 (ref.)
Yes	484	427	57	11.8	0.004	1.7 (1.2-2.5)	0.04	1.8 (1.0-3.2)
Missing	5							
History of anxiety	**n=1468**	**n=1342**	**n=126**	**%**				
No	1344	1235	109	8.1		1.0 (ref.)		1.0 (ref.)
Yes	124	107	17	13.7	0.04	1.8 (1.0-3.1)	0.3	1.4 (0.8-2.6)
Missing	10							

Table 6-23 Multivariable logistic analysis assessing risk factors for combined anterior and posterior PPGP in early/mid pregnancy - continued

6.5.2 Multivariable analysis assessing risk factors for PPGP in the last month of pregnancy

6.5.2.1 Multivariable analysis assessing risk factors for any PPGP in the last months of pregnancy

The model contained the variables; age, educational level, a history of any lumbopelvic pain in the year before pregnancy, a history of severe period pain, a history of anxiety, a history of depressive feelings/low mood, and smoking. The Omnibus Test of Model Coefficients was statistically significant (X^2=86.5, df=10, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=11.7, df=8, p=0.167) (Table 6-24 and Table 6-25).

Women aged 35 or older were less likely to experience PPGP in the last month of pregnancy (OR 0.4, 95% CI 0.2-0.8, p=0.04). Women with a history of any lumbopelvic pain in the year before pregnancy were more likely to have PPGP in the last month of pregnancy (OR 2.6, 95% CI 2.0-3.4, p<0.001). The other factors in the model were no longer significantly associated with PPGP in the last month of pregnancy, even though they were significant in univariate analysis.

Factors	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Age (years)	**n=1175**	**n=357**	**n=818**	**%**				
18-24	78	13	65	83.3		1.0 (ref.)		1.0 (ref.)
25-29	282	73	199	73.2	0.07	0.5 (0.3-1.0)	0.3	0.7 (0.3-1.3)
30-34	516	157	359	39.6	0.01	0.5 (0.2-0.9)	0.1	0.6 (0.3-1.1)
≥35	309	114	195	63.1	0.001	0.3 (0.2-0.6)	0.01	0.4 (0.2-0.8)
Missing	6							
Educational level	**n=1172**	**n=356**	**n=816**	**%**				
No formal education/primary/lower secondary/upper secondary	277	68	209	75.5	0.02	1.5 (1.1-2.0)	0.5	1.1 (0.8-1.6)
University degree or equivalent/postgraduate	895	288	608	67.8		1.0 (ref.)		1.0 (ref.)
Missing	9							
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=1169**	**n=354**	**n=815**	**%**				
No	620	247	373	60.2		1.0 (ref.)		1.0 (ref.)
Yes	549	107	442	80.5	<0.001	2.7 (2.1-3.6)	<0.001	2.6 (2.0-3.4)
Missing	12							

Table 6-24 Multivariable logistic analysis assessing risk factors for PPGP in the last month of pregnancy

Factors	Number of participants	No PPGP	Any PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
History of severe period pain	**n=1173**	**n=356**	**n=817**	**%**				
No	799	261	538	67.3		1.0 (ref.)		1.0 (ref.)
Yes	374	95	279	74.6	0.01	1.4 (1.1-1.9)	0.4	1.1 (0.8-1.5)
Missing	8							
History of anxiety	**n=1169**	**n=354**	**n=815**	**%**				
No	1068	337	731	68.4		1.0 (ref.)		1.0 (ref.)
Yes	101	17	84	83.2	0.003	2.3 (1.3-3.9)	0.1	1.6 (0.9-2.9)
Missing	12							
History of depression	**n=1172**	**n=355**	**n=817**	**%**				
No	1000	321	679	67.6		1.0 (ref.)		1.0 (ref.)
Yes	174	34	138	80.2	0.001	1.9 (1.3-2.9)	0.08	1.4 (1.0-2.3)
Missing	9							
Smoking	**n=1161**	**n=352**	**n=809**	**%**				
Smoking	69	14	55	79.7	0.04	1.9 (1.0-3.5)	0.4	1.4 (0.7-2.7)
Stopped smoking before pregnancy or when found out being pregnant	436	122	314	72.0	0.08	1.3 (1.0-1.6)	0.1	1.2 (0.9-1.6)
Not smoking	656	216	440	67.1		1.0 (ref.)		1.0 (ref.)
Missing	20							

Table 6-25 Multivariable logistic analysis assessing risk factors for PPGP in the last month of pregnancy - continued

6.5.2.2 Multivariable analysis assessing risk factors for posterior PPGP in the last months of pregnancy

Only two factors were significantly associated with posterior PPGP in the last month of pregnancy (BMI and a history of any lumbopelvic pain in the year before pregnancy) and were included in the multivariable model. The Omnibus Test of Model Coefficients was statistically significant (X^2=36.0, df=4, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=4.0, df=4, p=0.109) (Table 6-26).

Women with a history of any lumbopelvic pain in the year before pregnancy were more likely to experience posterior PPGP in the last month of pregnancy (OR 2.0, 95% CI 1.6-2.5, p<0.001). BMI was not significantly associated with posterior PPGP.

Factors	Number of participants	No posterior PPGP	Posterior PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	N	n	n	%				
BMI	**n=1094**	**n=618**	**n=476**	**%**				
Underweight	44	32	12	27.3	0.02	0.5 (0.2-0.9)	0.06	0.5 (0.3-1.0)
Ideal	740	406	334	45.1		1.0 (ref.)		1.0 (ref.)
Overweight	196	114	82	41.8	0.4	0.9 (0.6-1.2)	0.3	0.8 (0.6-1.2)
Obese/very obese	114	66	48	42.1	0.5	0.9 (0.6-1.3)	0.5	0.9 (0.6-1.3)
Missing	87							
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=1169**	**n=657**	**n=512**	**%**				
No	620	398	222	35.8		1.0 (ref.)		1.0 (ref.)
Yes	549	259	290	52.8	<0.001	2.0 (1.6-2.5)	<0.001	2.0 (1.6-2.5)
Missing	12							

Table 6-26 Multivariable logistic analysis assessing risk factors for posterior PPGP in the last month of pregnancy

6.5.2.3 Multivariable analysis assessing risk factors for combined anterior and posterior PPGP in the last months of pregnancy

The model contained the variables; age, BMI, marital status, a history of any lumbopelvic pain in the year before pregnancy, a history of severe period pain, history of depressive feelings/low mood, and smoking. The Omnibus Test of Model Coefficients was statistically significant (X^2=47.7, df=14, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=8.7, df=8, p=0.371) (Table 6-27 and Table 6-28).

Compared to women aged 18-24, women who were between 30 and 34 years (OR 0.4, 95% CI 0.2-0.8, p=0.01) and women aged 35 or older (OR 0.4, 95% CI 0.2-0.7, p=0.003) were less likely to experience combined anterior and posterior PPGP in the last month of pregnancy. On the other hand, obese and very obese women (OR 1.8, 95% CI 1.1-2.8, p=0.01) and women who were underweight (OR 2.2, 95% CI 1.1-4.4, p=0.02) were more likely to have combined anterior and posterior PPGP. A history of any lumbopelvic pain in the year before pregnancy was also a significant risk factor for combined PPGP in the last month of pregnancy (OR 1.4, 95% CI 1.1-1.9, p=0.02). Marital status, a history of severe period pain, a history of depressive feelings/low mood, and smoking, were variables that were significant in univariate analysis but not in the multivariable model.

Factors	Number of participants	No combined PPGP	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	N	n	%				
Age (years)	**n=1175**	**n=924**	**n=251**	**%**				
18-24	78	49	29	37.2		1.0 (ref.)		1.0 (ref.)
25-29	272	206	66	24.3	0.03	0.5 (0.3-0.9)	0.06	0.5 (0.3-1.0)
30-34	516	416	100	19.4	0.001	0.4 (0.2-0.7)	0.01	0.4 (0.2-0.8)
≥35	309	253	56	18.1	<0.001	0.4 (0.2-0.6)	0.003	0.4 (0.2-0.7)
Missing	6							
BMI	**n=1094**	**n=861**	**n=233**	**%**				
Underweight	44	30	14	31.8	0.04	2.0 (1.1-3.9)	0.02	2.2 (1.1-4.4)
Ideal	740	601	139	18.6		1.0 (ref.)		1.0 (ref.)
Overweight	196	151	45	23.0	0.2	1.3 (0.9-1.9)	0.2	1.2 (0.9-1.9)
Obese/very obese	114	79	35	30.7	0.003	1.9 (1.2-3.0)	0.01	1.8 (1.1-2.8)
Missing	87							
Marital status	**n=1173**	**n=922**	**n=251**	**%**				
Married	748	607	141	18.9		1.0 (ref.)		1.0 (ref.)
Single	37	28	9	24.3	0.4	1.4 (0.6-3.0)	0.9	1.0 (0.4-2.4)
Living with partner	310	227	83	26.8	0.004	1.6 (1.2-2.1)	0.06	1.4 (1.0-2.0)
In a relationship - not living together	78	60	18	23.1	0.4	1.3 (0.7-2.3)	0.3	0.7 (0.3-1.4)
Missing	8							

Table 6-27 Multivariable logistic analysis assessing risk factors for combined anterior and posterior PPGP in the last month of pregnancy

Factors	Number of participants	No combined PPGP	Combined anterior & posterior PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=1169**	**n=919**	**n=250**	**%**				
No	620	507	113	18.2		1.0 (ref.)		1.0 (ref.)
Yes	549	412	137	25.0	0.005	1.5 (1.1-2.0)	0.02	1.4 (1.1-1.9)
Missing	12							
History of severe period pain	**n=1173**	**n=923**	**n=250**	**%**				
No	799	647	152	19.0		1.0 (ref.)		1.0 (ref.)
Yes	374	276	98	26.2	0.01	1.5 (1.1-2.0)	0.3	1.2 (0.9-1.6)
Missing	8							
History of depressive feelings/low mood	**n=1172**	**n=922**	**n=250**	**%**				
No	1000	797	203	20.3		1.0 (ref.)		1.0 (ref.)
Yes	172	125	47	27.3	0.04	1.5 (1.0-2.1)	0.2	1.3 (0.9-2.0)
Missing	9							
Smoking	**n=1161**	**n=913**	**n=248**	**%**				
Smoking	69	47	22	31.9	0.01	2.1 (1.2-3.6)	0.3	1.5 (0.8-2.8)
Stopped smoking before pregnancy or when found out being pregnant	436	331	105	24.1	0.03	1.4 (1.0-1.9)	0.06	1.4 (1.0-1.9)
Not smoking	656	535	121	18.4		1.0 (ref.)		1.0 (ref.)
Missing	20							

Table 6-28 Multivariable logistic analysis assessing risk factors for combined anterior and posterior PPGP in the last month of pregnancy - continued

6.6 Discussion: Prevalence of and risk factors for PPGP

The prevalence of PPGP in this study and the potential risk factors that were examined are discussed in the context of existing literature in sections 6.6.1 and 6.6.2. When making these comparisons, it is important to bear in mind that this study only included first-time mothers. Very few existing studies conducted subgroup analysis according to parity, yet, the nine studies included in the systematic review (Chapter 3) that examined parity as a risk factor, all found that women who already had a child were more likely to have PPGP in subsequent pregnancies, in univariate analysis. Three of the five studies that conducted multivariable analysis also found parity to be a significant risk factor for PPGP.

6.6.1 Discussion of the prevalence of PPGP in this study in the context of previous studies

The prevalence of PPGP in the literature varies widely (Appendix 1). In this study, the period prevalence of PPGP was 60.1% (n=886) in early/mid pregnancy and 69.7% (n=821) in the last month of pregnancy. Endresen (1995) reported a 42.4% (n=2306) PPGP period prevalence that started at any time during pregnancy in cohort of 5438 women in Norway. This was collected retrospectively after the birth and a direct question was used on whether or not women had experienced PPGP during pregnancy instead of a pain diagram, which may be why the prevalence was lower than in this study. In a Danish study, Larsen *et al.* (1999) found a much lower prevalence of PPGP of only 14% (n=224) in a cohort of 1600 women, but the criteria for PPGP included; having pain on at least two of five daily activities and positive clinical tests. Another study in Denmark reported a prevalence of 23% (n=405) (Albert *et al.* 2002). This study included a physical examination in the assessment of PPGP and it assessed the point prevalence at 33 weeks gestation (not period prevalence), which may, in part, explain the discrepancy with this study. A more recent study in Sweden, which also included a questionnaire and physical examination in assessing for PPGP, found a point prevalence in early pregnancy (12-18 weeks) of 33% (n=99) (Gutke *et al.* 2007). Granath *et al.* (2006) reported a similar point prevalence of 25% (n=98) in 390 women with an average

gestation of 19 weeks, and Mousavi *et al.* (2007) found a point prevalence of 28% (n=91) in 325 women between 12 and 36 weeks gestation, with both studies including a questionnaire and physical examination in their assessment.

The point prevalence of PPGP in a large Norwegian, questionnaire-based cohort study was 21.1% (n=15491) at 17 weeks gestation and 58% (n=41241) at 30 weeks gestation (Bjelland *et al.* 2013b). Similarly, Gjestland *et al.* (2013) found a point prevalence of 51.7% (n=1423) at 32 weeks gestation. In a cross-sectional study, Al-Sayegh *et al.* (2012) reported a PPGP point prevalence of 15.8% (n=44), but this did not include the 81 women (29%) who had PPGP as well as PLBP, and women were in any trimester of pregnancy when completing the questionnaire. Pierce *et al.* (2012) found a slightly higher PPGP point prevalence of 22% (n=21) in a small cohort of 99 women in their third trimester of pregnancy, and 32% (n=32) had PGPP and PLBP. Malmqvist *et al.* (2012) reported a PPGP period prevalence during pregnancy of 26% (n=313), but again, an additional 21.6% (n=260) had PPGP and PLBP. In a Spanish cohort of 1158 women of at least 28 weeks gestation, Kovacs *et al.* (2012) found a 64.7% 4-week period prevalence of PPGP. This is comparable to the 69.7% (n=821) PPGP period prevalence in the last month of pregnancy in this study. The increasing point prevalence of PPGP with gestational age observed by Eggen *et al.* (2012) in 257 women in Norway (from 18% at 20 weeks to 51% at 36 weeks), and by Brown & Johnston (2013) in 580 women in the UK (from 12% in first trimester to 79.9% in the 3rd trimester), was also apparent in this study with a PPGP period prevalence for early/mid pregnancy of 60.1% (n=886) and 69.7% (n=821) in the last month of pregnancy. Stomp-van den Berg *et al.* (2012) reported a similarly high PPGP prevalence of 73% at 33 weeks gestation.

Concerning sub-outcomes of PPGP, Ostgaard *et al.* (1996) reported a prevalence of posterior PPGP of 34% between 20 and 29 weeks gestation in 363 women in Sweden. This is slightly lower than the prevalence of posterior PPGP in early/mid pregnancy in this study (48.9%; n=722), probably because the period prevalence was from the start of pregnancy in this study. Moreover, Ostgaard *et al.* (1996) included a physical

examination to assess for PPGP. Bjorklund & Bergstrom (2000) assessed the prevalence in four countries (Sweden, Tanzania, Finland and Zanzibar; n=752) and found that between 23-39% of women reported symphyseal pain during pregnancy. This is much higher than the 2.3% (n=34) and 4.5% (n=53) of women that reported anterior PPGP in early/mid pregnancy and the last month of pregnancy in this study, but Bjorklund & Bergstrom (2000) examined the period prevalence from the start of pregnancy until 35-37 weeks gestation or postpartum, depending on the study site. Robinson *et al.* (2006) found a 46% (n=843) PPGP period prevalence during pregnancy, with 19% having anterior PPGP, 14% posterior PPGP and 9% combined anterior and posterior PPGP. Although the period prevalence of combined PPGP in early/mid pregnancy was similar in this study (8.8%; n=130), posterior PPGP (48.9%; n=722) was more common, and anterior PPGP (2.3%; n=34) was less common in this study. However, data was collected retrospectively in Robinson *et al.* (2006) with some women having to remember years back. In a more recent prospective study including 283 women, 52% (n=147) had PPGP and 25% (n=71) had both PPGP and PLBP at 33 weeks gestation, based on a questionnaire and physical examination, with 5% (n=15) having anterior PPGP, 35% posterior PPGP, and 19% combined anterior and posterior PPGP (Robinson *et al.* 2010a).

In a very large cohort of 91721 women, 14.8% reported pelvic girdle syndrome in the third trimester of pregnancy (Bjelland *et al.* 2013a), compared to 18.2% (n=113) of women with combined anterior and posterior PPGP in the last month of pregnancy in this study. Pelvic girdle syndrome is defined as pain in both sacroiliac joints and the pubic symphysis, whereas combined anterior and posterior PPGP also includes women with one-sided sacroiliac and pubic symphysis pain. Malmqvist *et al.* (2012) reported a period prevalence during pregnancy of 15.4% (n=186) for pelvic girdle syndrome, 9.2% (n=111) for anterior PPGP, and 19.6% (n=236) for posterior PPGP, but this only included women with moderate to severe pain. Mens *et al.* (2012b) found a seven-day prevalence of 3.3% (n=6) for anterior PPGP, 36.8% (n=67) for posterior PPGP, and 9.9% (n=18) for combined anterior and posterior PPGP in 182 women between 20 and 30 weeks gestation. Even though the prevalence of posterior PPGP in

this study was higher, this is likely to be due to the longer period included, compared to only seven days in Mens *et al.* (2012b). Finally, Filipec & Jadanec (2013) reported a 38.8% incidence of sacroiliac dysfunction (posterior PPGP) in a cohort of 600 women in Croatia, with an incidence of only 6.5% in the first trimester, increasing to 32% in the second trimester and 78% in the third trimester. In this study, the prevalence of any PPGP in women with no history of any low back or pelvic girdle pain in the year before pregnancy, was 42% (n=337) in early/mid pregnancy and 60.2% (n=373) in the last month of pregnancy, which is comparable since it includes also women with anterior or combined PPGP and the last month of pregnancy does not cover the whole third trimester.

Despite the great variation in prevalence reported in the different studies, when examining the context of the methods of PPGP assessment, the time of follow-up, and whether point or period prevalence was assessed, this variation is plausible.

The prevalence of PPGP in the hospital records was very low (5.8%; n=78) compared to the self-reported prevalence in the surveys of 60.1% (n=886) in early/mid pregnancy and 69.7% (n=821) in the last month of pregnancy. The criteria for PPGP to be recorded in the hospital records are not clear. This low prevalence may be, in part, due to women not reporting their symptoms to the healthcare professionals involved in their care or the healthcare professional not enquiring after or recording PPGP symptoms (Chapter 7, Section 7.3.3).

6.6.2 Discussion of the risk factors for PPGP identified in this study in the context of the systematic review (Chapter 3)

In this section, the findings of 16 potential risk factors that were examined in this study are compared to the data from the systematic review on risk factors for PPGP (Chapter 3).

Women aged 35 years or older were less likely to experience any PPGP, posterior PPGP or combined anterior and posterior PPGP in early/ pregnancy. Women aged 30 years or older were also less likely to have any PPGP or combined anterior and posterior PPGP in the last month of pregnancy. This is consistent with the findings of four of eight studies included in the systematic review that examined age as a risk factor (Appendix 17). The finding that older women are at lower risk of, in particular, combined anterior and posterior PPGP, supports the results from Bjelland *et al.* (2010), who found that pelvic girdle syndrome and severe pelvic girdle syndrome were less common in women over 35 in a sample of 75955 women. However, women over 35 in this study were more likely to experience anterior PPGP in early/mid pregnancy. Klemetti *et al.* (2011) examined the association between age and symphysis pubis dysfunction during pregnancy and found that multiparous women over 35 had a lower risk. However, only nulliparous women took part in the present study, which may, in part, explain this discrepancy, but further analysis with a larger sample is needed to explore this further.

In this study, being obese or very obese (BMI≥30) was significantly associated with an increased risk of any PPGP and combined anterior and posterior PPGP in early/mid pregnancy, and of combined anterior and posterior PPGP in the last month of pregnancy. This supports existing studies included in the systematic review, of which six studies that conducted multivariable analysis all found a positive association between high BMI and PPGP (Appendix 16). The strong association between obesity and combined anterior and posterior PPGP supports the findings of Bjelland *et al.* (2010), who found that obese women were more likely to have pelvic girdle syndrome in the third trimester of pregnancy.

A history of any lumbopelvic pain in the year before pregnancy was strongly associated with PPGP in early/mid pregnancy and the last month of pregnancy. In the systematic review, two studies examined any history of low back pain as a risk factor, two examined any history of low back pain not related to pregnancy, two examined low back pain in previous pregnancies, and two examined pelvic girdle pain in previous pregnancies

(Appendix 16 and 25). These factors were all significantly associated with an increased risk of PPGP. Malmqvist *et al.* (2012) also found a positive association between low back pain and pelvic girdle pain in the year before pregnancy and moderate to severe PPGP any time during pregnancy.
A history of injury to the back was associated with any PPGP and posterior PPGP in early/mid pregnancy, in univariate analysis. This factor was not included in the multivariable models because of collinearity with a history of lumbopelvic pain. One study in the systematic review found a positive association between a history of trauma to the back and PPGP (Albert *et al.* 2006) (Appendix 21). This factor requires further investigation to draw any strong conclusions, but it is plausible that injury/trauma to the back may impact lumbopelvic functional stability, leading to increased vulnerability to develop PPGP.

Women's ethnic background was associated with combined anterior and posterior PPGP in univariate analysis with women of black/African background having a greater risk compared to women of white background; however, the small number of women in some categories led to violation of the assumptions. One study in the systematic review compared Pakistani to Norwegian women and found that they were less likely to have PPGP, but no adjustment for confounders was done (Vangen *et al.* 1999) (Appendix 26).

Women's educational level was not a significant risk factor for PPGP in this study. In the systematic review, four studies examined education level as a potential risk factor, of which three found women with a lower education to be more at risk of PPGP (Appendix 17). Only one of the studies (Bjelland *et al.* 2010) conducted multivariable analysis and found that women with a lower education were more likely to experience pelvic girdle syndrome. In this study, having no university qualification was associated with combined anterior and posterior PPGP in univariate analysis, but not in multivariable analysis. However, Bjelland *et al.* (2010) involved a much larger sample (n=75955), and thus, had increased power to detect smaller effects.

Employment status was not associated with PPGP in the multivariable analyses in this study. Similarly, Larsen *et al.* (1999) did not find an association between 'being in work', 'working part-time', 'shiftwork' or 'having a fixed salary', and PPGP. Wergeland & Strand (1998) also found that women doing 35 hours or more, or 40 hours or more, of paid work per week were not more or less likely to have PPGP during pregnancy. Finally, Endresen (1995) reported no significant association between PPGP and being permanently employed (Appendix 26).

Marital status was not associated with PPGP in the multivariable analysis in this study. Larsen *et al.* (1999) also found that living with or being married to a partner was not a significant risk factor for PPGP (Appendix 26).

A history of anxiety was not associated with PPGP in the multivariable models in this study. In contrast, Kovacs *et al.* (2012) found a positive association between anxiety and PPGP in the third trimester (Appendix 22). However, in the present study, a history of anxiety was obtained by asking women the question whether or not they had experienced 'intense anxiety (such as panic attacks)', whereas Kovacs *et al.* (2012) used the state-trait anxiety inventory to assess anxiety, which is a 40-item questionnaire. The latter is likely to provide a more comprehensive and accurate assessment of anxiety, although no multivariable analysis was conducted to adjust for potential confounders.

A history of depressive feelings, low mood or feeling sad was not associated with PPGP in multivariable analyses. Kovacs *et al.* (2012) found a positive association between slight and moderate depression and PPGP, but serious depression was not a significant risk factor for PPGP compared to no depression (Appendix 22). In the present study, this variable was assessed by asking women if they had experienced 'feeling depressed, low mood or sad (lasting two weeks or more)'. Kovacs *et al.* (2012) used the Beck Depression Inventory, which gives a score from 0 to 63 and classifies people in categories according to severity, giving a more accurate assessment of depression. However, as for anxiety, they did not adjust for confounders in the analysis.

Smoking was not associated with PPGP in the multivariable models in this study. The seven studies in the systematic review that examined the association between smoking and PPGP had conflicting results, although the majority (5/7) found smoking to be a significant risk factor for PPGP or any of its sub-outcomes (Appendix 16). Bjelland *et al.* (2010) found daily, but not occasional, smokers to be at increased risk of pelvic girdle syndrome in multivariable analysis. Smoking was significantly associated ($p \leq 0.05$) with combined anterior and posterior PPGP in univariate analysis in this study, but not in multivariable analysis. It may be that the larger sample and thus increased power in Bjelland *et al.* (2010) allowed for a smaller effect to be detected. Moreover, combined anterior and posterior PPGP included some women who would not fit the definition of pelvic girdle syndrome, which may also contribute to this finding. In addition, smoking quantity was not taken into account in this study.

A history of heavy periods and a history of severe period pains had not yet been examined in any previous studies in relation to PPGP. In this study, both factors were not significantly associated with PPGP. In the systematic review, one study examined the association between diabetes mellitus and symphysiolysis (Lebel *et al.* 2010), and one study assessed the relation between diabetes and pelvic girdle syndrome. Both studies found that diabetes was a significant risk factor (Appendix 25). Unfortunately, this association could not be examined in this study due to the small number of women with diabetes in the sample. Similarly, too few women had had surgery to the back to examine the association with PPGP. No studies included in the systematic review investigated this factor.

It was not appropriate to pool the findings of this study with any of the studies included in the systematic review because of differences in risk factor measurement and whether or not it was related to previous pregnancies, differences in outcomes in terms of severity and any PPGP sub-outcomes examined, and different times of follow-up.

6.7 Prevalence of persistent PPGP postpartum

6.7.1 Self-reported prevalence of Persistent PPGP

This section reports the self-reported prevalence of persistent PPGP in the four postpartum follow-up periods. For women to be categorised as having 'persistent' PPGP they had to have had PPGP during pregnancy and reported persistent symptoms at each follow-up survey postpartum. A total of 816 women with PPGP during pregnancy were followed up four times postpartum. PPGP during pregnancy was defined as pain in the pelvic girdle area on the pain diagram during early (survey 1) and in the last month of pregnancy (survey 2 retrospectively collected), or, during late but not early pregnancy. Women who reported PPGP in early pregnancy but not in the last month of pregnancy were not included in the 'PPGP group' for postpartum follow-up because symptoms resolved during pregnancy. Women who reported PPGP in early pregnancy (survey 1) but did not complete survey 2, or data of the last month of pregnancy was missing, were included in the PPGP group. Findings are presented also by pain location (anterior, posterior, combined anterior and posterior PPGP), which refers to the pain location at that particular follow-up; for example, a women with persistent anterior PPGP 3-6 months postpartum means that she reported anterior PPGP in survey 3 in addition to reporting any PPGP during pregnancy and 0-3 months postpartum. Women who became pregnant again were excluded from any further follow-up data. Figure 6-2 provides an overview of the women included in postpartum follow-up. Figure 6-3 summarises the prevalence of persistent PPGP at the four postpartum follow-up periods of this study, which is outlined in detail in Table 6-29 to Table 6-32.

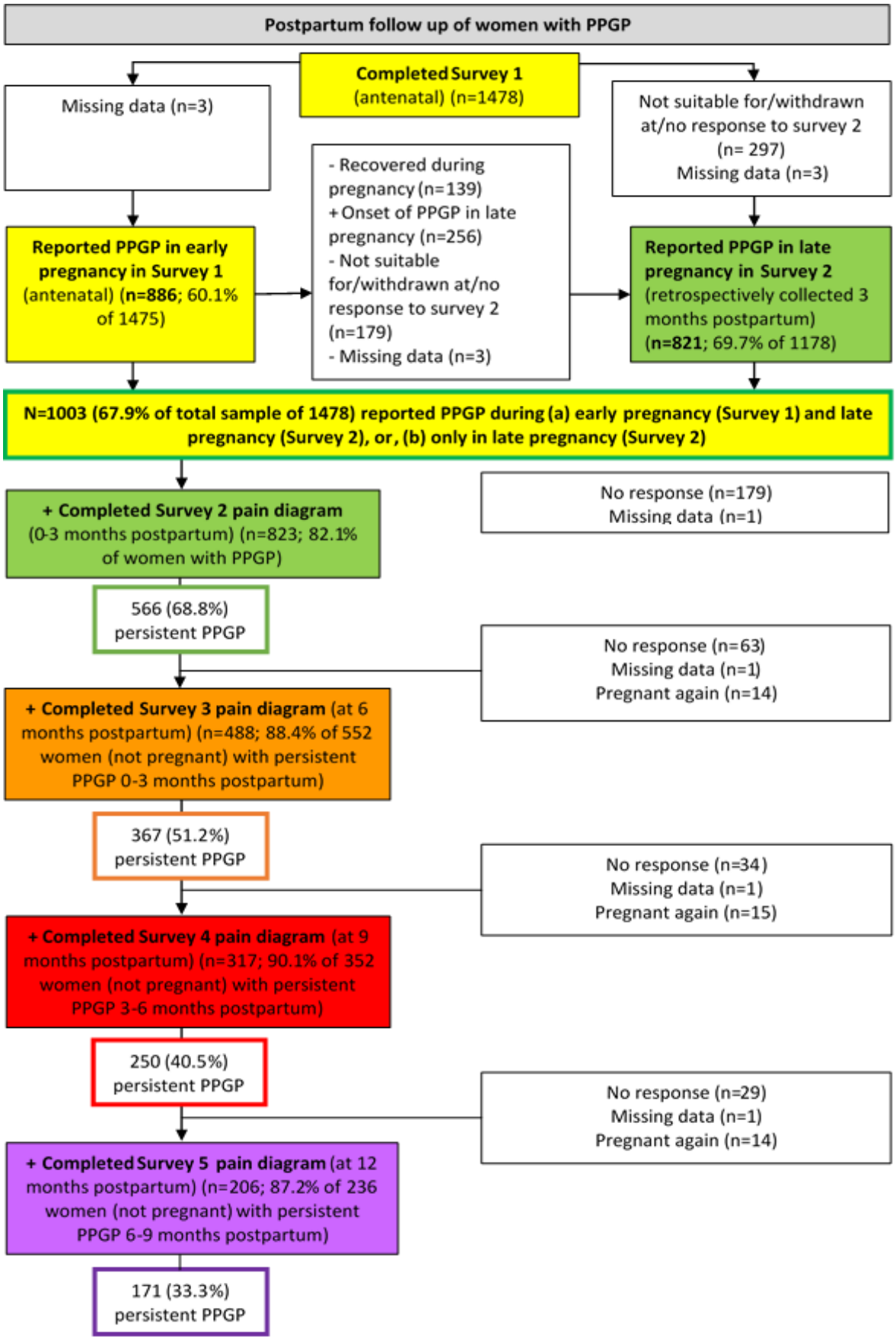

Figure 6-2 Flow chart of postpartum retention rate of the women who reported PPGP

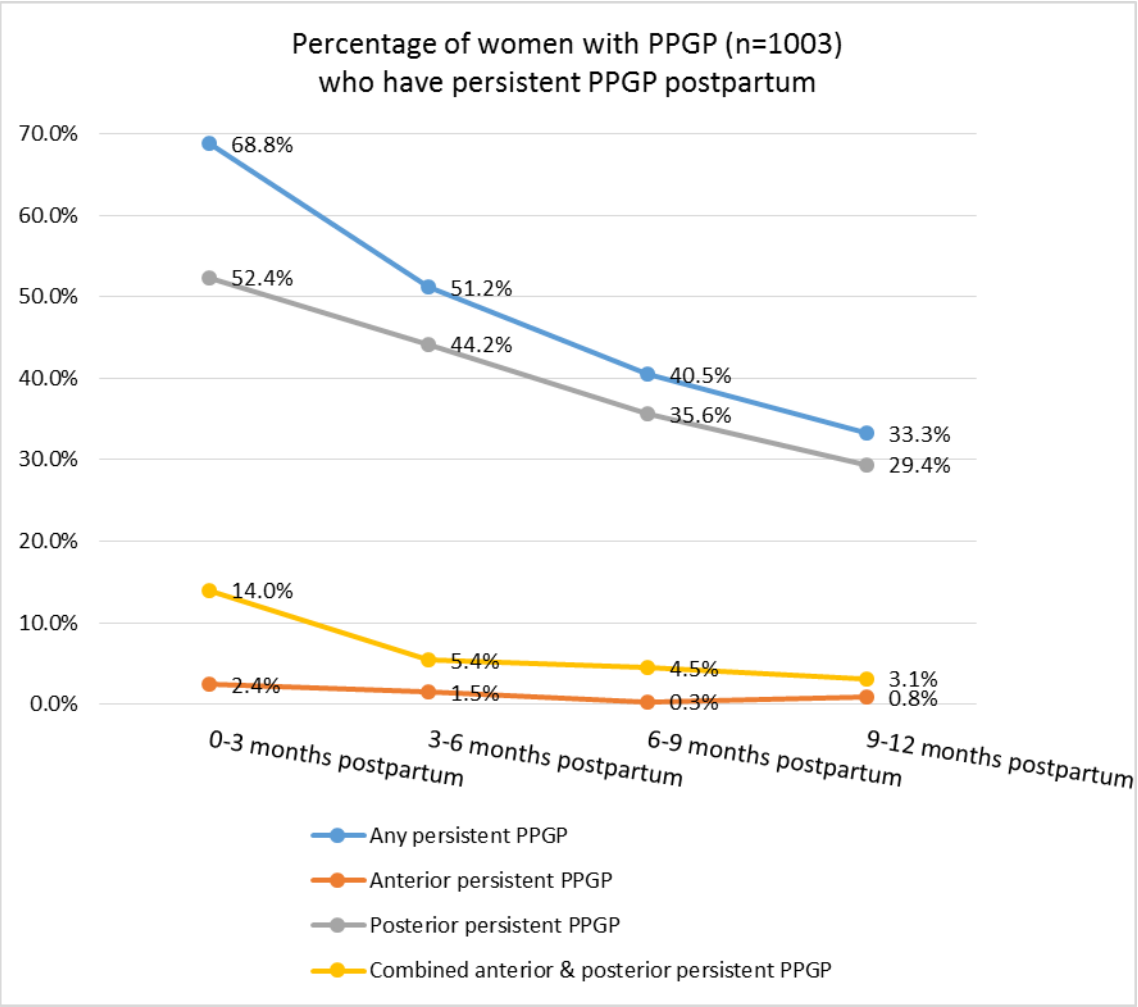

Figure 6-3 Percentage of women with PPGP who continue to have persistent symptoms postpartum at four postpartum follow-up points

6.7.1.1 Prevalence of persistent PPGP 0-3 months postpartum

The majority (68.8%; n=566) of women who had PPGP during pregnancy continued to have persistent symptoms in the initial three months after the birth (Table 6-29). For women who did not have a history of low back and/or pelvic girdle pain in the year before pregnancy, the percentage of women who did not recover was lower (51.9%; n=221).

Prevalence of persistent PPGP 0-3 months postpartum									
	Any persistent PPGP		Anterior persistent PPGP		Posterior persistent PPGP		Combined anterior & posterior persistent PPGP		Missing
	n=823*	**%**	**n=823***	**%**	**n=823***	**%**	**n=823***	**%**	
All women	566	68.8	20	2.4	431	52.4	115	14.0	1
	n=374**	**%**	**n=374****	**%**	**n=374****	**%**	**n=374****	**%**	
Women with no low back and/or pelvic girdle pain in the year before becoming pregnant	221	59.1	11	2.9	170	45.5	40	10.7	3

*Of the 1003 women who had PPGP in pregnancy, 179 did not return Survey 2 (0-3 months postpartum), and one woman did not complete the pain diagram in Survey 2 (missing), giving a sample of 823 (82.1%).

**Of the 823 women with PPGP in pregnancy, 374 (45.4%) had no history of low back and/or pelvic girdle pain in the year before pregnancy

Table 6-29 Prevalence of persistent PPGP 0-3 months postpartum

6.7.1.2 Prevalence of persistent PPGP 3-6 months postpartum

Between three and six months postpartum a further 17.6% of women with PPGP during pregnancy recovered, with 51.2% (n=367) continuing to have persistent symptoms (Table 6-30). Similarly, of the women with PPGP who did not have any low back and/or pelvic girdle pain in the year before pregnancy, a further 18.2% recovered and 40.9% (n=138) had persistent PPGP.

Prevalence of persistent PPGP 3-6 months postpartum													
	Any persistent PPGP			Anterior persistent PPGP			Posterior persistent PPGP			Combined anterior & posterior persistent PPGP			Missing
	n	% (n=488*)	% (n=717^)	n	% (n=488*)	% (n=717^)	n	% (n=488*)	% (n=717^)	n	% (n=488*)	% (n=717^)	
All women (n=488*)	367	75.2	51.2	11	2.3	1.5	317	65.0	44.2	39	8.0	5.4	1
	n	**% (n=198**)**	**% (n=337†)**	**n**	**% (n=198**)**	**% (n=337†)**	**n**	**% (n=198**)**	**% (n=337†)**	**n**	**% (n=198**)**	**% (n=337†)**	
Women with no low back and/or pelvic girdle pain in the year before becoming pregnant (n=198)**	138	69.7	40.9	7	3.5	2.1	117	59.1	34.7	14	7.1	4.2	0

*Of the 566 women who reported persistent PPGP 0-3 months postpartum (Survey 2), 14 became pregnant again, 63 did not return Survey 3 and one woman did not completed the pain diagram in Survey 3 (missing), giving a sample of 488 (88.4% of 552 eligible women).

**Of the 552 women who reported persistent PPGP 0-3 months postpartum (Survey 2) and were not pregnant again, 216 had no history of low back and/or pelvic girdle pain of whom 198 (91.7%) returned Survey 3.

^Of the 823 women with PPGP who completed Survey 2, 19 became pregnant again, 86 did not return Survey 3, and one did not complete the pain diagram in Survey 3, giving a sample of 717 (89.2% of 804 eligible women).

† Of the 374 women with PPGP and no history of low back and/or pelvic girdle pain in the year before pregnancy who completed Survey 2, 6 became pregnant again and 31 did not return Survey 3, giving a sample of 337 (91.6% of 368 eligible women).

Table 6-30 Prevalence of persistent PPGP 3-6 months postpartum

6.7.1.3 Prevalence of persistent PPGP 6-9 months postpartum

Six to nine months after the birth, an additional 10.7% of women with PPGP recovered, with 40.5% (n=250) continuing to have persistent PPGP (Table 6-31). In the group of women with PPGP but no history of low back and/or pelvic girdle pain in the year before pregnancy, a further 15.1% recovered, with 25.8% (n=74) continuing to have symptoms 6 to 9 months postpartum.

Prevalence of persistent PPGP 6-9 months postpartum													
	Any persistent PPGP			Anterior persistent PPGP			Posterior persistent PPGP			Combined anterior & posterior persistent PPGP			Missing
	n	% (n=317*)	% (n=618^)	n	% (n=317*)	% (n=618^)	n	% (n=317*)	% (n=618^)	n	% (n=317*)	% (n=618^)	
All women (n=317*)	250	78.9	40.5	2	0.6	0.3	220	69.4	35.6	28	8.8	4.5	1
	n	% (n=114**)	% (n=287†)	n	% (n=114**)	% (n=287†)	n	% (n=114**)	% (n=287†)	n	% (n=114**)	% (n=287†)	
Women with no low back and/or pelvic girdle pain in the year before becoming pregnant (n=114)**	74	64.9	25.8	1	0.9	0.3	61	53.5	21.2	12	10.5	4.2	0

*Of the 367 women who reported persistent PPGP 3-6 months postpartum (Survey 3), 15 became pregnant again, 34 did not return Survey 4 and one did not completed the pain diagram in Survey 4 (missing), giving a sample of 317 (90.1% of 352 eligible women).

**Of the 352 women who reported persistent PPGP 3-6 months postpartum (Survey 3) and were not pregnant again, 130 had no history of low back and/or pelvic girdle pain of whom 114 (87.7%) returned Survey 4.

^Of the 717 women with PPGP who completed Survey 2 and 3, a further 22 women became pregnant again, 75 did not return Survey 4 and two did not complete the pain diagram in Survey 4, giving a sample of 618 (% of 695 eligible women).

† Of the 337 women with PPGP and no history of low back and/or pelvic girdle pain in the year before pregnancy who completed Survey 2 and 3, a further 12 became pregnant again, and 38 did not return Survey 4, giving a sample of 287 (88.3% of 325 eligible women).

Table 6-31 Prevalence of persistent PPGP 6-9 months postpartum

6.7.1.4 Prevalence of persistent PPGP 9-12 months postpartum

Nine to 12 months postpartum, a further 7.2% of women with PPGP recovered, but 33.3% (n=171) continued to have persistent PPGP (Table 6-32). Even in the group of women with no history of low back and/or pelvic girdle pain in the year before pregnancy, 18.9% (n=45) had persistent symptoms 9 to 12 months after the birth.

Prevalence of persistent PPGP 9-12 months postpartum													
	Any persistent PPGP			Anterior persistent PPGP			Posterior persistent PPGP			Combined anterior & posterior persistent PPGP			Missing
	n	% (n=206*)	% (n=514^)	n	% (n=206*)	% (n=514^)	N	% (n=206*)	% (n=514^)	n	% (n=206*)	% (n=514^)	
All women (n=206*)	171	83.0	33.3	4[††]	1.9	0.8	151	73.3	29.4	16	7.8	3.1	1
	n	**% (n=60**)**	**% (n=238[†])**	**n**	**% (n=60**)**	**% (n=238[†])**	**N**	**% (n=60**)**	**% (n=238[†])**	**n**	**% (n=60**)**	**% (n=238[†])**	
Women with no low back and/or pelvic girdle pain in the year before becoming pregnant (n=60)**	45	75.0	18.9	1	1.7	0.4	38	63.3	16.0	6	10.0	2.5	1

*Of the 250 women who reported persistent PPGP 6-9 months postpartum (Survey 4), 14 became pregnant again, 29 did not return Survey 5 and one did not completed the pain diagram in survey 5 (missing), giving a sample of 206 (87.2% of 236 eligible women).

**Of the 236 women who reported persistent PPGP 6-9 months postpartum (Survey 4) and were not pregnant again, 68 had no history of low back and/or pelvic girdle pain of whom 61 returned Survey 4 and 60 (88.2%) had complete data (1 missing).

^Of the 618 women with PPGP who completed Survey 2, 3 and 4, a further 43 women became pregnant again, 56 did not return Survey 5 and five did not complete the pain diagram in Survey 5, giving a sample of 514 (89.3% of 575 eligible women).

[†] Of the 287 women with PPGP and no history of low back and/or pelvic girdle pain in the year before pregnancy who completed Survey 2, 3 and 4, a further 26 women became pregnant again, 20 did not return Survey 5 and three woman did not complete the pain diagram in survey 5, giving a sample of 238 (91.2% of 261 eligible women).

[††] This prevalence of persistent PPGP 9-12 months postpartum (n=4) is higher than the prevalence of persistent PPGP 6-9 months postpartum (n=1; Table 6-31) because women might have persistent PPGP with changing pain location.

Table 6-32 Prevalence of persistent PPGP 9-12 months postpartum

6.7.2 Self-reported severity of symptoms and activity limitation related to persistent PPGP measured by the Pelvic Girdle Questionnaire

6.7.2.1 Self-reported severity of symptoms and activity limitation related to persistent PPGP 6-9 months postpartum

The mean total score (0-75) on the Pelvic Girdle Questionnaire (PGQ) for the 239 women who reported persistent PPGP 6 to 9 months postpartum and completed the PGQ (11 missing) was 15.4 (SD 11.4) (Table 6-33). The highest score was 65, and five women had a total score of zero even though they had reported having had some pain in the pelvic girdle area between 6 and 9 months postpartum on the pain diagram. Possibly, symptoms could have resolved at the time of completing survey 4 and they may have completed the PGQ accordingly (instead of applying it to the past three months as stated in the question). Over two-thirds of women reported a total score (0-75) between one and 29 (Table 6-34). On the symptom subscale, the highest score was 12. Thirteen women had a score of zero (Table 6-35). The symptom subscale includes pain severity in the morning and evening; hence, women experiencing pain only during specific activities may not have reported any pain in the symptom subscale. Just under two-thirds of women scored one to four on the symptom activity scale (0-15). For the activity subscale (0-60), just under 80% (n=191) of women had a score between one and 29 and the highest score was 53 (Table 6-36). The zero activity subscale score for 16 women may, in part, be explained by symptoms that do not impact women's activities.

Pelvic Girdle Questionnaire 6-9 months postpartum	Missing	n	Mean (SD)	Mean (SD) %	Range
PGQ Total score (0-75)	11	239	15.4 (11.4)	20.5 (15.2)	0-65
PGQ Symptom subscale (0-15)	10	240	3.9 (2.6)	26.0 (17.3)	0-12
PGQ Activity subscale (0-60)	7	243	11.3 (9.4)	18.8 (15.7)	0-53

Table 6-33 Mean Pelvic Girdle Questionnaire scores for women with persistent PPGP 6-9 months postpartum

PGQ Total Score (0-75)	n=239	%
Score 0	5	2.1
Score 1-9	75	31.4
Score 10-19	95	39.7
Score 20-29	40	16.7
Score 30-39	13	5.4
Score 40-49	7	2.9
Score ≥50	4	1.7

Table 6-34 Pelvic Girdle Questionnaire total scores for women with persistent PPGP 6-9 months postpartum

PGQ Symptom subscale (0-15)	n=240	%
Score 0	13	5.4
Score 1-4	148	61.7
Score 5-9	68	28.3
Score 10-15	11	4.6

Table 6-35 Pelvic Girdle Questionnaire Symptom subscale scores for women with persistent PPGP 6-9 months postpartum

PGQ Activity subscale (0-60)	n=243	%
Score 0	16	6.6
Score 1-9	112	46.3
Score 10-19	79	32.6
Score 20-29	21	8.7
Score 30-39	10	4.1
Score ≥40	5	2.2

Table 6-36 Pelvic Girdle Questionnaire Activity subscale scores for women with persistent PPGP 6-9 months postpartum

In addition to the Pelvic Girdle Questionnaire, women where asked the extent to which their persistent PPGP caused difficulty lifting and handling their baby. About half of the women (72.2%; n=176) reported that they had difficulty to at least a small extent (Table 6-37).

Difficulty lifting/handling their baby	n=244	%
Not at all	68	27.9
To a small extent	121	49.6
To some extent	48	19.7
To a large extent	7	2.9
Missing	6	

Table 6-37 The extent to which women with persistent PPGP 6-9 months postpartum have difficulty/handling their baby

6.7.2.2 Self-reported severity of symptoms and activity limitation related to persistent PPGP 9-12 months postpartum

The mean total score on the PGQ (0-75) for the 166 women with persistent PPGP 9-12 months postpartum who completed the PGQ (5 missing) was 15.4 (SD 11.8) and the highest score was 58 (Table 6-38). About two-thirds of women had a total score between one and 19 and five women had a score of zero (Table 6-39). On the symptom subscale (0-15), the mean score was 3.8 (SD2.7), with most women having a score between one and four and 13 women scoring zero (Table 6-40). The mean score on the activity subscale (0-60) was 11.5 (SD 9.5), about three-quarters (76.5%) had a score between one and 19, and nine women had a score of zero (Table 6-41). As discussed in section 6.8.2.1, zero scores could be due to resolution of symptoms, having symptoms but no activity limitation, or pain being activity-specific in the absence of pain in the morning or evening. The mean total PGQ scores of women with persistent PPGP 6-9 months postpartum and women with persistent PPGP 9-12 months postpartum, were not significantly different (U=19440; p=0.73).

Pelvic Girdle Questionnaire 9-12 months postpartum	Missing	N	Mean (SD)	Mean (SD) %	Range
PGQ Total score (0-75)	5	166	15.4 (11.8)	20.5 (15.7)	0-58
PGQ Symptom subscale (0-15)	5	166	3.8 (2.7)	25.3 (18.0)	0-12
PGQ Activity subscale (0-60)	5	166	11.5 (9.5)	19.2 (15.8)	0-47

Table 6-38 Mean Pelvic Girdle Questionnaire scores for women with persistent PPGP 9-12 months postpartum

PGQ Total Score (0-75)	n=166	%
Score 0	5	3.0
Score 1-9	57	34.3
Score 10-19	57	34.3
Score 20-29	28	16.9
Score 30-39	9	5.4
Score 40-49	7	4.2
Score ≥50	3	1.8

Table 6-39 Pelvic Girdle Questionnaire total scores for women with persistent PPGP 9-12 months postpartum

PGQ Symptom subscale (0-15)	n=166	%
Score 0	13	7.8
Score 1-4	100	60.2
Score 5-9	46	27.7
Score 10-15	7	4.2

Table 6-40 Pelvic Girdle Questionnaire Symptom subscale scores for women with persistent PPGP 9-12 months postpartum

PGQ Activity subscale (0-60)	n=166	%
Score 0	9	5.4
Score 1-9	78	47.0
Score 10-19	49	29.5
Score 20-29	19	11.4
Score 30-39	8	4.8
Score ≥40	3	1.8

Table 6-41 Pelvic Girdle Questionnaire Activity subscale scores for women with persistent PPGP 9-12 months postpartum

The majority of women had some difficulty lifting/handling their baby (71.7%; n=119) 9-12 months postpartum, although only 4.2% (n=7) had difficulty to a large extent (Table 6-42).

Difficulty lifting/handling their baby	n=166	%
Not at all	47	28.3
To a small extent	79	47.6
To some extent	33	19.9
To a large extent	7	4.2
Missing	5	

Table 6-42 The extent to which women with persistent PPGP 9-12 months postpartum have difficulty/handling their baby

6.8 Health-seeking behaviours of women with Persistent PPGP 6-9 and 9-12 months postpartum

Women with persistent PPGP in survey 4 (6-9 months postpartum) and survey 5 (9-12 months postpartum) also completed questions concerning their health-seeking behaviours related to their persistent PPGP.

6.8.1.1 Health-seeking behaviour of women with Persistent PPGP 6-9 months postpartum

Of the 250 women with persistent PPGP 6 to 9 months postpartum, 245 completed the question regarding pain medication (5 missing) of whom 83 (33.9%; n=83) reported having taken some medication in the prior four weeks. Paracetamol and nurofen/isobrufen were the two most common medications (Table 6-43). 'Other' included biofreeze, voltarol gel, glucosamine gel, heat pads/hot water bottles, and vimovo (naproxen + omeprazole).

Medications	n=83	%	Missing
Paracetamol	57	70.4	2
Paracetamol & codeine	10	12.7	4
Ponstan (mefenamic acid)	9	11.3	3
Difene (Voltarol) taken orally	14	17.5	3
Difene (Voltarol) suppository	1	1.3	5
Nurofen/isobrufen	45	57	4
Aspirin	2	2.5	4
Local anaesthetic gel	8	10.3	5
Other	13	16.7	5

Table 6-43 Medications taken by women with persistent PPGP 6-9 months postpartum

A total of 139 (55.6%) of the 245 women with persistent PPGP 6-9 months postpartum (5 missing) had discussed their symptoms with a healthcare professional, family or friend. The physiotherapist (18.1%; n=25) and GP/local doctor (16.7%; n=23) were the most common healthcare professionals they had talked to (Table 6-44). Other healthcare professionals included a chiropractor (n=2), osteopath (n=2), acupuncturist

(n=1), hipropath[3] (n=1), massage therapist (n=1), pain specialist (n=1), orthopaedic specialist (n=1), personal trainer (n=1), and pilatus instructor (n=1). Under half of the 245 women with persistent PPGP had discussed their symptoms with their partner (44.1%; n=108), who was the person they most commonly had talked to. One women had also discussed her symptoms with her employer ('other').

Discussed persistent PPGP with:	n=139	%	Missing
General practitioner (GP)/local doctor	23	16.7	1
Public health nurse	6	4.3	1
GP practice nurse	4	2.9	1
Obstetrician/Gynaecologist	2	1.4	1
Physiotherapist	25	18.1	1
Other health professional	11	8.0	1
Partner	108	78.3	1
Friend	47	34.1	1
Sister	33	23.9	1
Mother	56	40.6	1
Other	1	0.7	1

Table 6-44 People with whom women with persistent PPGP 6-9 months postpartum had discussed their symptoms with

6.8.1.2 Health-seeking behaviour of women with Persistent PPGP 9-12 months postpartum

A total of 60 (36.1%) of the 166 women with persistent PPGP 9-12 months postpartum who completed the questions regarding health-seeking (5 missing) said they had taken medication to relieve their symptoms in the four weeks before completing survey 5. Paracetamol was most commonly used (67.8%; n=40), followed by nurofen/isobrufen (48.3%; n=28) (Table 6-45). The five women who ticked 'other' had used Voltarol gel (2), heat packs, tramadol and syndol (a combination of paracetamol, codeine, caffeine, doxylamine).

[3]This women wrote that she had seen a 'hipropath'. It is unclear what type of practicioner this is. This might be a typo.

Medication	n=60	%	Missing
Paracetamol	40	67.8	6
Paracetamol & codeine	14	23.7	6
Ponstan (mefenamic acid)	6	10.3	6
Difene (Voltarol) taken orally	8	13.8	6
Difene (Voltarol) suppository	1	1.8	7
Nurofen/isobrufen	28	48.3	7
Aspirin	1	1.8	8
Local anaesthetic gel	9	15.8	7
Other	5	10.2	11

Table 6-45 Medications taken by women with persistent PPGP 9-12 months postpartum

A total of 73 (44.0%) of 171 women with persistent PPGP 9-12 months postpartum ticked that they had discussed their symptoms with a healthcare professional, family member or friend. Similar to the 6-9 months follow-up data (section 6.7.1.1), women most often spoke to their partner about their complaint, and the physiotherapist or GP were the most commonly consulted healthcare professionals (Table 6-46).

Discussed persistent PPGP with:	n=73	%	Missing
General practitioner (GP)/local doctor	8	12.5	5
Public health nurse	2	2.8	5
GP practice nurse	0	0.0	5
Obstetrician/Gynaecologist	1	1.4	5
Physiotherapist	13	19.1	5
Other health professional	5	7.4	5
Partner	57	79.2	5
Friend	15	20.8	5
Sister	13	18.1	5
Mother	26	36.1	5
Other	0	0.0	5

Table 6-46 People with whom women with persistent PPGP 9-12 months postpartum had discussed their symptoms with

6.9 Univariate analysis assessing prognostic factors for PPGP

Twenty-one variables were examined as potential prognostic factors for PPGP at the four follow-up periods in this study. As for the assessment of risk factors, variables were often recoded as appropriate, in which case the original data are provided in additional tables in appendices that are referenced in the text.

6.9.1 Prognostic factors for PPGP persisting 0-3 months postpartum – Univariate analysis

The univariate analyses for potential prognostic factors for PPGP persisting in the first three months postpartum are presented in Table 6-47.

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference[a]						
	n=823	**n=257**	**n=566**	**%**		
18-24	65	14	51	78.5	0.09	1.8 (0.9-3.4)
25-29	202	66	136	67.3		1.0 (ref.)
30-34	361	121	240	66.5	0.8	1.0 (0.7-1.4)
≥35	195	56	139	71.3	0.4	1.2 (0.8-1.8)
Missing	0					
Age (years) 18-25 reference[a]						
	n=823	**n=257**	**n=566**	**%**		
18-24	65	14	51	78.5		1.0 (ref.)
25-29	202	66	136	67.3	0.1	0.6 (0.3-1.1)
30-34	361	121	240	66.5	0.06	0.5 (0.3-1.0)
≥35	195	56	139	71.3	0.3	0.7 (0.3-1.3)
Missing	0					
BMI[b]						
	n=763	**n=244**	**n=512**	**%**		
Underweight	28	7	21	75	0.3	1.6 (0.7-3.8)
Ideal	513	176	337	65.7		1.0 (ref.)
Overweight	134	46	88	65.7	1.0	1.0 (0.7-1.5)
Obese/very obese	88	15	73	83.0	0.002	2.5 (1.4-4.6)
Missing	60					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Educational level[c]						
	n=820	**n=256**	**n=564**	**%**		
No formal education/ primary/lower secondary/upper secondary	212	52	160	75.5	0.02	1.6 (1.1-2.2)
University degree or equivalent/ postgraduate	608	204	404	66.4		1.0 (ref.)
Missing	3					
Employment status[d]						
	n=814	**n=256**	**n=558**	**%**		
Working	687	224	463	67.4		1.0 (ref.)
Not working	127	32	95	74.8	0.1	1.4 (0.9-2.2)
Missing	9					
Return to work[e]						
	n=821	**n=257**	**n=564**	**%**		
Returned to work/study	42	15	27	64.3		1.0 (ref.)
Paid maternity leave	573	175	398	69.5	0.5	1.3 (0.7-2.4)
Unpaid maternity leave	111	47	64	57.7	0.5	0.8 (0.4-1.6)
Not in paid work or studying	95	20	75	78.9	0.07	2.1 (0.9-4.6)
Missing	2					
Marital status						
	n=822	**n=256**	**n=566**	**%**		
Married	511	168	343	67.1		1.0 (ref.)
Single	28	7	21	75.0	0.4	1.5 (0.6-3.5)
Living with partner	224	66	158	70.5	0.4	1.2 (0.8-1.7)
In a relationship - not living together	59	15	44	74.6	0.2	1.4 (0.8-2.7)
Missing	1					
Ethnicity						
	n=819	**n=256**	**n=563***	**%**		
White background	783	248	535	68.3	0.9	1.0 (ref.)
Black or African background	5	0	5	100	x	x
Asian background	21	5	16	76.2	0.4	1.5 (0.5-4.1)
Mixed background	10	3	7	70.0	0.9	1.1 (0.3-4.2)
Missing	4					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Low back pain in the 12 months before pregnancy						
	n=820	**n=255**	**n=565**	**%**		
No	637	210	427	67.0		1.0 (ref.)
Yes	183	45	138	75.4	0.03	1.5 (1.0-2.2)
Missing	3					
Pelvic girdle pain in the 12 months before pregnancy						
	n=822	**n=257**	**n=565**	**%**		
No	414	171	243	58.7		1.0 (ref.)
Yes	408	86	322	78.9	<0.001	2.6 (1.9-3.6)
Missing	1					
History of heavy periods						
	n=822	**n=257**	**n=565**	**%**		
No	711	230	481	67.7		1.0 (ref.)
Yes	111	27	84	75.7	0.09	1.5 (0.9-2.4)
Missing	181					
History of severe period pain						
	n=822	**n=257**	**n=565**	**%**		
No	541	188	353	65.2		1.0 (ref.)
Yes	281	69	212	75.4	0.003	1.6 (1.2-2.3)
Missing	1					
Anxiety during pregnancy (DASS)[f]						
	n=803	**n=254**	**n=550**	**%**		
Normal/mild	747	236	511	68.4		1.0 (ref.)
Moderate/severe/very severe	56	17	39	69.6	0.8	1.1 (0.6-1.9)
Missing	20					
Depression during pregnancy (DASS)[g]						
	n=809	**n=252**	**n=557**	**%**		
Normal/mild	763	246	517	67.8		1.0 (ref.)
Moderate/severe/ very severe	46	6	40	87.0	0.009	3.1 (1.3-7.6)
Missing	14					

Factor	Number of participants	No persistent PPGP	Persistent PPGP	p		Unadjusted OR (95% CI)
Depression during pregnancy (EPDS)[g]						
	n=811	**n=253**	**n=509**	**%**		
Score 0-12	745	236	509	68.3		1.0 (ref.)
Score ≥13	66	17	49	74.2	0.3	1.3 (0.7-2.4)
Missing	12					
Depression during pregnancy[g] (EPDS & DASS)						
	n=801	**n=249**	**n=552**	**%**		
Normal/mild	723	231	492	68.0		1.0 (ref.)
Moderate/severe/ very severe	78	18	60	76.9	0.1	1.6 (0.9-2.7)
Missing	22					
Stress during pregnancy (DASS)[h]						
	n=805	**n=251**	**n=554**	**%**		
Normal	708	229	479	67.7		1.0 (ref.)
Mild/ moderate	78	18	60	76.9	0.1	1.6 (0.9-2.8)
Severe/very severe	19	4	15	78.9	0.3	1.8 (0.6-5.4)
Missing	18					
Smoking						
	n=814	**n=254**	**n=560**	**%**		
Smoking	56	20	36	64.3	0.6	0.9 (0.5-1.5)
Stopped smoking before pregnancy or when found out being pregnant	314	90	224	71.3	0.3	1.2 (0.9-1.6)
Not smoking	444	144	300	67.6	0.4	1.0 (ref.)
Missing	9					
Breastfeeding						
	n=813	**n=255**	**n=558**	**%**		
Never breastfed	171	41	130	76.0	0.02	1.6 (1.1-2.5)
Initiated breastfeeding but stopped between 0-3 months postpartum	258	83	175	67.8	0.6	1.1 (0.8-1.5)
Still breastfeeding at 3 months postpartum	384	131	253	65.9		1.0 (ref.)
Missing	190					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Mode of birth (7 categories)[i]						
	n=791	**n=246**	**n=545**	**%**		
Spontaneous birth without epidural	123	32	91	74.0		1.0 (ref.)
Spontaneous birth with epidural	158	42	116	73.4	0.9	1.0 (0.6-1.7)
Vacuum or kiwi birth	172	64	108	62.8	0.04	0.6 (0.4-1.0)
Forceps or combined instrumental birth	102	25	77	75.5	0.8	1.1 (0.6-2.0)
Caesarean section with no labour	111	36	75	67.6	0.3	0.7 (0.4-1.3)
Caesarean section in 1st stage labour	99	36	63	63.6	0.1	0.6 (0.3-1.1)
Caesarean section in 2nd stage labour	26	11	15	57.7	0.1	0.5 (0.2-1.2)
Missing	32					
Mode of birth (5 categories)[j]						
	n=791	**n=246**	**n=545**	**%**		
Spontaneous birth without epidural	123	32	91	74.0		1.0 (ref.)
Spontaneous birth with epidural	158	42	116	73.4	0.9	1.0 (0.6-1.7)
Instrumental birth	274	89	185	67.5	0.2	0.7 (0.5-1.2)
Caesarean section with no labour	111	36	75	67.6	0.3	0.7 (0.4-1.3)
Caesarean section in 1st or 2nd stage labour	125	47	78	62.4	0.1	0.6 (0.3-1.0)
Missing	32					
PPGP Pain location during pregnancy						
	n=822	**n=256**	**n=566**	**%**		
Anterior	47	26	21	44.7		1.0 (ref.)
Posterior	618	197	421	68.1	0.001	2.6 (1.5-4.8)
Combined anterior & posterior	157	33	124	79.0	<0.001	4.7 (2.3-9.2)
Missing	181					
History of injury to the back						
	n=803	**n=251**	**n=552**	**%**		
No	764	240	524	68.6		1.0 (ref.)
Yes	39	11	28	71.8	0.7	1.2 (0.6-2.4)
Missing	20					

[a] The over 40 years age group was merged with the 35-39 years group due to the small numbers in the over 40 group (Appendix 79, a).
[b] The 'obese' and 'very obese' group were merged because of small numbers in the 'very obese' group (Appendix 79, b).
[c] Initial analysis for the factor educational level was carried out initially with four categories (Appendix 79, c).
[d] Initial analysis of employment status was done with six categories (Appendix 79, d), but due to small numbers of women in certain categories, they were merged into a binary variable.
[e] Women who had returned to work or study were merged into one category.
[f] Anxiety was measured using the DASS-21 (Depression, Anxiety and Stress Scale) (Antony *et al.* 1998), which categorises women in one of five categories (normal, mild, moderate, severe, very severe). Some categories contained few women (Appendix 79, f); hence categories were merged into a binary variable (normal/mild versus moderate/severe/very severe).
[g] Depression was measured using two different scales; the DASS-21 (Depression, Anxiety and Stress Scale) and the EPDS (Edinburgh Postnatal Depression Scale). The DASS-21 categorises women in one of five categories (normal, mild, moderate, severe, very severe) (Antony *et al.* 1998), but 30% of cells had expected counts of less than five (Appendix 79, g). Categories were merged into two categories because of the small number of women in the severe/very severe group (normal/mild versus moderate/severe/very severe). The EDPS score was categorised into a binary variable as well (score <13 (normal/mild) versus score ≥13 (moderate/severe)). A combined binary variable was created for the DASS and EPDS; women who had at least moderate depression on either scale (≥13 on EPDS or at least moderate on DASS) versus women who did not.
[h] Stress was measured using the DASS-21 (Antony *et al.* 1998), which categorises women in one of five categories (normal, mild, moderate, severe, very severe). Due to the small number of women in some categories (Appendix 79, h), categories were merged into three categories (normal, mild/moderate, and severe/very severe).
[i] Mode of birth was obtained from women's hospital records if they had consented for their records to be accessed (n=1365). Mode of birth of women for whom we did not have medical records access (n=113) was obtained from survey 2 (self-reported).
[j] Analysis was also carried out with five categories in accordance with most existing literature (Chapter 3).

Table 6-47 Prognostic factors for PPGP persisting 0-3 months postpartum – Univariate analysis

6.9.2 Multivariable analysis assessing prognostic factors for PPGP 0-3 months postpartum

Variables that were significantly associated (for at least one category compared to a reference) with persistence of PPGP 0 to 3 months postpartum ($p \leq 0.05$) in univariate analysis were; BMI, educational level, any low back pain in the year before pregnancy, any pelvic girdle pain in the year before pregnancy, a history of severe period pain, depression (DASS), breastfeeding, pain location, and mode of birth. The variables 'any low back pain in the year before pregnancy' and 'any pelvic girdle pain before pregnancy' were merged into a binary variable 'any lumbopelvic pain in the year before pregnancy' to avoid collinearity, because there was a strong association between the two variables ($df=1$, $n=1000$, $X^2=110.5$, $p<0.001$). The Omnibus Test of Model Coefficients was statistically

significant (X^2=75.7, df=17, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=6.0, df=8, p=0.643) (Table 6-48 and Table 6-49).

Women who were obese or very obese were more likely to have persistent PPGP in the first three months postpartum (OR 2.3, 95% CI 1.2-4.4, p=0.01). Women with a history of any lumbopelvic pain before pregnancy were also significantly more likely to have persistent PPGP 0 to 3 months after birth (OR 2.4, 95% CI 1.7-3.4, p<0.001), as were women with a history of severe period pain before pregnancy (OR 1.5, 95% CI 1.0-2.1, p=0.04). A posterior (OR 2.0, 95% CI 1.0-3.9, p=0.04) or combined anterior and posterior PPGP (OR 3.4, 95% CI 1.6-7.3, p=0.001) pain location during pregnancy was associated with persistent PPGP 0 to 3 months postpartum, when compared to anterior PPGP. On the other hand, women who gave birth by vacuum/kiwi were more likely to recover in the first three months postpartum (OR 0.5, 95% CI 0.3-0.9, p=0.02). Educational level, a history of depression during pregnancy, and breastfeeding were variables that were associated with persistent PPGP 0 to 3 months postpartum in univariate analysis, but not in multivariable analysis.

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	N	n	n	%				
BMI	**n=763**	**n=244**	**n=512**	**%**				
Underweight	28	7	21	75.0	0.3	1.6 (0.7-3.8)	0.6	1.3 (0.5-3.3)
Ideal	513	176	337	65.7		1.0 (ref.)		1.0 (ref.)
Overweight	134	46	88	65.7	1.0	1.0 (0.7-1.5)	0.9	1.0 (0.6-1.5)
Obese/very obese	88	15	73	83.0	0.002	2.5 (1.4-4.6)	0.01	2.3 (1.2-4.4)
Missing	60							
Educational level	**n=820**	**n=256**	**n=564**	**%**				
No formal education/primary/ lower secondary/ upper secondary	212	52	160	75.5	0.02	1.6 (1.1-2.2)	0.2	1.3 (0.8-2.0)
University degree or equivalent/ postgraduate	608	204	404	66.4		1.0 (ref.)		1.0 (ref.)
Missing	3							
Any lumbopelvic pain in the 12 months pre-pregnancy	**n=820**	**n=255**	**n=565**	**%**				
No	374	153	221	59.1		1.0 (ref.)		1.0 (ref.)
Yes	446	102	344	77.1	<0.001	2.3 (1.7-3.2)	<0.001	2.4 (1.7-3.4)
Missing	3							
History of severe period pain	**n=822**	**n=257**	**n=565**	**%**				
No	541	188	353	65.2		1.0 (ref.)		1.0 (ref.)
Yes	281	69	212	75.4	0.003	1.6 (1.2-2.3)	0.04	1.5 (1.0-2.1)
Missing	1							

Table 6-48 Multivariable logistic analysis assessing prognostic factors for PPGP 0-3 months postpartum

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Depression during pregnancy (DASS)	**n=809**	**n=252**	**n=557**	**%**				
Normal/mild	763	246	517	67.8		1.0 (ref.)		1.0 (ref.)
Moderate/severe/very severe	46	6	40	87.0	0.009	3.1 (1.3-7.6)	0.09	2.3 (0.9-5.7)
Missing	14							
Breastfeeding	**n=813**	**n=255**	**n=558**	**%**				
Never breastfed	171	41	130	76.0	0.02	1.6 (1.1-2.5)	0.4	1.2 (0.7-2.0)
Initiated breastfeeding but stopped between 0-3 months postpartum	258	83	175	67.8	0.6	1.1 (0.8-1.5)	0.2	0.8 (0.5-1.1)
Still breastfeeding at 3 months postpartum	384	131	253	65.9		1.0 (ref.)		1.0 (ref.)
Missing	190							
Mode of birth	**n=791**	**n=246**	**n=545**	**%**				
Spontaneous birth without epidural	123	32	91	74.0		1.0 (ref.)		1.0 (ref.)
Spontaneous birth with epidural	158	42	116	73.4	0.9	1.0 (0.6-1.7)	0.3	0.7 (0.4-1.4)
Vacuum or kiwi birth	172	64	108	62.8	0.04	0.6 (0.4-1.0)	0.02	0.5 (0.3-0.9)
Forceps/combined instrumental birth	102	25	77	75.5	0.8	1.1 (0.6-2.0)	0.6	0.8 (0.4-1.7)
Caesarean section with no labour	111	36	75	67.6	0.3	0.7 (0.4-1.3)	0.3	0.7 (0.4-1.3)
Caesarean section in 1st stage labour	99	36	63	63.6	0.1	0.6 (0.3-1.1)	0.06	0.5 (0.3-1.0)
Caesarean section in 2nd stage labour	26	11	15	57.7	0.1	0.5 (0.2-1.2)	0.06	0.4 (0.2-1.0)
Missing	32							
PPGP pain location during pregnancy	**n=822**	**n=256**	**n=566**	**%**				
Anterior	47	26	21	44.7		1.0 (ref.)		1.0 (ref.)
Posterior	618	197	421	68.1	0.001	2.6 (1.5-4.8)	0.04	2.0 (1.0-3.9)
Combined anterior & posterior	157	33	124	79.0	<0.001	4.7 (2.3-9.2)	0.001	3.4 (1.6-7.3)
Missing	181							

Table 6-49 Multivariable logistic analysis assessing prognostic factors for PPGP 0-3 months postpartum - continued

6.9.3 Prognostic factors for PPGP persisting 3-6 months postpartum – Univariate analysis

The univariate analyses for potential prognostic factors for PPGP persisting three to six months postpartum are presented in Table 6-50.

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference[a]						
	n=717	**n=350**	**n=367**	**%**		
18-24	53	19	34	64.2	0.04	2.0 (1.1-3.7)
25-29	175	92	83	47.4		1.0 (ref.)
30-34	320	156	164	51.3	0.4	1.2 (0.8-1.7)
≥35	169	83	86	50.9	0.5	1.1 (0.8-1.8)
Missing	0					
Age (years) 18-24 reference[a]						
	n=717	**n=350**	**n=367**	**%**		
18-24	53	19	34	64.2		1.0 (ref.)
25-29	175	92	83	47.4	0.04	0.5 (0.3-1.0)
30-34	320	156	164	51.3	0.08	0.6 (0.3-1.1)
≥35	169	83	86	50.9	0.09	0.6 (0.3-1.0)
Missing	0					
BMI[b]						
	n=669	**n=329**	**n=340**	**%**		
Underweight	24	12	12	50.0	0.9	1.0 (0.5-2.3)
Ideal	448	227	221	49.3		1.0 (ref.)
Overweight	117	65	52	44.4	0.3	0.8 (0.5-1.2)
Obese/very obese	80	25	55	68.8	0.002	2.3 (1.4-3.8)
Missing	48					
Educational level[c]						
	n=715	**n=349**	**n=366**	**%**		
No formal education/ primary/lower secondary/ Upper secondary	180	74	106	58.9	0.02	1.5 (1.1-2.1)
University degree or equivalent/ postgraduate	353	275	260	48.6		1.0 (ref.)
Missing	2					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Employment status[d]						
	n=710	**n=348**	**n=362**	**%**		
Working	587	293	294	50.1		1.0 (ref.)
Not working	123	55	68	55.3	0.3	1.2 (0.8-1.8)
Missing	7					
Return to work[e]						
	n=713	**n=348**	**n=365**	**%**		
Returned to work/study 0-3 months postpartum	32	14	18	56.3		1.0 (ref.)
Returned to work/study 3-6 months postpartum	120	57	63	52.5	0.7	0.9 (0.4-1.9)
Paid maternity leave	158	75	83	52.5	0.7	0.9 (0.4-1.9)
Unpaid maternity leave	303	160	143	47.2	0.3	0.7 (0.3-1.4)
Not in paid work or studying	100	42	58	58.0	0.9	1.1 (0.5-2.4)
Missing	4					
Marital status						
	n=717	**n=350**	**n=367**	**%**		
Married	452	228	224	49.6		1.0 (ref.)
Single	24	9	15	62.5	0.2	1.7 (0.8-4.0)
Living with partner	194	92	102	52.6	0.5	1.1 (0.8-1.6)
In a relationship - not living together	47	21	26	55.3	0.5	1.3 (0.7-2.3)
Missing	0					
Ethnicity						
	n=714	**n=349**	**n=365 ***	**%**		
White background	684	337	347	50.7		1.0 (ref.)
Black or African background	5	1	4	80.0	0.2	3.9 (0.4-34.9)
Asian background	16	8	8	50.0	1.0	1.0 (0.4-2.6)
Mixed background	9	3	6	66.7	0.4	1.9 (0.5-7.8)
Missing	3					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Low back pain in the 12 months before pregnancy						
	n=714	**n=348**	**n=366**	**%**		
No	561	278	283	50.4		1.0 (ref.)
Yes	153	70	83	54.2	0.4	1.2 (0.8-1.7)
Missing	0					
Pelvic girdle pain in the 12 months before pregnancy						
	n=716	**n=350**	**n=366**	**%**		
No	372	225	147	39.5		1.0 (ref.)
Yes	344	125	219	63.7	<0.001	2.7 (2.0-3.6)
Missing	1					
History of heavy periods						
	n=716	**n=349**	**n=367**	**%**		
No	619	306	313	50.6		1.0 (ref.)
Yes	97	43	54	55.7	0.4	1.2 (0.8-1.9)
Missing	1					
History of severe period pain						
	n=716	**n=349**	**n=367**	**%**		
No	470	243	227	48.3		1.0 (ref.)
Yes	246	106	140	56.9	0.03	1.4 (1.0-1.9)
Missing	1					
Anxiety during pregnancy (DASS)[f]						
	n=703	**n=345**	**n=358**	**%**		
Normal/mild	6544	323	331	50.6		1.0 (ref.)
Moderate/severe/ very severe	49	22	27	55.1	0.5	1.2 (0.7-2.1)
Missing	14					
Anxiety 0-3 months postpartum (DASS)[f]						
	n=711	**n=349**	**n=362**	**%**		
Normal/mild	683	339	344	50.4		1.0 (ref.)
Moderate/severe/ very severe	28	10	18	64.3	0.2	1.8 (0.8-3.9)
Missing	6					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Depression during pregnancy (DASS)[g]						
	n=704	**n=344**	**n=360**	**%**		
Normal/mild	668	330	338	50.6		1.0 (ref.)
Moderate/severe/ very severe	36	14	22	61.1	0.2	1.5 (0.8-3.1)
Missing	13					
Depression during pregnancy (EPDS)[g]						
	n=706	**n=344**	**n=362**	**%**		
Score 0-12	650	321	329	50.6		1.0 (ref.)
Score ≥13	56	23	33	58.9	0.2	1.4 (0.8-2.4)
Missing	11					
Depression 0-3 months postpartum (DASS)[g]						
	n=709	**n=348**	**n=361**	**%**		
Normal/mild	667	330	337	50.5		1.0 (ref.)
Moderate/severe/ very severe	42	18	24	57.1	0.4	1.3 (0.7-2.5)
Missing	8					
Depression 0-3 months postpartum (EPDS)[g]						
	n=709	**n=345**	**n=364**	**%**		
Score 0-12	657	325	332	50.5		1.0 (ref.)
Score ≥13	52	20	32	61.5	0.1	1.6 (0.9-2.8)
Missing	8					
Stress during pregnancy (DASS)[h]						
	n=704	**n=344**	**n=360**	**%**		
Normal	622	311	311	50.0		1.0 (ref.)
Mild/moderate	66	26	40	60.6	0.1	1.5 (0.9-2.6)
Severe/very severe	16	7	9	56.3	0.6	1.3 (0.5-3.5)
Missing	13					
Stress 0-3 months postpartum (DASS)[h]						
	n=710	**n=348**	**n=362**	**%**		
Normal/mild	649	327	322	49.6		1.0 (ref.)
Moderate/severe/ very severe	61	21	40	65.6	0.02	1.9 (1.1-3.4)
Missing	7					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Smoking						
	n=708	**n=147**	**n=364**	**%**		
Smoking	48	25	23	47.9	0.8	0.9 (0.5-1.7)
Stopped smoking before pregnancy or when found out being pregnant	267	122	145	54.3	0.3	1.2 (0.9-1.6)
Not smoking	393	197	196	49.9		1.0 (ref.)
Missing	9					
Breastfeeding						
	n=713	**n=348**	**n=365**	**%**		
Never breastfed	154	70	84	54.5	0.3	1.3 (0.9-1.9)
Initiated breastfeeding but stopped between 0-3 months postpartum	213	97	116	54.5	0.2	1.3 (0.9-1.9)
Initiated breastfeeding but stopped between 3-6 months postpartum	93	50	43	46.2	0.2	0.9 (0.6-1.5)
Still breastfeeding at 6 months postpartum	253	131	122	48.2		1.0 (ref.)
Missing	4					
Mode of birth (7 categories)						
	n=689	**n=333**	**n=356**	**%**		
Spontaneous birth without epidural	109	44	65	59.6		1.0 (ref.)
Spontaneous birth with epidural	134	61	73	54.5	0.4	0.8 (0.5-1.4)
Vacuum or kiwi birth	149	83	66	44.3	0.02	0.5 (0.3-0.9)
Forceps or combined instrumental birth	90	42	48	53.3	0.4	0.8 (0.4-1.4)
Caesarean section with no labour	99	50	49	49.5	0.1	0.7 (0.4-1.1)
Caesarean section in 1st stage labour	87	43	44	50.6	0.2	0.7 (0.4-1.2)
Caesarean section in 2nd stage labour	21	10	11	52.4	0.5	0.7 (0.3-1.9)
Missing	28					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Mode of birth (5 categories)						
	n=689	**n=333**	**n=356**	**%**		
Spontaneous birth without epidural	109	44	65	59.6		1.0 (ref.)
Spontaneous birth with epidural	134	61	73	54.5	0.4	0.8 (0.5-1.4)
Instrumental birth	239	125	114	47.7	0.04	0.6 (0.4-1.0)
Caesarean section with no labour	99	50	49	49.5	0.1	0.7 (0.4-1.1)
Caesarean section in 1st or 2nd stage labour	108	53	55	50.9	0.2	0.7 (0.4-1.2)
Missing	28					
PPGP Pain location during pregnancy						
	n=716	**n=349**	**n=367**	**%**		
Anterior	44	33	11	25.0		1.0 (ref.)
Posterior	534	261	273	51.1	0.001	3.1 (1.6-6.3)
Combined anterior & posterior	138	55	83	60.1	<0.001	4.5 (2.1-9.7)
Missing	1					
History of injury to the back						
	n=699	**n=342**	**n=357**	**%**		
No	667	332	335	50.2		1.0 (ref.)
Yes	32	10	22	68.8	0.05	2.2 (1.0-4.7)
Missing	284					

*Chi square assumption was violated with >20% of cells having an expected count of less than five

[a] The 35-40 age group and the over 40 years group were merged, because of few women in the latter (Appendix 80, a).

[b] The 'obese' and 'very obese' categories were merged due to the small number of women in the 'very obese' group (Appendix 80, b).

[c] The categories 'university degree or equivalent' and 'postgraduate qualification' were merged since they were not significantly different. Few women had 'no formal education/primary/lower secondary' education; hence, this category was merged with 'upper secondary' education.

[d] Analysis was conducted with six categories initially (Appendix 80, d). Eight women who ticked 'other' and said they were self-employed were included in the 'full-time paid employment' category. One women who was doing a paid internship was also included in that category. Subsequently, categories were merged into a binary variable because there was violation of the chi square assumptions.

[e] If women had returned to work outside the home, they were categorised according to the time they had resumed work. Next, categories were merged into three categories (Appendix 80, e).

[f] The five DASS categories were merged into a binary variable due to the small number of women in some categories (Appendix 80, f).

[g] Depression during pregnancy and three months postpartum were measured both by the DASS-21 and EPDS. Findings using both scales are presented for depression during

pregnancy and depression three months postpartum. The chi square assumptions were violated (Appendix 80, g), hence categories were merged into binary variables.
[h] Categories were merged because there were few women in the severe and very severe groups (Appendix 80, h).

Table 6-50 Prognostic factors for PPGP persisting 3-6 months postpartum – Univariate analysis

6.9.4 Multivariable analysis assessing prognostic factors for PPGP 3-6 months postpartum

Variables that were significantly associated with persistent PPGP 3 to 6 months postpartum in univariate analysis were; age, BMI, educational level, a history of pelvic girdle pain in the year before pregnancy, a history of severe period pain, stress in the first three months after the birth, mode of birth, PPGP pain location during pregnancy, and a history of injury to the back. The variable 'depression 0-3 months postpartum' was not included in the multivariable model because only one category was significantly associated with persistent PPGP 3 to 6 months postpartum in the presence of violation of the chi square assumptions, and it was not significantly associated with persistent PPGP after recoding the variable into a binary variable. The Omnibus Test of Model Coefficients for the multivariable model was statistically significant (X^2=77.6, df=19, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=4.4, df=8, p=0.822) (Table 6-51 to Table 6-53).

Obese and very obese women were more likely to have persistent PPGP 3 to 6 months postpartum (OR 1.9, 95% CI 1.1-3.4, p=0.02). Women with a history of any pelvic girdle pain in the year before pregnancy were also less likely to recover by then (OR 2.5, 95% CI 1.7-3.5, p<0.001). Compared to anterior PPGP, women who had posterior PPGP (OR 2.4, 95% CI 1.1-5.1, p=0.02) or combined anterior and posterior PPGP (OR 4.0, 95% CI 1.8-9.4, p=0.001) during pregnancy were more likely to have persistent symptoms. On the other hand, women who gave birth by vacuum/kiwi birth (OR 0.4, 95% CI 0.3-0.8, p=0.004) or by forceps/combined instrumental birth (OR 0.5, 95% CI 0.3-1.0, p=0.04) were less likely to continue to have persistent PPGP 3 to 6 months after the birth. The variables age, educational level, a history of severe period pain, and a history of injury to the back, were not associated with persistent PPGP in the multivariable model.

Factors	Number of participants	No persistent PPGP	Persistent PPGP		P	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	N	n	n	%				
Age (years)	**n=717**	**n=350**	**n=367**	**%**				
18-24	53	19	34	64.2		1.0 (ref.)		1.0 (ref.)
25-29	175	92	83	47.4	0.04	0.5 (0.3-1.0)	0.3	0.6 (0.3-1.4)
30-34	320	156	164	51.3	0.08	0.6 (0.3-1.1)	1	1.0 (0.5-2.2)
≥35	169	83	86	50.9	0.09	0.6 (0.3-1.0)	0.6	1.3 (0.5-2.9)
Missing	0							
BMI	**n=669**	**n=329**	**n=340**	**%**				
Underweight	24	12	12	50.0	0.9	1.0 (0.5-2.3)	0.9	1.0 (0.4-2.4)
Ideal	448	227	221	49.3		1.0 (ref.)		1.0 (ref.)
Overweight	117	65	52	44.4	0.3	0.8 (0.5-1.2)	0.3	0.8 (0.5-1.3)
Obese/very obese	80	25	55	68.8	0.002	2.3 (1.4-3.8)	0.02	2.0 (1.1-3.4)
Missing	48							
Educational level	**n=715**	**n=349**	**n=366**	**%**				
No formal education/primary/ lower secondary/ Upper secondary	180	74	106	58.9	0.02	1.5 (1.1-2.1)	0.2	1.3 (0.9-2.1)
University degree or equivalent/ postgraduate	353	275	260	48.6		1.0 (ref.)		1.0 (ref.)
Missing	2							

Table 6-51 Multivariable logistic analysis assessing prognostic factors for PPGP 3-6 months postpartum

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	N	n	n	%				
Any pelvic girdle pain in the 12 months pre-pregnancy	**n=716**	**n=350**	**n=366**	**%**				
No	372	225	147	39.5		1.0 (ref.)		1.0 (ref.)
Yes	344	125	219	63.7	<0.001	2.7 (2.0-3.6)	<0.001	2.5 (1.7-3.5)
Missing	1							
History of severe period pain	**n=716**	**n=349**	**n=367**	**%**				
No	470	243	227	48.3		1.0 (ref.)		1.0 (ref.)
Yes	246	106	140	56.9	0.03	1.4 (1.0-1.9)	0.1	1.4 (0.9-2.0)
Missing	1							
Stress 0-3 months postpartum	**n=710**	**n=348**	**n=362**	**%**				
Normal/mild	649	327	322	49.6		1.0 (ref.)		1.0 (ref.)
Moderate/severe/very severe	61	21	40	65.6	0.02	1.9 (1.1-3.4)	0.1	1.7 (0.9-3.2)
Missing	7							
PPGP pain location during pregnancy	**n=716**	**n=349**	**n=367**	**%**				
Anterior	44	33	11	25.0		1.0 (ref.)		1.0 (ref.)
Posterior	534	261	273	51.1	0.001	3.1 (1.6-6.3)	0.02	2.4 (1.1-5.1)
Combined anterior & posterior	138	55	83	60.1	<0.001	4.5 (2.1-9.7)	0.001	4.0 (1.8-9.4)
Missing	1							

Table 6-52 Multivariable logistic analysis assessing prognostic factors for PPGP 3-6 months postpartum - continued

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	N	n	n	%				
Mode of birth	**n=689**	**n=333**	**n=356**	**%**				
Spontaneous birth without epidural	109	44	65	59.6		1.0 (ref.)		1.0 (ref.)
Spontaneous birth with epidural	134	61	73	54.5	0.4	0.8 (0.5-1.4)	0.1	0.7 (0.4-1.2)
Vacuum or kiwi birth	149	83	66	44.3	0.02	0.5 (0.3-0.9)	0.004	0.5 (0.3-0.8)
Forceps or combined instrumental birth	90	42	48	53.3	0.4	0.8 (0.4-1.4)	0.04	0.5 (0.3-1.0)
Caesarean section with no labour	99	50	49	49.5	0.1	0.7 (0.4-1.1)	0.08	0.6 (0.3-1.1)
Caesarean section in 1st stage labour	87	43	44	50.6	0.2	0.7 (0.4-1.2)	0.08	0.6 (0.3-1.1)
Caesarean section in 2nd stage labour	21	10	11	52.4	0.5	0.7 (0.3-1.9)	0.4	0.6 (0.2-1.8)
Missing	28							
History of any injury to the back	**n=699**	**n=342**	**n=357**	**%**				
No	667	332	335	50.2		1.0 (ref.)		1.0 (ref.)
Yes	32	10	22	68.8	0.05	2.2 (1.0-4.7)	0.5	1.3 (0.6-3.2)
Missing	284							

Table 6-53 Multivariable logistic analysis assessing prognostic factors for PPGP 3-6 months postpartum - continued

6.9.5 Prognostic factors for PPGP persisting 6-9 months postpartum – Univariate analysis

The univariate analyses for potential prognostic factors for PPGP persisting six to nine months postpartum are presented in Table 6-54.

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference[a]						
	n=618	**n=369**	**n=250**	**%**		
18-24	44	20	24	54.5	0.1	1.9 (0.9-3.6)
25-29	150	91	59	39.3		1.0 (ref.)
30-34	275	165	110	40.0	0.9	1.0 (0.7-1.5)
≥35	149	92	57	38.3	0.8	1.0 (0.6-1.5)
Missing	0					
Age (years) 18-24 reference[a]						
	n=618	**n=369**	**n=250**	**%**		
18-24	44	20	24	54.5		1.0 (ref.)
25-29	150	91	59	39.3	0.1	0.5 (0.3-1.1)
30-34	275	165	110	40.0	0.1	0.6 (0.3-1.1)
≥35	149	92	57	38.3	0.1	0.5 (0.3-1.0)
Missing	0					
BMI[b]						
	n=578	**n=348**	**n=230**	**%**		
Underweight	19	12	7	36.8	1.0	1.0 (0.4-2.6)
Ideal	393	248	145	36.9		1.0 (ref.)
Overweight	97	63	34	35.1	0.7	0.9 (0.6-1.5)
Obese/very obese	69	25	44	63.8	<0.001	3.0 (1.7-5.1)
Missing	40					
Educational level[c]						
	n=616	**n=367**	**n=249**	**%**		
No formal education/primary/ lower secondary/ Upper secondary	147	71	76	51.7	0.002	1.8 (1.2-2.7)
University degree or equivalent/ postgraduate	469	296	173	36.9		1.0 (ref.)
Missing	2					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Employment status[d]						
	n=617	**n=368**	**n=249**	**%**		
Working	501	294	207	41.3		1.0 (ref.)
Not working	116	74	42	36.2	0.3	0.8 (0.5-1.2)
missing	1					
Return to work						
	n=617	**n=368**	**n=249**	**%**		
Returned to work/study 0-3 months postpartum	25	12	13	52.0		1.0 (ref.)
Returned to work/study 3-6 months postpartum	88	51	37	42.0	0.4	0.7 (0.3-1.6)
Returned to work/study 6-9 months postpartum	192	107	85	44.3	0.5	0.7 (0.3-1.7)
Paid maternity leave	11	9	2	18.2	0.1	0.2 (0.03-1.1)
Unpaid maternity leave	200	128	72	36.0	0.1	0.5 (0.2-1.2)
Not in paid work or studying	101	61	40	39.6	0.3	0.6 (0.3-1.5)
Missing	1					
Return to work[e]						
	n=617	**n=368**	**n=249**	**%**		
Returned to work/study	305	170	135	44.3		1.0 (ref.)
Maternity leave (paid or unpaid)	211	137	74	35.1	0.04	0.7 (0.5-1.0)
Not in paid work or studying	101	61	40	39.6	0.4	0.8 (0.5-1.3)
Missing	1					
Marital status						
	n=618	**n=368**	**n=250**	**%**		
Married	395	245	150	38.0		1.0 (ref.)
Single	20	10	10	50.0	0.3	1.6 (0.7-4.0)
Living with partner	165	95	70	42.4	0.3	1.2 (0.8-1.7)
In a relationship - not living together	38	18	20	52.6	0.1	1.8 (0.9-3.5)
Missing	0					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Ethnicity						
	n=616	**n=368**	**n=248***	**%**		
White background	594	356	238	40.1	0.8	1.0 (ref.)
Black or African background	2	2	0	0.0	x	x
Asian background	13	7	6	46.2	0.7	1.3 (0.4-3.9)
Mixed background	7	3	4	57.1	0.4	2.0 (0.4-9.0)
Missing	2					
Low back pain in the 12 months before pregnancy						
	n=615	**n=365**	**n=250**	**%**		
No	484	294	190	39.3		1.0 (ref.)
Yes	131	71	60	45.8	0.2	1.3 (0.9-1.9)
Missing	3					
Pelvic girdle pain in the 12 months before pregnancy						
	n=617	**n=367**	**n=250**	**%**		
No	318	238	80	25.2		1.0 (ref.)
Yes	299	129	170	56.9	<0.001	3.9 (2.8-5.5)
Missing	1					
History of heavy periods						
	n=617	**n=367**	**n=250**	**%**		
No	530	321	209	39.4		1.0 (ref.)
Yes	87	46	41	47.1	0.2	1.4 (0.9-2.2)
Missing	1					
History of severe period pain						
	n=617	**n=367**	**n=250**	**%**		
No	402	250	152	37.8		1.0 (ref.)
Yes	215	117	98	45.6	0.06	1.4 (1.0-2.0)
Missing	1					
Anxiety during pregnancy[f]						
	n=608	**n=363**	**n=245**	**%**		
Normal/mild	563	339	224	39.8		1.0 (ref.)
Moderate/severe/ very severe	45	24	21	46.7	0.4	1.3 (0.7-2.4)
Missing	10					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Anxiety 0-3 months postpartum[f]						
	n=612	**n=364**	**n=248**	**%**		
Normal/mild	590	354	236	40.0		1.0 (ref.)
Moderate/severe/ very severe	22	10	12	54.5	0.2	1.8 (0.8-4.2)
Missing	8					
Depression during pregnancy (DASS)[g]						
	n=609	**n=363**	**n=246**	**%**		
Normal/mild	575	344	231	40.2		1.0 (ref.)
Moderate/severe/ very severe	34	19	15	44.1	0.6	1.2 (0.6-2.4)
Missing	9					
Depression during pregnancy (EPDS)[g]						
	n=607	**n=360**	**n=247**	**%**		
Score 0-12	557	331	226	40.6		1.0 (ref.)
Score ≥13	50	29	21	42.0	0.8	1.1 (0.6-1.9)
Missing	11					
Depression 0-3 months postpartum (DASS)[g]						
	n=611	**n=365**	**n=246**	**%**		
Normal/mild	574	347	227	39.5		1.0 (ref.)
Moderate/severe/ very severe	37	18	19	51.4	0.2	1.6 (0.8-3.1)
Missing	7					
Depression 0-3 months postpartum (EPDS)[g]						
	n=613	**n=363**	**n=250**	**%**		
Score 0-12	568	341	227	40.0		1.0 (ref.)
Score ≥13	45	22	23	51.1	0.1	1.6 (0.9-2.9)
Missing	5					
Stress during pregnancy[h]						
	n=608	**n=362**	**n=246**	**%**		
Normal	531	324	207	39.0		1.0 (ref.)
Mild/moderate	61	30	31	50.8	0.1	1.6 (1.0-2.8)
Severe/very severe	16	8	8	50.0	0.4	1.6 (0.6-4.2)
Missing	10					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Stress 0-3 months postpartum[h]						
	n=611	**n=364**	**n=247**	**%**		
Normal/mild	560	345	215	38.4		1.0 (ref.)
Moderate/severe/ very severe	51	19	32	62.7	0.001	2.7 (1.5-4.9)
Missing	7					
Smoking						
	n=609	**n=362**	**n=247**	**%**		
Smoking	37	24	13	35.1	0.7	1.4 (0.7-2.8)
Stopped smoking before pregnancy or when found out being pregnant	236	136	100	42.4	0.4	1.2 (0.6-2.5)
Not smoking	336	202	134	39.9		1.0 (ref.)
Missing	9					
Breastfeeding						
	n=614	**n=367**	**n=247**	**%**		
Never breastfed	12	71	56	44.1	0.2	1.4 (0.9-2.3)
Initiated breastfeeding but stopped between 0-3 months postpartum	178	95	83	46.6	0.04	1.6 (1.0-2.4)
Initiated breastfeeding but stopped between 3-6 months postpartum	78	50	28	35.9	1.0	1.0 (0.6-1.8)
Initiated breastfeeding but stopped between 6-9 months postpartum	75	51	24	32.0	0.8	0.8 (0.5-1.5)
Still breastfeeding at 9 months postpartum	156	100	56	35.9		1.0 (ref.)
Missing	4					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Mode of birth (7 categories)						
	n=596	**n=352**	**n=244**	**%**		
Spontaneous birth without epidural	97	54	43	44.3	0.9	1.0 (ref.)
Spontaneous birth with epidural	110	65	45	40.9	0.6	0.9 (0.5-1.5)
Vacuum or kiwi birth	133	84	49	36.8	0.3	0.7 (0.4-1.2)
Forceps or birth instrumental birth	79	46	33	41.8	0.7	0.9 (0.5-1.6)
Caesarean section with no labour	84	50	34	40.5	0.6	0.9 (0.5-1.5)
Caesarean section in 1st stage labour	75	42	33	44.0	1	1.0 (0.5-1.8)
Caesarean section in 2nd stage labour	18	11	7	38.9	0.7	0.8 (0.3-2.2)
Missing	22					
Mode of birth (5 categories)						
	n=596	**n=352**	**n=244**	**%**		
Spontaneous birth without epidural	97	54	43	44.3	0.9	1.0 (ref.)
Spontaneous birth with epidural	110	65	45	40.9	0.6	0.9 (0.5-1.5)
Instrumental birth	212	130	82	38.7	0.3	0.8 (0.5-1.3)
Caesarean section with no labour	84	50	34	40.5	0.6	0.9 (0.5-1.5)
Caesarean section in 1st or 2nd stage labour	93	53	40	43.0	0.9	0.9 (0.5-1.7)
Missing	22					
PPGP Pain location during pregnancy						
	n=617	**n=367**	**n=250**	**%**		
Anterior	37	32	5	13.5		1.0 (ref.)
Posterior	459	274	185	40.3	0.003	4.3 (1.7-11.3)
Combined anterior & posterior	121	61	60	49.6	<0.001	6.3 (2.3-17.2)
Missing	1					
History of injury to the back						
	n=606	**n=361**	**n=245**	**%**		
No	582	354	228	39.2		1.0 (ref.)
Yes	24	7	17	70.8	0.004	3.8 (1.5-9.2)
Missing	12					

*Chi square assumption was violated with >20% of cells having an expected count of less than five

[a] The over 40 years age group was merged with the 35-39 years group due to the small numbers in the over 40 group (Appendix 81, a).
[b] The 'obese' and 'very obese' categories were merged due to the small number of women in the 'very obese' group (Appendix 81, b).
[c] For education level, initial analysis as carried out with four categories (Appendix 81, c), but few women had no formal qualification or had only completed primary/lower secondary education, resulting in violation of the chi square assumptions; hence, this category was merged with 'upper secondary education'.
[d] For employment status, analysis was conducted with six categories initially (Appendix 81, d). Eleven women who ticked 'other' and said they were self-employed were included in the 'full-time paid work' category. One woman on a full-time paid internship was also included in that category. Categories were merged into a binary variable because of the small number of women in some categories leading to violation of the chi square assumptions.
[e] Initial analysis did not show any significant association between return to work and persistence of PPGP 6 to 9 months postpartum; however, only 18.5% of women on paid maternity leave had persistent PPGP 6 to 9 months postpartum, but the number of women in this category was small. Subsequently, categories were merged, increasing power.
[f] The five DASS categories were merged into a binary variable due to the small number of women in some categories (Appendix 81, e).

[g] Categories were merged to address the violation of the chi square assumptions (Appendix 81, f). Subsequently, categories were merged into a binary variable.
[h] Categories were merged because the chi square assumptions were violated (Appendix 81, g).

Table 6-54 Prognostic factors for PPGP persisting 6-9 months postpartum – Univariate analysis

6.9.6 Multivariable analysis assessing prognostic factors for PPGP 6-9 months postpartum

The variables significantly associated with persistent PPGP 6 to 9 months postpartum in univariate analysis were; BMI, educational level, return to work, a history of any pelvic girdle pain in the before pregnancy, stress in the first three months postpartum, breastfeeding, PPGP pain location during pregnancy, and a history of injury to the back. The variable 'depression 0-3 months postpartum' was not included in the multivariable model because only one category was significantly associated with persistent PPGP 6 to 9 months postpartum in the presence of violation of the chi square assumptions, and it was not significantly associated with persistent PPGP after recoding the variable into a binary variable. The Omnibus Test of Model Coefficients for the multivariable model was statistically significant (X^2=103.1, df=15, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=9.4, df=8, p=0.307) (Table 6-55 to Table 6-57).

Obese and very obese women were more likely to have persistent PPGP 6 to 9 months postpartum (OR 2.5, 95% 1.4-4.5, p=0.003). Women with no university qualification or equivalent were also more likely to have persistent PPGP (OR 1.6, 95% CI 1.0-2.6, p=0.04). Moreover, a history of any pelvic girdle pain in the year before pregnancy (OR 3.5, 95% CI 2.4-5.1, p<0.001), stress in the first three months postpartum (OR 2.4, 95% 1.2-4.8, p=0.01), and having combined anterior and posterior PPGP during pregnancy (OR 4.2, 95% CI 1.4-12.5, p=0.009) were significantly associated with persistent PPGP 6 to 9 months postpartum. Return to work, breastfeeding, and a history of any injury to the back were not significantly associated with persistent PPGP 6 to 9 months postpartum in multivariable analysis.

Factors	Number of participants	No persistent PPGP	Persistent PPGP		P	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
BMI	**n=578**	**n=348**	**n=230.**	**%**				
Underweight	19	12	7	36.8	1.0	1.0 (0.4-2.6)	0.9	1.0 (0.4-3.0)
Ideal	393	248	145	36.9		1.0 (ref.)		1.0 (ref.)
Overweight	97	63	34	35.1	0.7	0.9 (0.6-1.5)	0.6	0.9 (0.5-1.5)
Obese/very obese	69	25	44	63.8	<0.001	3.0 (1.7-5.1)	0.003	2.4 (1.4-4.5)
Missing	40							
Educational level	**n=616**	**n=367**	**n=249**	**%**				
No formal education/primary/lower secondary/Upper secondary	147	71	76	51.7	0.002	1.8 (1.2-2.7)	0.04	1.6 (1.0-2.6)
University degree or equivalent/postgraduate	469	296	173	36.9		1.0 (ref.)		1.0 (ref.)
Missing	2							
Return to work	**n=617**	**n=368**	**n=249**	**%**				
Returned to work/study	305	170	135	44.3		1.0 (ref.)		1.0 (ref.)
Maternity leave (paid or unpaid)	211	137	74	35.1	0.04	0.7 (0.5-1.0)	0.3	0.8 (0.5-1.2)
Not in paid work or studying	101	61	40	39.6	0.4	0.8 (0.5-1.3)	0.1	0.7 (0.4-1.2)
Missing	1							

Table 6-55 Multivariable logistic analysis assessing prognostic factors for PPGP 6-9 months postpartum

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Any pelvic girdle pain in the 12 months pre-pregnancy	**n=617**	**n=367**	**n=250**	**%**				
No	318	238	80	25.2		1.0 (ref.)		1.0 (ref.)
Yes	299	129	170	56.9	<0.001	3.9 (2.8-5.5)	<0.001	3.5 (2.4-5.1)
Missing	1							
Stress 0-3 months postpartum	**n=611**	**n=364**	**n=247**	**%**				
Normal/mild	560	345	215	38.4		1.0 (ref.)		1.0 (ref.)
Moderate/severe/very severe	51	19	32	62.7	0.001	2.7 (1.5-4.9)	0.01	2.5 (1.2-4.8)
Missing	7							
PPGP pain location during pregnancy	**n=617**	**n=367**	**n=250**	**%**				
Anterior	37	32	5	13.5		1.0 (ref.)		1.0 (ref.)
Posterior	459	274	185	40.3	0.003	4.3 (1.7-11.3)	0.1	2.3 (0.8-6.6)
Combined anterior & posterior	121	61	60	49.6	<0.001	6.3 (2.3-17.2)	0.009	4.2 (1.4-12.4)
Missing	1							

Table 6-56 Multivariable logistic analysis assessing prognostic factors for PPGP 6-9 months postpartum – continued

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Breastfeeding	**n=614**	**n=367**	**n=247**	**%**				
Never breastfed	12	71	56	44.1	0.2	1.4 (0.9-2.3)	0.6	0.9 (0.5-1.5)
Initiated breastfeeding but stopped between 0-3 months postpartum	178	95	83	46.6	0.04	1.6 (1.0-2.4)	0.3	1.3 (0.8-2.1)
Initiated breastfeeding but stopped between 3-6 months postpartum	78	50	28	35.9	1.0	1.0 (0.6-1.8)	0.4	0.7 (0.4-1.4)
Initiated breastfeeding but stopped between 6-9 months postpartum	75	51	24	32.0	0.8	0.8 (0.5-1.5)	0.5	0.8 (0.4-1.5)
Still breastfeeding at 9 months postpartum	156	100	56	35.9		1.0 (ref.)		1.0 (ref.)
Missing	4							
History of any injury to the back	**n=606**	**n=361**	**n=245**	**%**				
No	582	354	228	39.2		1.0 (ref.)		1.0 (ref.)
Yes	24	7	17	70.8	0.004	3.8 (1.5-9.2)	0.07	2.6 (0.9-7.2)
Missing	12							

Table 6-57 Multivariable logistic analysis assessing prognostic factors for PPGP 6-9 months postpartum - continued

6.9.7 Prognostic factors for PPGP persisting 9-12 months postpartum – Univariate analysis

The univariate analyses for potential prognostic factors for PPGP persisting three to six months postpartum are presented in Table 6-58.

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Age (years) 25-29 reference[a]						
	n=514	**n=369**	**n=250**	**%**		
18-24	32	18	14	43.8	0.3	1.6 (0.7-3.5)
25-29	124	83	41	33.1		1.0 (ref.)
30-34	232	159	73	31.5	0.7	0.9 (0.6-1.5)
≥35	126	83	43	34.1	0.9	1.0 (0.6-1.8)
Missing	0					
Age (years) 18-24 reference[a]						
	n=514	**n=369**	**n=250**	**%**		
18-24	32	18	14	43.8		1.0 (ref.)
25-29	124	83	41	33.1	0.3	0.6 (0.3-1.4)
30-34	232	159	73	31.5	0.2	0.6 (0.3-1.3)
≥35	126	83	43	34.1	0.3	0.7 (0.3-1.5)
Missing	0					
BMI[b]						
	n=488	**n=329**	**n=159**	**%**		
Underweight	16	13	3	18.8	0.4	0.6 (0.2-2.0)
Ideal	335	237	98	29.3		1.0 (ref.)
Overweight	78	54	24	30.8	0.8	1.1 (0.6-1.9)
Obese/very obese	59	25	34	57.6	<0.001	3.3 (1.9-5.8)
Missing	26					
Educational level[c]						
	n=512	**n=342**	**n=170**	**%**		
No formal education/primary/lower secondary/ Upper secondary	121	73	48	39.7	0.08	1.5 (1.0-2.2)
University degree or equivalent/ postgraduate	391	269	122	31.2		1.0 (ref.)
Missing	2					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Employment status[d]						
	n=507	**n=310**	**n=167**	**%**		
Working	414	280	134	32.4		1.0 (ref.)
Not working	93	60	33	35.5	0.6	1.1 (0.7-1.8)
Missing	7					
Return to work						
	n=507	**n=340**	**n=167**	**%**		
Returned to work/study 0-3 months postpartum	22	13	9	40.9		1.0 (ref.)
Returned to work/study 3-6 months postpartum	71	46	25	35.2	0.6	0.8 (0.3-2.1)
Returned to work/study 6-9 months postpartum	153	102	51	33.3	0.5	0.7 (0.3-1.8)
Returned to work/study 9-12 months postpartum	149	102	47	31.5	0.4	0.7 (0.3-1.7)
Paid maternity leave	2	1	1	50.0	0.8	1.4 (0.1-26.2)
Unpaid maternity leave	29	25	4	13.8	0.03	0.2 (0.1-0.9)
Not in paid work or studying	81	51	30	37.0	0.7	0.9 (0.3-2.2)
Missing	7					
Marital status						
	n=514	**n=343**	**n=171**	**%**		
Married	330	229	101	30.6		1.0 (ref.)
Single	16	8	8	50.0	0.1	2.3 (0.8-6.2)
Living with partner	141	92	49	34.8	0.4	1.2 (0.8-1.8)
In a relationship - not living together	27	14	13	48.1	0.1	2.1 (1.0-4.6)
Missing	0					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Ethnicity						
	n=512	**n=343**	**n=169***	**%**		
White background	492	329	163	33.1		1.0 (ref.)
Black or African background	2	2	0	0.0	x	x
Asian background	11	7	4	36.4	0.8	1.2 (0.3-4.0)
Mixed background	7	5	2	28.6	0.8	0.8 (0.2-4.2)
Missing	2					
Low back pain in the 12 months before pregnancy						
	n=512	**n=341**	**n=171**	**%**		
No	408	278	130	31.9		1.0 (ref.)
Yes	104	63	41	39.4	0.1	1.4 (0.9-2.2)
Missing	2					
Pelvic girdle pain in the 12 months before pregnancy						
	n=513	**n=341**	**n=171**	**%**		
No	261	213	48	18.4		1.0 (ref.)
Yes	252	129	123	48.8	<0.001	4.2 (2.8-6.3)
Missing	1					
History of heavy periods						
	n=514	**n=343**	**n=171**	**%**		
No	446	301	145	32.5		1.0 (ref.)
Yes	68	42	26	38.2	0.4	1.3 (0.8-2.2)
Missing	0					
History of severe period pain						
	n=514	**n=343**	**n=171**	**%**		
No	339	230	109	32.1		1.0 (ref.)
Yes	175	113	62	35.4	0.5	1.2 (0.8-1.7)
Missing	0					
Anxiety during pregnancy (DASS)[e]						
	n=507	**n=338**	**n=169**	**%**		
Normal/mild	474	317	157	33.1		1.0 (ref.)
Moderate/severe /very severe	33	21	12	36.4	0.7	1.2 (0.6-2.4)
Missing	7					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Anxiety 0-3 months postpartum (DASS)[e]						
	n=509	**n=338**	**n=171**	**%**		
Normal/mild	488	327	161	33.0		1.0 (ref.)
Moderate/severe / very severe	21	11	10	47.6	0.2	1.9 (0.8-4.4)
Missing	5					
Depression during pregnancy (DASS)[f]						
	n=506	**n=337**	**n=169**	**%**		
Normal/mild	476	320	156	32.8		1.0 (ref.)
Moderate/severe/ very severe	30	17	13	43.3	0.2	1.6 (0.7-3.3)
Missing	8					
Depression during pregnancy (EPDS)[f]						
	n=505	**n=310**	**n=168**	**%**		
Score 0-12	462	310	152	32.9		1.0 (ref.)
Score ≥13	43	27	16	37.2	0.6	1.2 (0.6-2.3)
Missing	9					
Depression 0-3 months postpartum (DASS)[f]						
	n=508	**n=341**	**n=169**	**%**		
Normal/mild	476	320	156	32.8		1.0 (ref.)
Moderate/severe/ very severe	32	19	13	40.6	0.4	1.4 (0.7-2.9)
Missing	6					
Depression 0-3 months postpartum (EPDS)[f]						
	n=510	**n=339**	**n=171**	**%**		
Score 0-12	469	316	153	32.6		1.0 (ref.)
Score ≥13	41	23	18	43.9	0.1	1.6 (0.8-3.1)
Missing	4					
Stress during pregnancy (DASS)[g]						
	n=508	**n=339**	**n=169**	**%**		
Normal	443	304	139	31.4	0.1	1.0 (ref.)
Mild/moderate	53	29	24	45.3	0.04	1.8 (1.0-3.2)
Severe/very severe	12	6	6	50.0	0.2	2.2 (0.7-6.9)
Missing	6					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Stress 0-3 months postpartum (DASS)[g]						
	n=510	**n=340**	**n=170**	**%**		
Normal/mild	467	323	144	30.8		1.0 (ref.)
Moderate/severe /very severe	43	17	26	60.5	<0.001	3.4 (1.8-6.5)
Missing	4					
Smoking						
	n=507	**n=338**	**n=169**	**%**		
Smoking	30	20	10	33.3	0.9	1.0 (0.4-2.1)
Stopped smoking before pregnancy or when found out being pregnant	201	137	64	31.8	0.6	0.9 (0.6-1.3)
Not smoking	276	181	95	34.0		1.0 (ref.)
Missing	7					
Breastfeeding						
	n=511	**n=342**	**n=169**	**%**		
Never breastfed	103	64	39	37.5	0.5	1.2 (0.7-2.2)
Initiated breastfeeding but stopped between 0-3 months postpartum	149	96	53	35.6	0.7	1.1 (0.6-1.9)
Initiated breastfeeding but stopped between 3-6 months postpartum	65	45	20	30.8	0.7	0.9 (0.5-1.7)
Initiated breastfeeding but stopped between 6-9 months postpartum	60	44	16	26.7	0.4	0.7 (0.4-1.5)
Initiated breastfeeding but stopped between 9-12 months postpartum	35	27	8	22.9	0.3	0.6 (0.2-1.4)
Still breastfeeding at 12 months postpartum	99	66	33	33.3		1.0 (ref.)
Missing	3					

Factor	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)
Mode of birth (7 categories)						
	n=495	**n=330**	**n=165**	**%**		
Spontaneous birth without epidural	83	50	33	39.8		1.0 (ref.)
Spontaneous birth with epidural	92	64	28	30.4	0.2	0.7 (0.4-1.2)
Vacuum or kiwi birth	108	77	31	28.7	0.1	0.6 (0.3-1.1)
Forceps or combined instrumental birth	59	39	20	33.9	0.5	0.8 (0.4-1.6)
Caesarean section with no labour	73	51	22	30.1	0.2	0.7 (0.3-1.3)
Caesarean section in 1st stage labour	65	40	25	38.5	0.9	1.0 (0.5-1.8)
Caesarean section in 2nd stage labour	15	9	6	40.0	1	1.0 (0.3-3.1)
Missing	19					
Mode of birth (5 categories)						
	n=495	**n=330**	**n=165**	**%**		
Spontaneous birth without epidural	83	50	33	39.3		1.0 (ref.)
Spontaneous birth with epidural	92	64	28	30.4	0.2	0.7 (0.4-1.2)
Instrumental birth	167	116	51	30.5	0.1	0.7 (0.4-1.2)
Caesarean section with no labour	73	51	22	30.1	0.2	0.7 (0.3-1.3)
Caesarean section in 1st or 2nd stage labour	80	49	31	38.8	0.9	1.0 (0.5-1.8)
Missing	19					
PPGP Pain location during pregnancy						
	n=513	**n=342**	**n=171**	**%**		
Anterior	30	28	2	6.7		1.0 (ref.)
Posterior	385	253	132	34.3	0.01	7.3 (1.7-31.1)
Combined anterior & posterior	98	61	37	37.8	0.01	8.5 (1.9-37.7)
Missing	1					
History of injury to the back						
	n=504	**n=337**	**n=167**	**%**		
No	484	330	154	31.8		1.0 (ref.)
Yes	20	7	13	65.0	0.004	4.0 (1.6-10.2)
Missing	10					

*Chi square assumption was violated with >20% of cells having an expected count of > 5

[a] The over 40 years age group was merged with the 35-39 years group due to the small numbers in the over 40 group (Appendix 82, a).
[b] The categories 'obese' and 'very obese' were merged due to the small number of women in the latter (Appendix 82, b).
[c] The number of women with no qualification, primary or lower secondary qualification was low, and chi square assumptions were violated (Appendix 82, c); hence categories were merged into a binary variable.
[d] Analysis was conducted with six categories initially (Appendix 81, d). Five self-employed women were included in 'full-time paid work'. Categories were merged into a binary variable because of small numbers.
[e] For anxiety, the five DASS categories were merged into a binary variable due to the small number of women in some categories and chi square assumption violation (Appendix 82, e).
[f] Categories were merged to address violation of the chi square assumptions (Appendix 82, f).
[g] Categories were merged to address violation of chi square assumptions (Appendix 82, g).

Table 6-58 Prognostic factors for PPGP persisting 9-12 months postpartum – Univariate analysis

6.9.8 Multivariable analysis assessing prognostic factors for PPGP 9-12 months postpartum

The variables significantly associated with persistent PPGP 9 to 12 months postpartum in univariate analysis were; BMI, return to work, a history of any pelvic girdle pain in the before pregnancy, stress in the first three months postpartum, PPGP pain location during pregnancy, and a history of injury to the back. The Omnibus Test of Model Coefficients was statistically significant (X^2=87.6, df=11, p<0.001) and the Hosmer and Lemeshow Test also supported the model (X^2=4.1, df=7, p=0.773) (Table 6-59 and Table 6-60).

Obese and very obese women were more likely to have persistent PPGP 9 to 12 months postpartum (OR 3.1, 95% CI 1.7-6.0, p<0.001). Women with a history of any pelvic girdle pain in the year before pregnancy were also more likely to report persistent PPGP (OR 3.7, 95% CI 2.4-5.8, p<0.001), as were women who experience stress in the first three months after the birth (OR 3.4, 95% CI 1.6-7.2, p=0.001). Compared to women with anterior PPGP during pregnancy, women with combined anterior and posterior PPGP were less likely to recover (OR 4.5, 1.0-21.6, p=0.05). On the other hand, women on unpaid maternity leave were less likely to experience persistent PPGP 9 to 12 months postpartum (OR 0.3, 95% CI 0.09-1.0, p=0.04). A history of injury to the back was not associated with persistent PPGP 9 to 12 months postpartum in multivariable analysis.

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
BMI	**n=488**	**n=329**	**n=159**	**%**				
Underweight	16	13	3	18.8	0.4	0.6 (0.2-2.0)	0.7	0.8 (0.2-2.9)
Ideal	335	237	98	29.3		1.0 (ref.)		1.0 (ref.)
Overweight	78	54	24	30.8	0.8	1.1 (0.6-1.9)	1	1.0 (0.6-1.8)
Obese/very obese	59	25	34	57.6	<0.001	3.3 (1.9-5.8)	<0.001	3.1 (1.7-6.0)
Missing	26							
Return to work	**n=507**	**n=340**	**n=167**	**%**				
Returned to work/study	395	263	132	33.4		1.0 (ref.)		1.0 (ref.)
Paid maternity leave	2	1	1	50.0	0.6	2.0 (0.1-35.1)	0.8	1.3 (0.08-21.9)
Unpaid maternity leave	29	25	4	13.5	0.04	0.4 (0.1-0.9)	0.04	0.3 (0.09-1.0)
Not in paid work or studying	81	51	30	37	0.5	1.2 (0.7-1.9)	0.9	1.0 (0.5-1.8)
Missing	7							
Any pelvic girdle pain in the 12 months pre-pregnancy	**n=513**	**n=341**	**n=171**	**%**				
No	261	213	48	18.4		1.0 (ref.)		1.0 (ref.)
Yes	252	129	123	48.8	<0.001	4.2 (2.8-6.3)	<0.001	3.7 (2.4-5.8)
Missing	1							

Table 6-59 Multivariable logistic analysis assessing prognostic factors for PPGP 9-12 months postpartum

Factors	Number of participants	No persistent PPGP	Persistent PPGP		p	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)
	n	n	n	%				
Stress 0-3 months postpartum	**n=510**	**n=340**	**n=170**	**%**				
Normal/mild	467	323	144	30.8		1.0 (ref.)		1.0 (ref.)
Moderate/severe/very severe	43	17	26	60.5	<0.001	3.4 (1.8-6.5)	0.001	3.4 (1.6-7.2)
Missing	4							
PPGP pain location during pregnancy	**n=513**	**n=342**	**n=171**	**%**				
Anterior	30	28	2	6.7		1.0 (ref.)		1.0 (ref.)
Posterior	385	253	132	34.3	0.01	7.3(1.7-31.1)	0.09	3.6 (0.8-16.6)
Combined anterior & posterior	98	61	37	37.8	0.01	8.5 (1.9-37.7)	0.05	4.5 (0.9-21.6)
Missing	1							
History of any injury to the back	**n=504**	**n=337**	**n=167**	**%**				
No	484	330	154	31.8		1.0 (ref.)		1.0 (ref.)
Yes	20	7	13	65.0	0.004	4.0 (1.6-10.2)	0.1	2.4 (0.8-6.9)
Missing	10							

Table 6-60 Multivariable logistic analysis assessing prognostic factors for PPGP 9-12 months postpartum - continued

6.10 Discussion: Prevalence of and prognostic factors for PPGP persisting postpartum

The findings of the second half of this chapter related to the prevalence of persistent PPGP and prognostic factors for PPGP are compared to the existing literature and the findings of the systematic review (Chapter 3) in sections 6.17.1 and 6.17.2.

6.10.1 Discussion of the prevalence of persistent PPGP in this study in the context of previous studies

The period prevalence of persistent PPGP postpartum in this study dropped from 68.8% (n=566) 0 to 3 months postpartum, to 51.2% (n=367) 3 to 6 months postpartum, to 40.5% (n=250) 6 to 9 months postpartum, and to 33.3% (n=171) 9 to 12 months postpartum. Larsen *et al.* (1999) found a lower prevalence of persistent PPGP in a cohort of 1600 women in Denmark, with 31% (n=87) having persistent PPGP two months postpartum, 23% (n=64) six months postpartum, and 12% twelve months postpartum. However, the study had a more narrow definition of PPGP and women had to have pain on at least two of five daily activities and test positive on clinical tests. In another Danish study, 8.6% (n=29) had daily persistent PPGP at two years postpartum (Albert *et al.* 2002). In a cohort in the Netherlands, 10% (n=43) had persistent moderate to severe PPGP 18 months postpartum (Rost *et al.* 2006). Gutke *et al.* (2011) reported a persistent PPGP point prevalence of 17% (n=46) three months postpartum, and 5% (n=14) had persistent PPGP in combination with PLBP.

Concerning sub-outcomes of PPGP by pain location, Ostgaard *et al.* (1996) followed up 164 women with posterior PPGP, of whom 45% had persistent symptoms 11 weeks postpartum and 31% had not recovered at 23 weeks postpartum. In the present study, of the women who experienced posterior PPGP during pregnancy, 52.4% (n=431) had persistent PPGP 0 to 3 months postpartum and 44.2% (n=317) 3 to 6 months postpartum, but this was the period prevalence which may explain the slightly higher numbers. In another Swedish study, Noren *et al.* (2002) reported that 8% (n=16) had

persistent posterior PPGP three years postpartum. Bjelland *et al.* (2013b) found a 22% (n=9909) prevalence of persistent PPGP in a large cohort in Norway, with 3% (n=1252) having persistent pelvic girdle syndrome and 0.5% (n=196) having severe persistent pelvic girdle syndrome six months postpartum. In the present study, 14% (n=115) of women with combined anterior and posterior PPGP during pregnancy had persistent PPGP in the first three months postpartum, and 5.4% (n=39) had persistent symptoms 3 to 6 months postpartum. This slightly higher prevalence may, in part, be because this study examined period prevalence. Moreover, combined anterior and posterior PPGP encompasses some women (with one-sided sacroiliac and pubic symphysis pain) that are not included in pelvic girdle syndrome.

Similar to studies examining PPGP during pregnancy, persistent PPGP prevalence numbers vary in the literature due to different definitions and whether point or period prevalence was assessed (Appendix 1). This study only followed women up to 12 months postpartum, making comparisons with studies that re-assessed women at a later time difficult.

6.10.2 Discussion of the prognostic factors for PPGP identified in this study in the context of the systematic review (Chapter 3)

In this section, the findings of this study concerning prognostic factors for PPGP are compared to the findings of the systematic review (Chapter 3). Table 6-61 provides an overview of the significance of factors that were included in any of the multivariable models for the four postpartum follow-up periods. Factors that were only examined in univariate analysis, but were not included in any of the final multivariable models are also discussed.

FACTORS EXAMINED in multivariable analyses	Persistent PPGP 0-3 months postpartum	Persistent PPGP 3-6 months postpartum	Persistent PPGP 6-9 months postpartum	Persistent PPGP 9-12 months postpartum
Age (years)	x	X	x	x
BMI	v	V	v	v
Educational level 2 cat	x	X	v	x
Return to work	x	X	x	v
Any lumbopelvic pain or pelvic girdle pain in 12 months pre-pregnancy	v	V	v	v
A history of heavy periods	x	X	x	x
A history of severe period pain	v	X	x	x
Depression during pregnancy	x	X	x	x
Stress 0-3 months postpartum	N/A	X	v	v
Smoking	x	X	x	x
Breastfeeding	x	X	x	x
Mode of birth	v	V	x	x
PPGP pain location during pregnancy	v	V	v	v
A history of any injury to the back	x	X	x	x

The variables employment status, marital status, ethnicity, a history of heavy periods, anxiety during pregnancy, anxiety 0-3 months postpartum, stress during pregnancy, and smoking, were not statistically significant in univariate analysis for any of the follow-up periods. Depression 0-3 months postpartum was not included in multivariable analyses because of violation of chi square assumptions.
v: Statistically significantly associated with persistent PPGP in multivariable analysis (highlighted in yellow)
x: Not statistically significantly associated with persistent PPGP in multivariable analysis

Table 6-61 Overview of statistical significance of examined prognostic factors for PPGP in multivariable analyses

Obese and very obese women were more likely to have persistent PPGP at all four follow-up periods in this study. Similarly, Robinson *et al.* (2010b) found that women with a pre-pregnancy BMI of over 25 kg/m^2 were less likely to recover 12 weeks postpartum compared to women with a lower BMI. Bjelland *et al.* (2013b) reported that women with a BMI of 30 kg/m^2 or higher were more likely to have persistent pelvic girdle syndrome at six months postpartum. Data from this study could not be pooled with either of these previous studies due to differences in outcomes and outcome measurement.

A history of any lumbopelvic pain in the year before pregnancy was strongly associated with persistent PPGP in the first three months after the birth. Similarly, Robinson *et al.* (2010b) found that women with pre-pregnancy low back pain were more likely to have persistent PPGP 12 weeks postpartum (Appendix 54). A history of any pelvic girdle pain in the year before pregnancy was strongly associated with persistent PPGP 3 to 12 months postpartum in this study. Bjelland *et al.* (2013b) reported a positive association between previous low back pain and persistent pelvic girdle syndrome and severe pelvic girdle syndrome, but no studies examined a history of pelvic girdle pain as prognostic factor.

Women who gave birth by vacuum or kiwi were significantly less likely to have persistent PPGP 0 to 3 and 3 to 6 months postpartum compared to women who had a spontaneous vaginal birth without epidural. In contrast, Bjelland *et al.* (2013c) found that instrumental birth was associated with persistent pelvic girdle syndrome six months postpartum, and a planned caesarean section was associated with severe persistent pelvic girdle syndrome (Appendix 56).

Women with posterior or combined anterior and posterior PPGP during pregnancy were more likely to have persistent PPGP 0 to 3 and 3 to 6 months postpartum. Similarly, Robinson *et al.* (2010b) found that women with pain in three to four locations of the pelvic girdle were more likely to have persistent PPGP 12 weeks postpartum (Appendix 54). There was also a significant association between combined anterior and posterior PPGP and

persistent PPGP 6 to 9 and 9 to 12 months postpartum in this study, but no previous studies examined pain location as a prognostic factor at these follow-up times.

There was no significant association between anxiety or depression, during pregnancy or first three months postpartum, and persistent PPGP at any of the follow-up periods in this study. Stress during pregnancy did not affect the prognosis of PPGP, but women with moderate or more severe stress in the first three months postpartum were more likely to have persistent PPGP 6 to 9 and 9 to 12 months postpartum. No studies included in the systematic review examined anxiety, depression or stress as prognostic factors, or as a result of PPGP. However, Bjelland *et al.* (2013b) assessed the impact of emotional distress at 17 weeks or 30 weeks of pregnancy on persistent pelvic girdle syndrome six months postpartum and found a positive association (Appendix 57).

Smoking was not a significant prognostic factor in this study. Bjelland *et al.* (2013b) found occasional smokers to be more likely to have persistent pelvic girdle syndrome six months postpartum, but this was not the case for the sub-outcome severe persistent pelvic girdle syndrome, nor for daily smokers (Appendix 56).

The variables; age, educational level employment status, return to work, marital status, ethnicity, a history of heavy periods, a history of severe period pain, breastfeeding, and a history of injury to the back, were not significant prognostic factors in this study and had not been examined in any of the studies included in the systematic review.

6.11 Conclusion

This chapter presented the findings of the quantitative phase (1) of this PhD study, including the prevalence of PPGP and persistent PPGP, and data on risk and prognostic factors for PPGP, primarily addressing objectives 1 to 3 of this study. Pregnancy-related pelvic girdle pain was common, affecting more than half of women. A high BMI and a history of any lumbopelvic pain in the year before pregnancy were significant risk factors, while an older age seem to have a protective effect. The prevalence of persistent PPGP reduced as time went on, but about a third of women who experienced PPGP during pregnancy continued to have symptoms a year after the birth. A high BMI, a history of lumbopelvic or pelvic girdle pain in the year before pregnancy, and a posterior or combined anterior and posterior PPGP pain location during pregnancy, made full recovery from PPGP less likely. Women who gave birth by vacuum or kiwi were less likely to have persistent PPGP in the first six months after the birth, but not later on. Women with stress in the first three months after the birth were more likely to have persistent symptoms 6 to 9 and 9 to 12 months postpartum.

In the next chapter (7), the findings of the qualitative phase (2) of this study are presented.

Chapter 7 Findings & Discussion: Phase 2 Qualitative

7.1 Introduction

This chapter presents the findings of the qualitative phase (2) of this study. This phase particularly addressed the following objectives of the study:

(4) To explore women's experiences with regards to the impact of self-reported persistent PPGP postpartum on their life, in particular on the care of their infant and parental role

(5) To explore the health-seeking behaviours of women with PPGP that persists postpartum

Demographic information of the women who were interviewed and details of participants' pain severity, location and pattern (obtained from the pre-interview questionnaire; Appendix 66) are provided in Section 7.2. In section 7.3, the themes and categories that emerged from the data are described, with quotes included to demonstrate the findings. These themes/categories are discussed in Section 7.4 in the context of existing literature (Chapter 2) and the theoretical framework (Chapter 4). Full details of the analysis process were outlined in the chapter 5 (section 5.4.4.2). Before concluding this chapter, section 7.5 outlines the findings of the member checking that was done as a strategy to ensure methodological rigour.

7.2 Participant characteristics and demographics

7.2.1 Age

Twenty-three women were interviewed, following consent. The average age of the interviewees was 32 (SD=4.2), with the youngest woman being 22 and the eldest 38 years of age.

≤ 24	25-29	30-34	35-39	≥ 40
2	2	12	7	0

Table 7-1 Age (years) categories of interviewees

7.2.2 Country of birth

Twenty of the interviewees were native English speakers, 19 were born in Ireland and one in the United Kingdom. One woman was born in Poland, one in Denmark and one in Italy. For these three women, English was their second language.

7.2.3 Socio-economic status

Twenty-one of the 23 (91%) women were in full-time employment before going on maternity leave, one woman was unemployed and one was studying.

The highest qualification of the interviewees was as follows:

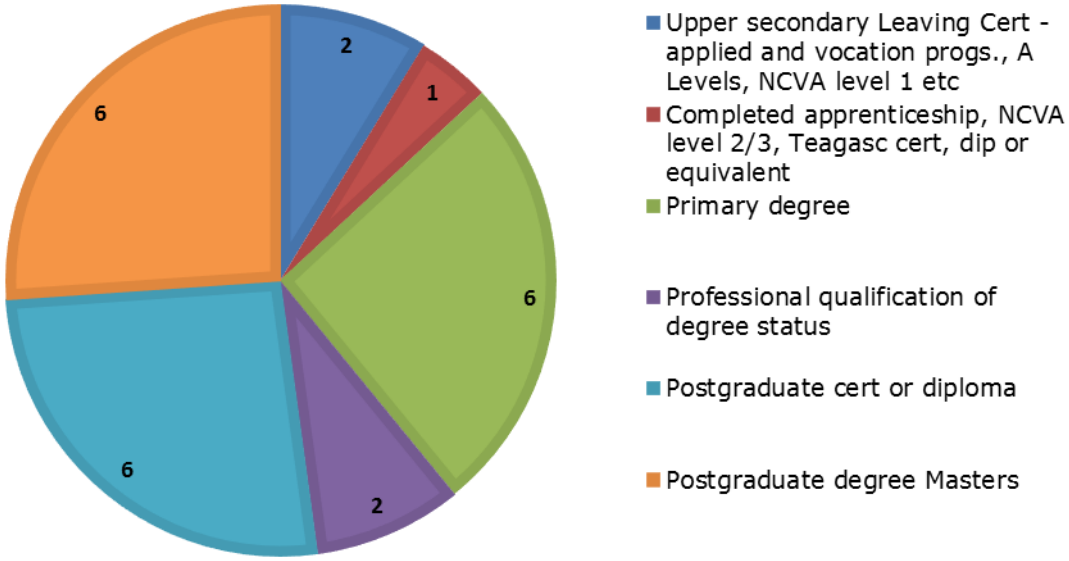

Figure 7-1 Highest qualification of interviewees

Fifteen women were married, six were living with their partner but were not married. Two women were in a relationship but not living together, one of whom was living with her mother and the other with her grandmother. All other women lived with their partner or husband, with the exception of one woman whose husband lived abroad. Two women also had an additional family member living in the house.

7.2.4 Pain severity

On the numerical pain rating scale (0-10) the average pain severity in the morning amongst interviewees was 5.0 (SD 2.3), ranging from 0 to 8 with median 5. In the evening, the average pain severity reported was 5.7 (SD 1.9) ranging from 2 to 8, with median 6.

7.2.5 Pain pattern

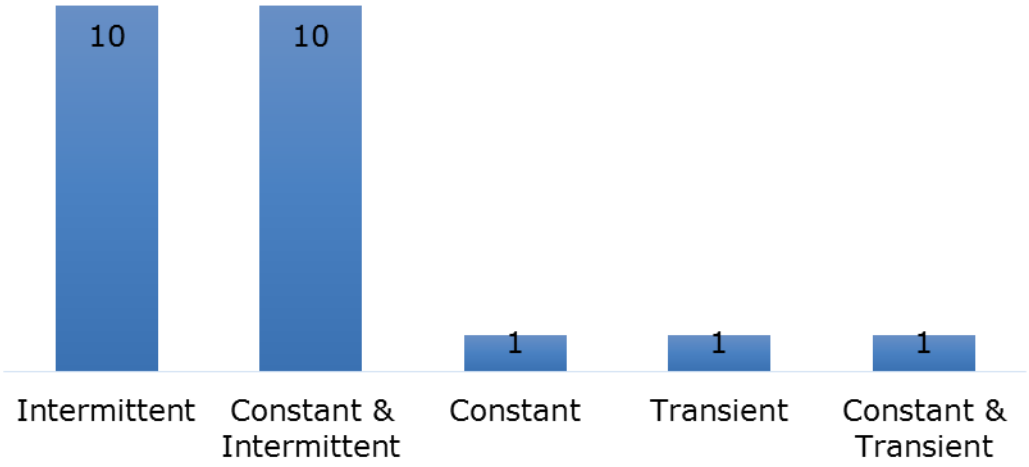

Figure 7-2 Persistent PPGP pain patterns of interviewees

'Transient' pain was described as brief/momentary, while 'intermittent' pain was said to be periodic/rhythmic. Women who ticked both constant, and intermittent or transient pain patterns, meant that on some days the pain would be constant, while other days it would be intermittent/transient.

7.2.6 Pain location

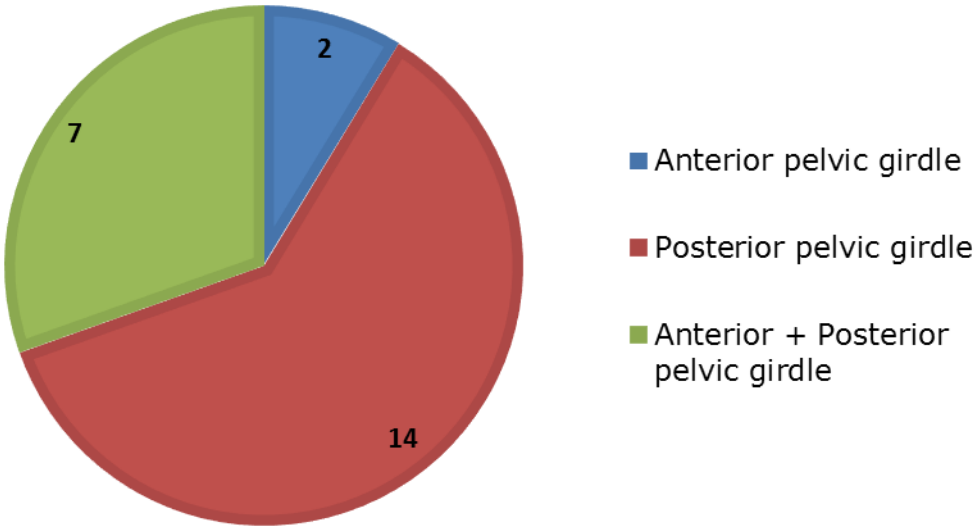

Figure 7-3 Pain location of persistent PPGP in interviewees

Twelve of the 23 women also experienced some pain in areas other than the pelvic girdle, although the latter was their primary area of complaint.

7.2.7 Time postpartum

The mean number of days postpartum at the time of the interview was 183 days (SD 69 days). Fourteen participants were between 3 and 6 months (91-182 days) postpartum when they took part in the interview, six women were between 6 and 9 months (183-273 days) and, for three women, between 9 and 12 months (274-364 days) had passed since the birth. During the analysis, no differences in emerging themes/categories were identified that seemed related to the time elapsed since birth, but the number of days postpartum when the interview took place is included in the identifier of each individual quote in the results, for information (Section 7.3). For example, the identifier '(13; 137 days)' refers to participant 13 who was interviewed 137 days postpartum.

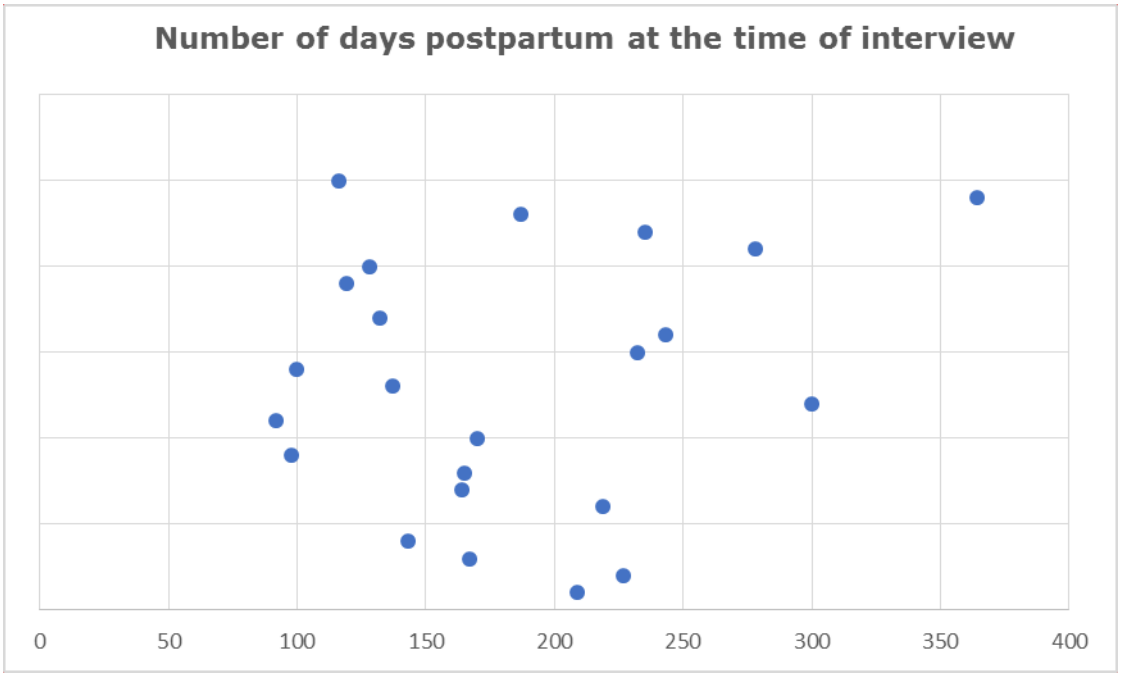

Figure 7-4 The number of days since the birth of their baby at the time of the interview for the 23 participants

7.3 Emerging themes and categories

Six themes, each with several categories, emerged from the women's accounts of their experiences (Table 7-2).

Categories	Themes
• Attitudes to pain: balancing activities • Everyday challenges • Coping strategies • Additional support	'Putting up with it': Coping with everyday life
• Physical feelings of pain • Cognitive components of pain: Why me? • Affective components of pain	'I don't feel back to normal'
• Lack of follow-up after birth • Healthcare professionals ignore it	'They didn't ask, I didn't tell'
• Talking to others • Triggers to seek help • Barriers to getting help	Seeking advice and support
• 'I thought it would be gone by now' –previous expectations • Lack of information	'Unexpected'
• A changing pain • Uncertainty & hope for the future • Having another baby; 'I'm worried but it wouldn't stop me'	'What next?'

Table 7-2 Overview of emerging themes and categories

Although no existing thematic framework was used for the analysis, but instead the themes and categories emerged from the data, considering the main objectives of phase 2 of this study, the themes 'Putting up with it', 'I don't feel back to normal', 'Unexpected' and 'what next', mainly address the first objective (4) to explore women's experiences of how their persistent PPGP impacts their life. The themes 'They didn't ask, I didn't tell' and 'Seeking advice and support' on the other hand mostly encompass experiences of women in terms of the help they received and sought, the second objective (5) of this qualitative phase of the study.

7.3.1 'Putting up with it'; Coping with everyday life

Attitudes to pain: balancing activities

The women said they generally just 'put up with the pain' and 'got on' with their daily lives. They also told how they often had no choice in avoiding pain-provoking activities if nobody was around to help.

> *But I have to lift him during the day, I have to lift my son; I have to change him, so I just grin and bear it. (13; 137 days)*

However, eight women said that their persistent PPGP stopped them from doing things or going out of the house, although for others the pain was present but did not prevent activities. Many women (12) expressed that the PPGP is something they have to be cognisant off when doing and planning things.

> *You're always conscious that it's there and that you have to mind it now, that you don't want it to get any worse. (22; 235 days)*

Then again, they could not make it a priority in their busy lives as new mums.

> *I suppose the honest thing is; it's at the bottom of a long list of things that I have to worry about at the moment so I ignore it, I just let it go. (10; 170 days)*

This ambiguity reflects the challenging balancing act that women had to deal with daily: on the one hand, continuing as normal, and on the other hand, trying to avoid worsening of their symptoms.

> *Sometimes I'll just go for a walk because I feel like my pelvis is kind of stuck. So sometimes it helps to walk it out. But then I feel like if I go for a walk, am I going to be twice as bad afterwards? I feel like if I've had a walk I've done more good than harm, or has it done more harm than good? (4; 143 days)*

Everyday challenges

Women said their persistent PPGP affects their ability to do everyday activities. All women described how their PPGP affected activities related to taking care of their child, such as lifting and carrying their baby and getting down on the floor to play with him/her. Four women said they were afraid of dropping their baby if they had a sudden pain.

> *When I get that sharp type of pain, that worries me, you know, you might get weakness or something when you're carrying him (baby), like that the pain would come if you'd move a certain way maybe, you know, carrying the car seat or whatever. (1; 209 days)*

Although they generally still could continue such activities despite of the pain, they expressed frustration that it made everyday tasks more difficult.

> *…it's frustrating because I know that he wants me to go around in the house and hold him and put him to sleep, and he cries because I think he feels that I'm a little bit frustrated and in pain, so he starts crying as well, so yeah, that is a bit frustrating that I can't take care of him as well, well not as well, but there is this kind of note of that the pain is always there you know and it's annoying, I have to say. (25; 116 days)*

Moreover, ten women said that household activities were challenging and provoked pain, although this was regarded as less important than taking care of their baby.

> *Other activities, like day-to-day; hoovering, sweeping the floor, washing the floor, you know, all these things; I can do them but I have to stop maybe 2-3 times while I'm doing them so sometimes they're really only half done. (8; 165 days)*

Although exercise was a common coping strategy that women tried, thirteen women described how exercise was challenging and aggravated their PPGP. For some it was a matter of distance or intensity, and others felt the pain more after exercise.

> *It's a lot worse after I've been walking, especially when I'm walking around here because it's hilly. I'll know that evening and the next morning that I've walked! (4; 143 days)*

Two women also mentioned that they experienced PPGP during sexual intercourse. Women did not feel their PPGP impacted their general health, with the exception of one woman who thought that taking painkillers was not good for her health and two women referred to the possible negative impact on their general health of not being able to exercise much.

Coping strategies

Self-management strategies

Most women felt they could cope with their persistent PPGP, but would prefer to be pain free.

> *I'm coping ok, I am managing. It is restricting but I suppose like last week we were away for a few days and that's when I really noticed that I really need to try and get something done about it because I knew I was being stopped from doing certain things I would have like to have done. But I am coping, I'd just like to be able to cope a bit better. (8; 165 days)*

They described numerous coping strategies. Women tried to avoid provocative activities where possible, or alternatively adapt them to continue being able to do them.

> *I have a changing unit upstairs and a changing unit downstairs. I'm not carrying her up to change her and I'm not changing her on a lower surface. And I suppose, always trying out first, like I'd sit first before I'll try and lift her from flat. And then kind of making sure that I'm in front of her to lift her up, so that I'm not lifting her at an awkward angle. (22; 235 days)*

Seventeen of the 23 women tried to, or believed they should, exercise regularly to improve their symptoms but had to be cautious not to exercise too intensively as this often had an adverse effect; finding this balance was challenging.

> *Exercise is good and it's not sore when I do it, well, it depends for how long. Particularly softer ground is better than concrete. I can really find the back [hurting] when I'm walking on concrete. (24; 364 days)*

Another significant barrier was finding the time and energy to exercise, while having to take care of the baby.

> *The only thing is; it's hard as a new mum; you don't have the time, I mean, I feel really that I'm not doing the exercises as much as I should be. (1; 209 days)*

Being mindful of their posture also helped them cope with everyday activities, from how they would sit, stand and lift, to the shoes they would wear, or trying to store items and do things at a more comfortable height.

> *Sometimes lying down, let's say when I'm using the laptop or something or even when he's (baby) on my lap, I have to make sure I'm sitting supported, because it can be quite sore as well. (11; 85 days)*

However, four women said their main coping strategy was 'trying not to think about it'.

> *I don't really think about it too much, I try not to, but it is sore you know, but I try not to think about it too much, you know, just blank it out. (14; 100 days)*

Most women did some stretching or applied pressure on tender muscles now and then throughout the day, which they felt gave temporary relief.

> *I spend a lot of time with my hand on it, you know, pressing really hard were the pain is, as sometimes that seems to work at bit. Yeah, I use my thumb and rub around; I spend a lot of time walking around the house like that. (15; 232 days)*

> *My daily routines; there are times, like even against the worktop if I was getting the dinner I would stretch. I love to cook or bake, and there are times that I literally have to sort of stretch against the worktop, like pull my back and hips out almost. (16; 243 days)*

Five women said they tried to rest between activities as a coping strategy although they had few opportunities for this; however, they believed that doing exercises would be important for recovery as well. Two women also tried to lose weight as they saw any excess weight as a contributing factor to their persistent PPGP.

Pain Medication & Treatments

Nine women mentioned using some pain medication, while five women said they were coping without painkillers and used other strategies such as stretching. Seven women were reluctant to take pain medication or were trying to cut down on painkillers that they had been prescribed.

> *I cut down on the pain relief so it's not as much; I'm glad I got off Solpadine because that was quite harsh on the system. Panadol is a little bit softer but obviously if it's a bad day you still need it. (17; 132 days)*

Three women said that they did not take any, or any stronger pain relief medication, because they were breastfeeding.

> *I'm not taking any painkillers at the moment because I'm breastfeeding and don't know what I can take, I think only paracetamol and I have to say it doesn't do much. (25; 116 days)*

Some women tried other remedies such as heat/cold packs, hot baths or supplements. Three women had attended a postnatal physiotherapy class at the maternity hospital. Moreover, four women had sought advice from private physiotherapists, chiropractors or osteopaths to help manage their symptoms, and two women said they were going to seek such help soon.

Additional Support

Women's partners played a crucial role in providing support to manage daily activities with the additional burden of having persistent PPGP.

> *Like it's no problem with help, like my boyfriend, if I say it is acting up he'll take him (the baby). That's no problem. (21; 278 days)*

The value of this support was demonstrated by the fact that they regretted that their partner was often not present during the day as he was at work.

> *I have my partner there and he'd sometimes step in in the evening time. I mean he's working all day and he'd be gone for long hours as he's self-employed so he does evening times, he can be out in weekends or whatever. So, there is not even a pattern you can put in place for him but he would help when he's there, he will try to give her the feed and stuff. (8; 165 days)*

Other family members also were a great support in various ways (e.g. by minding the baby sometimes, helping with housework). The importance of family support was emphasised by the four women whose family lived far away and hence they could not rely on this support as a result.

I don't have anyone else here you know; I'm not from Dublin, so I'm on my own. (15; 232 days)

Although their partner and family were the main sources of help, five women said they received support from friends.

I've friends that kind of say 'If you need a break, drop her in', or 'if you need to go off shopping or whatever, just to get a bit of headspace even', you know. They've all been very good. (17; 132 days)

One woman also employed someone to assist with housework, such as cleaning, because of her PPGP.

7.3.2 'I don't feel back to normal'

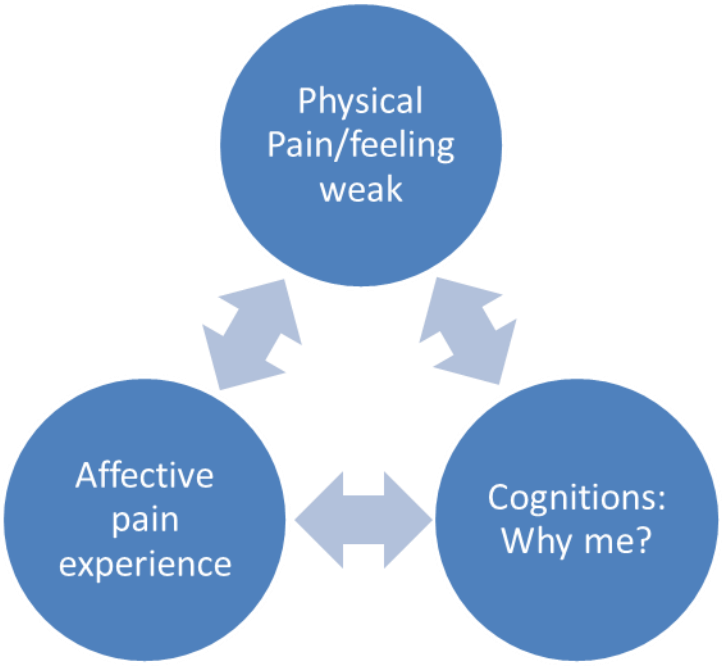

Figure 7-5 Pain experience; physical, cognitive and affective aspects

Physical feelings of pain

Women described their pain in a variety of ways depending on its pattern and severity. Eight women said it was a more constant or dull pain, whereas others experienced more severe or sharp pain.

It's not a horrible pain; I can still do things during the day and all, but I just never had any problems before so it's quite a new thing for me and it's a bit ehh…I'm a bit concerned; I hope it's gonna go away. (11; 85 days)

It's not enjoyable! And you know, some evenings I'm just here going; I burst into tears; my God, it's never going to get better. (13; 137 days)

Women who had more constant pain felt that they were coping less well than the women who said their pain was intermittent.

I am coping because it's not there all the time. If it was there all the time, I probably wouldn't be managing it because it eases after a while and I can kind of predict what triggers it. (20; 128 days)

Five women described their PPGP, not only in terms of the pain, but also how it made their body feel weaker and more restricted.

I started to exercise more because I was able to, and then I felt the pain was getting worse again. It felt like my pelvis was about to fall apart. That's the only way to describe it; it feels like it's kind of hanging and about to fall. (12; 300 days)

Nine women said that their PPGP slows them down. Seven women used the metaphor of 'feeling like an old lady' to describe how they felt. Four women said that it felt as if they were still pregnant.

It's just that before I wouldn't have issues, for instance doing gardening, you know. Now it's like half an hour and I'm all like 'kkkrrr', you know, you feel like some old woman with a walking stick. (20; 128 days)

I just feel slowed. I feel like sometimes that I'm not able to do quite as much with her (baby) as I would like. Sometimes if I'm down on the mat with her I feel like an old lady trying to get up like, it's just …But yeah, I suppose it just makes me feel a bit like; useless is a bit strong, but it makes me feel restricted. (4; 143 days)

In addition to their PPGP symptoms, seven women also found that they experienced pain in other areas that they related to their PPGP.

Most women's symptoms varied in severity throughout the day and with 'good' and 'bad' days; nine women said their symptoms were worse in the evening or at night, whilst for four women it was more painful in the mornings. For others, the pain was always present to some extent.

I mean some days it's not so bad so I just get on with it, but I feel sorry for everyone who really has such bad pain all the time! (10; 170 days)

Nine women said that their PPGP was very draining and made them feel even more tired, particularly for those women (7) who also experienced symptoms at night.

It's just I suppose because you're over-tired from having a small child and that it's just another layer of exasperation, you know (2; 227 days).

Cognitive components of pain: Why me?

All 23 women questioned why the pain was still there and tried to think of possible reasons. Thirteen women put it down to their posture and the way they carry and lift, or felt it was because their body was weakened from the pregnancy. Six women thought it might be because of a difficult birth that the PPGP persisted.

I don't know whether it was my posture or whether it was all the lifting and, you know, being up in the night and everything, but the pain did continue and it aches during the day and especially at night if I was up having to hold the baby a lot. (3; 167 days)

Something also, because having had the section, I don't know if I, like, held myself differently. I don't know if that sounds silly but I don't know if that contributed to the pain; like the way I would sit or lie or the way I would stand. I think that all kind of, yeah, I probably positioned myself in the wrong way or differently. (4; 143 days)

Someone else had read it could be hormonal, as she was still breastfeeding, and another woman noticed it was worse mid-menstrual cycle.

I am breastfeeding as well; I read that that can influence it, because you're still releasing that hormone that will loosen everything so maybe after I'll stop breastfeeding that will help as well but I mean, he's only just over 3 months now and I'll try to go 6 months and beyond I guess. (9; 98 days)

Some thoughts also provoked worry. Seven women were worried about being able to keep up when their child will be older and starts walking.

I don't feel as strong as I should and I don't feel as active as I'd like to be. Now, it doesn't really matter too much at the moment because she is not even crawling yet, but if she gets more active I want to be able to keep up with her. And I never saw myself as being inactive. (19; 119 days)

Three women also questioned whether they are damaging their pelvis more over time by just putting up with the pain.

It just makes simple enough things harder and then you have always a bit of worry; I am damaging something? Am I doing permanent damage by all the lifting of whatever way you're moving? (1; 209 days)

Affective components of pain

Women felt frustrated and annoyed by the pain, especially because they could not do the activities they would want to do.

> *I feel frustrated that I can't always do what I want to do. Or that I should maybe change what I was going to do, or that I get pain during an activity and that I think; maybe I should stop or maybe I should take down the intensity. I find that frustrating because I hadn't had to consider that before. (6; 219 days)*

However, they expressed joy because of having a baby, and eleven women said that the PPGP did not, and they would not let it, have an impact on being a good mother. On the other hand, seven women did feel that sometimes they were not able to do as many things with their child as they would like.

> *It affects things, certain things I can't do with her (baby) and that bothers me; when I can't get down with her and have a play with her. I suppose that would be the one that really bugs me; the fact that I can't get down on the floor with her and kind of have a play with her; that really bothers me. (2; 227 days)*

Nine women also described how they felt the pain was having a negative impact on their mood and made them less patient.

> *The pain just makes me cross and grumpy and out of sorts, and just niggly, that you'd love to go to bed but you can't go to bed. It's just, yeah, if you didn't have a baby, I would have been in bed a long time but you just have to get on with it. (22; 235 days)*

The five women whose pain was improving expressed feelings of happiness and relief that it was getting better.

7.3.3 'They didn't ask, I didn't tell'

Lack of follow-up after birth

Women said they would have liked more support and advice in hospital after the birth and more postnatal follow-up later on.

> *Before you have the baby you have so many check-ups and you have scans and everything, there is a fantastic support system, but once you've had the baby it's like you're left to your own devices. (16; 243 days)*

Three women said they would like to be able to go back to the maternity hospital for a longer period of time after the birth because of their expertise in maternity-related issues. However, the opinions of women who had attended postnatal hospital services for their PPGP postpartum were mixed; some were very satisfied with the advice given but others said the assessment and advice were limited. Other postnatal support that women would like to have had, included more physiotherapy classes postpartum specifically addressing PPGP, easier access to physiotherapy services or other practitioners such as osteopaths or chiropractors, and more structured follow-up care where they enquire about specific problems.

Healthcare professionals ignore it

Women said that healthcare professionals did not enquire after any persisting PPGP symptoms during their postpartum visits, and expressed a need for specific questions to be asked concerning their health.

> *I suppose the 6 weeks check; I was quite surprised by just how basic it was, you know, and I know a lot of friends have been the same. There is no kind of like real physical, like proper physical check. But I would feel that a lot of, even friends with things that are unaddressed, because it's a fairly just 'Ok, grand, see you now'. They didn't ask specific questions and it was very quick and it was very minimal. If you said you were fine, you were fine. (24; 364 days)*

Women thought postpartum contacts with their GP/public health nurse, including the 2 week and 6 week checks, were primarily focussed on the baby or sometimes on other birth-related problems the mother had such as a C-section scar.

> *The couple of times that I've seen someone we just talk about him and breastfeeding and stuff like that. So I haven't mentioned it but they haven't asked either. And at the 6 weeks check I didn't mention it to my GP either; I was concentrating on him (baby) and if he was doing well I just didn't think about me so. (25; 116 days)*

Women often did not mention their symptoms either because their own focus being on their baby's health, a perceived lack of time during the encounter, not having the opportunity to talk about it, or because they thought it was just part of having given birth. Some women who had mentioned it during pregnancy to their doctor and described being given little help at the time, felt there was no point in saying it again. Others forgot to mention it during the visit because of the intermittent nature of their pain and it not being present during the consultation.

> *But I think, like, they were not conscious of me having pain and there are days I think; 'Was I stupid never to tell?', but I don't have anything to compare it to so I was like 'That's part of giving birth I presume?' because I didn't know; it's my first baby so I didn't know any different. When I went to the 2 week and the 6 week check, the doctor never asked me; he just said 'how was I?' and I said 'I was grand', I didn't say anything. It was all about my baby. (16; 243 days)*

If their pain was mentioned, women felt their complaint was minimised, with the most common advice given being 'to give it time to settle'.

I've been to my doctor numerous times and I've kind of just been pushed off basically…kind of 'Just bide your time', 'give it time', 'give it time'. So, at this stage I'm going 'Jesus, she's nearly eight months!'…it's kind of time enough for it. So I don't really know what to do about it; if your doctor is kind of saying to you 'look, just give it time'. (2; 227 days)

As a result women wanted healthcare professionals to make 'a bigger deal out of it', listen to and examine their complaint carefully.

I found the GP wasn't as helpful as I thought. Once I mentioned pelvic girdle pain, she kind of just said that was part of the parcel and give it time. I kind of felt brushed off at that stage, so even going back to the doctor, I'd say I would probably go to a different doctor, because I didn't get listened to; that's a number of times that she's done that to me. (17; 132 days)

One woman, however, said she was very pleased with care and support that she had been offered by the public health nurse.

She was really attentive to me, she wanted to know how I was as well as how the baby was (16; 243 days).

7.3.4 Seeking advice and support

Talking to others

Most women had mentioned their persisting symptoms to their partner but did not really talk about it much.

He is aware I still have pain. We don't really talk too much about it, but it's still there, and he is very supportive anyway. (12; 300 days)

Conversely, one woman did say she often complained about having pain to her husband. Women greatly valued talking to other family members about their PPGP, particularly to their mother and/or sisters who had had children themselves, but sometimes this could be a source of worry if they had experienced persistent problems.

My mum, I suppose, just a cautionary tale in that she had, she'd say she had problems for years and that it had all started during pregnancy. And so, that was part of what made me think; I don't want that, let's go and do something about it and get a bit stronger because she would say that she should have done something about it afterwards. (6; 219 days)

Talking to other women who had experienced persistent PPGP, for example in mother and baby groups, was greatly valued in terms of advice of how to manage, but women often did not feel understood when talking to women without persistent PPGP. Some women had mentioned it to friends; however, others kept it to themselves as they did not want it to become 'the thing', or the focus of conversation was on the baby.

I don't think I've mentioned the pain to any friends after, since I've had her. You know, I suppose, we mostly just talk about her (baby), you know what I mean. (4; 143 days)

Triggers to seek help

The women who had sought help from a healthcare professional in addition to the routine checks concerning their persistent PPGP, had been prompted to do so because of various reasons. Two women said it was completing the MAMMI surveys that encouraged them to seek help.

I'm very grateful I took part in the MAMMI study because I wouldn't have known, in fact, I think the physio department; I only knew about that because it came up in the MAMMI study. Perhaps the midwife had told me as well, but I don't know, but I certainly know that it wouldn't get any better if I didn't see the physio. (13; 137 days)

For other women it was an acute flare-up of PPGP symptoms, realising the impact of the pain when noticing the difference after taking pain relief medication, or encouragement from family that made them seek professional help.

Well, I probably wouldn't have gotten help if my husband and family wouldn't have pushed it, but I'm glad they did. (3; 167 days)

Barriers to getting help

Women described various practical barriers to getting professional help. For some the cost of treatment stopped them from seeking help, while others who had sought help from private healthcare practitioners expressed dissatisfaction with having to pay for services and how the cost influenced the frequency of care.

I'm trying to take unpaid maternity leave from work, so I don't have the money to go to the chiropractor regularly or go and get massages every week, so I'm trying to space out the care so that I can afford to continue it. (19; 119 days)

Finding the time, finding someone to care for baby, and the distance to travel to the maternity hospital were other practical barriers.

I mean, what kind of slowed me going to the physio was again fitting it in, even the appointment, you know, getting somebody to mind the baby if they only have daytime appointments or whatever. (1; 209 days)

Four of the six women who had contacted the physiotherapy department in the hospital postpartum said they had difficulties getting through to them by telephone but all except one woman eventually got an appointment.

It was incredibly difficult to get an appointment to go and see a physio in the hospital. I rang 8-9 times and they rang me back but they didn't say anything; they just said 'oh I'm returning your call but you have a brand new baby and you don't have always time to answer the phone. So, if they had just rung back and said 'yes there is a class at Thursday at 10.30, please join us', that would have been very nice. So, eventually I spoke to someone anyway and I went to the physio class and they were wonderful. (13; 137 days)

Three women also expressed how conflicting advice from healthcare professionals added to their confusion.

> *I did have a few sessions with an osteopath actually during pregnancy. He diagnosed me with SPD. But then during the antenatal class they told us 'Right, this is all just your ligaments loosening and it's not SPD, it's not anything else if you've been told'; she actually said 'If you've been told by osteopaths or chiropractors or anything like that it is SPD, they were wrong' and like nobody had looked at us. Nobody had examined us! So that was a bit, you know… (9; 98 days)*

7.3.5 'Unexpected'

Thought it would be gone by now – previous expectations

During pregnancy many women (18) thought their PPGP symptoms were just 'part of pregnancy'. As a result, they thought it would resolve with the birth, or they said they had had no expectations during pregnancy about what would happen postpartum with regards to their symptoms.

> *But yeah, I thought it would just go away after the birth. I didn't really know I guess, I didn't think anything different. (3; 167 days)*

> *I suppose I expected maybe naively that after the birth, yes I probably would be a bit weary and that I would be tired. But I thought that all sorts of niggles and pains that I had would be gone, pretty much straight away, which you find out quick enough is not the case. (7; 164 days)*

As a result, for some women, it took some time to acknowledge they continued to have problems.

> *You kind of have to admit to yourself; yes there is still stuff left over from pregnancy and it has to be dealt with. (1; 209 days)*

Four women said they had not expected the pain to go away immediately after the birth; however, despite the fact that they had expected some PPGP postpartum, they had not thought that it would persist for so long.

> *I expected there to be pain afterwards I guess, but I didn't think of how long. (4; 143 days)*

Also, four women said they were somewhat surprised the pain persisted as they were fit before their pregnancy.

> *I would have done a lot of jogging before I was pregnant and so I would have considered myself quite fit and healthy and everything. (3; 167 days)*

Lack of information

Women felt unaware of any problems that might persist postpartum and expressed a desire for more information regarding specific issues that they might encounter after the birth, for example, persistent PPGP.

> *It would be great if there was more information about this type of pain, what to do about it. We got leaflets on the pelvic floor; it was all about the pelvic floor and doing the pelvic floor exercises, but that isn't really what's been impacted in me; it's more the joints and the skeleton, kind of the hips and the back of the pelvis, the tailbone, that sort of thing. (19; 119 days)*

Three women described how completing the MAMMI surveys had made them more conscious of their own health and wellbeing.

> *Up until this survey I wouldn't have really known like you think 'oh I'm the only one'… I wouldn't have thought of even checking it out, researching it or googling it. And it's just something I never really thought, I don't know, maybe information isn't there or maybe it is and just hadn't been highlighted. (8; 165 days)*

Suggestions of help and support that the women said they would have liked to have had included more specific and written information concerning PPGP with also practical advice of what to do if the pain persists postpartum.

7.3.6 'What next?'

A changing pain

Although all women stated their PPGP had started during pregnancy and persisted postpartum, for many, symptoms had changed over time. This change, however, varied across participants. Ten women said their symptoms were somewhat different at the time of the interview compared to during pregnancy. For some women, the pain had become less severe; for others, the pain had increased since the birth, or sometimes the type of pain had changed.

> *During the pregnancy the pain was like it is now but during the pregnancy it would come and go and it was more like a stabbing kind of pain, but now it's more like a continuous kind of strain, you know. (23; 187 days)*

Three women also mentioned that the pain location had changed; for example, from side to side or from the front to the back of the pelvis.

Ten women described how their PPGP symptoms had been 'hidden' behind general aches or other birth-related issues in the first few days or weeks immediately after the birth.

> *I had a C-section, so initially when I came home from hospital my focus was on the section pain. And I was trying to reduce the painkillers and get used to being more mobile. I first noticed the issues with my pelvis were still there when I was going up and down the stairs. (19; 119 days)*

For others (8), it was also the adjustment to motherhood that 'hid' the PPGP that early postpartum period.

Everything else was so overwhelming, you know, I didn't really think about that then. It's more when things settle down that you're going 'Oh, that's not great', because you're all kind of physically sore after the birth everywhere anyway. (24; 364 days)

Uncertainty & hope for the future

All women strongly hoped their symptoms would go away soon. However, they were doubtful whether they would. Women whose symptoms had improved somewhat over time (7) were more hopeful about the future progression of their PPGP than those who had worsened or equally severe symptoms.

I hope it's going to go away. And I can try and get a bit stronger, like I said. It is less than it was, so I feel if I keep working on it, it will go away but I don't know. (6; 219 days)

Six women expressed worries about going back to work, and one woman was on sick leave.

It's going to get better, fingers crossed. It's going to have to get better because as I said, I do have a job where I sit down a lot. It's a ten hours work day in a chair in front of a computer so it's going to have to be good before I go back to work because otherwise it's going to be long days. (20; 128 days)

Twelve women also felt they would have to do something actively about it to improve, either by doing more exercise or seeking advice from healthcare professionals.

I think it will not go away, it will stay there. So, it just means now that I have to do something about it, maybe massages or pilates or any kind of exercise that can help ease the pain. (25; 116 days)

However, they were uncertain of what to do or who to see.

> *I know I'm getting no kind of joy with my GP but I don't know what the next step could be, what I could personally do with it, who I could go to with it. So, I don't know; I'm kind of in limbo. I don't know what the next step is. (2; 227 days)*

One woman was an exception in that she thought she would just have to give it more time to resolve itself.

Other people's stories about persisting symptoms after birth added to the uncertainty and created worry about the progression of their PPGP.

> *I'd love to be just back to normal, pre-pregnancy, I wonder; is that possible? Is that normal? Does that happen? Because you know the way women say 'Well, wait until you have a baby' or you know 'Wait until you've your second' and they give you the impression that your body is never going to be the same again. (1; 209 days)*

Having another baby; I'm worried but it would not stop me

Eighteen women said that they were anxious that their symptoms would be worse when having another baby, although it would not stop them from becoming pregnant again.

> *I suppose I worry for the next pregnancy, what effect that might have. It wouldn't put me off, but I worry it might be more of a constant problem rather than just intermittent, you know. (24; 364 days)*

Four women did feel they had to try and get their symptoms improved or resolved before becoming pregnant again.

> *I'm very aware of; I'm kind of thinking of having more children, you know, and I really want it sorted before then. You know, I don't want to be irresponsible about it and not have it fixed before I go again. (1; 209 days)*

Six women also described how they would seek more help and try and manage it (their symptoms) earlier on if they were to become pregnant again.

> *Being pregnant again, I would probably have to look at something like physio, but also not letting that much weight come on this time…Maybe hopefully that would help you know. (15; 232 days)*

7.4 Discussion of the findings of Phase 2

This section discusses the findings of phase 2 of this study in the context of existing literature and the theoretical framework of this study (Chapter 4).

7.4.1 'Putting up with it'; Coping with everyday life

Attitudes to pain: balancing activities

The impact of persistent PPGP on everyday life and the balancing of activities that emerged from the interviews with the 23 women in this study also have been described previously by pregnant women with PPGP (Elden *et al.* 2013a, Persson *et al.* 2013, Elden *et al.* 2014) and thus seems to be a continuing challenge for women with persistent PPGP postpartum. Having a young child also makes it more difficult to pace activities (Persson *et al.* 2013), which may explain why women felt they just had to 'put up with the pain' and 'get on with' their daily tasks.

In the context of the fear-avoidance model of pain, where disengagement from normal activities is likely to result in chronicity (Leeuw *et al.* 2007), having to continue their daily activities could be seen as a positive necessity. However, the women who were interviewed already had chronic PPGP symptoms and they might have exhibited such behaviour during pregnancy when they first experienced PPGP. Furthermore, fear-avoidance behaviour is only one potential contributor to chronicity, and other physical, cognitive and emotional pain experience components also add to the complexity of chronic pain.

Despite the fact that women 'got on' with their daily activities, most women said they are conscious of their pain and try to adapt activities accordingly where possible. Pain has a tendency to conquer one's focus of attention (Eccleston & Crombez 1999) and patients with chronic pain are known to experience cognitive impairment when performing everyday attentional tasks, regardless of the disease status of chronic pain and the level of pain experienced (Dick *et al.* 2002). Habitual attention to pain is also predictive of disability, distress and use of health-care resources in people with chronic pain (Eccleston *et al.* 1997, McCracken 1997, McCracken 2007). This continuous attention to their pain described by the women in this study can thus be seen as a natural but potentially negative response to persistent PPGP. The exception were three women who said they tried not to think about their pain to help them cope, which may be because distraction reduces pain levels (Verhoeven *et al.* 2011). Better pain inhibition abilities also results in improved task performance (Verhoeven *et al.* 2011), although no conclusions can be drawn from this qualitative study regarding this and full inhibition of pain is unlikely because of the interruptive character of pain (Eccleston & Crombez 1999).

The constant balancing of activities could also go together with operant conditioning whereby certain behaviours are reinforced. However, this may in turn lead to aberrant behaviours that may enhance chronicity.

Everyday challenges

The transition to motherhood is inherently disruptive to daily life and 'learning mothering' can be overwhelming (Nelson 2003). The women in this study described how their persistent PPGP made everyday activities in this process more difficult. However, a clear distinction emerged in terms of the meaning women placed on having difficulty carrying out certain tasks. Activities that were part of caring for their child and were affected by their PPGP led to feelings of frustration, whereas for other tasks, the meaning of women's pain was considered much less significant. In line with the current definition of pain (Loeser 2012), this finding confirms that pain is a perception and not a mere physical sensation. This distinction of meaning of their pain is important, as it will likely influence the emotional aspects of women's pain experience.

Two women also mentioned that they experienced pain in their pelvic girdle during sexual intercourse, which is something that has been described by women suffering from PPGP during pregnancy where it was a stronger theme (Elden *et al.* 2013a, Persson *et al.* 2013). Possibly this may be because of fear of harming the foetus during pregnancy (Bartellas *et al.* 2000); however, it is not known whether or not the researchers asked a specific question concerning their sex life, which could be another reason why this was a clear theme during pregnancy.

Coping strategies

Self-management strategies

Coping is broadly defined as any behaviour in response to pain (McCracken & Eccleston 2003). Women described many coping strategies, both active and passive, based on experience of what provokes/relieves the pain, or advice from others. Chang *et al.* (2011) surveyed 183 pregnant women with low back and/or pelvic girdle pain during pregnancy regarding the coping strategies they used, and found that rest, task persistence and seeking assistance were the three most common ones. Women in this study described similar strategies and highlighted the difficult balance between continuing as normal, and adapting or avoiding activities. The challenge of balancing rest and activity could be interpreted as a difficulty in differentiating helpful and unhelpful coping strategies. This uncertainty could also impede self-efficacy and reduce their confidence that they can successfully execute a course of action to relieve their symptoms (Bandura 1997). Self-efficacy has an important psychological influence on chronic pain, and higher self-efficacy is associated with less functional impairment, less affective distress and reduced pain (Jackson *et al.* 2014). Addressing the need for more precise and consistent advice may enhance self-efficacy in women with persistent PPGP postpartum.

Pain Medication & Treatments

Nine women said they were taking some pain medication. Greater pain severity has been linked to increased health-seeking behaviour (Cornally & McCarthy 2011a). However, the reason why some women sought help, and others not, is likely to be multifactorial. Pain cognitions may lead to

increased health-seeking behaviour; for example, catastrophising thoughts bring about increased healthcare utilisation (Quartana *et al.* 2009). Other interpersonal dimensions such as attachment styles with family and friends are also influential, including early encounters with healthcare professionals. Preoccupied and fearful attachment styles have been associated with increased healthcare utilisation, although not with pain intensity (Ciechanowski *et al.* 2003). Cornally & McCarthy (2011b) identified three antecedents to help-seeking including problem recognition (a), decision to act (b) and selection of sources of help (c), all of which are likely to be influenced by the advice and information that women seek or receive. This again demonstrates the close relationship between the emerging themes from this study.

Additional Support

Support, in general, when having a first baby is important (Zhang & Jin 2014). For women with PPGP, it is thus understandable that help of family and friends was very much valued, a feeling that was expressed by the women in this study.

Examining the societal aspects of the pain experience, other people, especially close relations, play a key role both in terms of how they perceive and how they respond to the other person's pain, and this can in turn influence one's pain. Social support has been defined as a complex concept consisting of 'resources and interactions with others that help people cope with problems' and patients with pain do better when receiving adequate social support (Masters *et al.* 2007) (pp11).

Women's partners were said to be a key source of support. For patients with chronic pain, 'providing help' has been shown to be the most common of twelve spouse responses when noticing their partner is in pain during everyday activities (Newton-John & Williams 2006). This solicitous type of response from their spouse, which was reported by most women in this study, has previously been found to be more likely for male spouses compared to female spouses (Newton-John & Williams 2006). Exploring gender differences, however, was beyond the objectives of this study and all of the spouses of the interviewees were male. The importance of support

from their partner was also an emerging theme from studies looking at women's experiences of PPGP during pregnancy. However, the women in the present study were grateful for their partner's support, but did not say it was putting their relationship under negative pressure, despite the increased dependence, unlike women with PPGP in previous studies who described how their complaint puts strain on their relationship (Elden *et al.* 2013a, Persson *et al.* 2013). This finding, however, may have resulted from sampling bias due to the nature of sampling approaches in qualitative research. Such solicitous response from their partner could also be considered a secondary gain, although women did not describe it in this way, but rather, expressed regret about this dependence.

Despite the importance of social support, its effects are influenced by other characteristics such as the attachment style and extent of pain catastrophising, adding to the complexity of the social modulation of pain (Krahe *et al.* 2013). Attachment styles are cognitive schemas that influence the way people interact and their interpretations of interactions (Bowlby 1973). Insecure attachment styles, which include dismissive, preoccupied and fearful attachment styles, may negatively impact on patients' adjustments to chronic pain and are associated with increased negative affect (Ciechanowski *et al.* 2003). Catastrophising has also recently been defined as an interpersonal construct in the Communal Coping Model (Sullivan *et al.* 2001) and is related to less perceived spousal support (Cano 2004). Similarly, in this study women said they felt supported by their spouse and few seemed to express catastrophising thoughts. However, no conclusions can be drawn from these qualitative data regarding interviewees' attachment styles and whether or not women catastrophised.

Relationships is one of the five areas of disruption in women's transition to motherhood identified by Nelson (2003). When becoming a mother, women need to adapt to changed relationships with their partner, family and friends. Having persistent PPGP might present an additional challenge to this process because of the extra support that the women interviewed in this study said they needed.

7.4.2 'I don't feel back to normal'

Physical feelings of pain

Women described their physical pain in various ways during the interview, with different patterns and varying severity across participants. More severe pain in PPGP has been associated with greater functional disability; however, the impact of the pain pattern on disability has not been investigated as much (Albert *et al.* 2002, Gutke *et al.* 2011).

In contrast to Elden *et al.* (2014), who found that pregnant women had difficulties describing their PPGP, women in the postpartum period did not seem to have this difficulty, although they did use a variety of words to express their symptoms. This disparity may have occurred because, in this study, women's pain had been present for longer and, over time, they became more familiar with their symptoms, making it easier to describe them.

Women also said their pain slowed them down and they felt physically restricted, in line with previous literature demonstrating that many women with PPGP report disability during pregnancy and postpartum (Ronchetti *et al.* 2008, Gutke *et al.* 2011). For women who had pain in other areas, this could also add to the impact of women's pain on their life; for example, women with combined PLBP and PGPP are more likely to have persistent symptoms (Gutke *et al.* 2008b).

Furthermore, women felt their PPGP was draining and tiring. Early motherhood is a time inherently characterised by reduced sleep due to the needs of the infant, but most women in this study felt their PPGP added to this exhaustion, although they were all first-time mothers and could not make comparisons with previous experiences. Pain processing in the brain takes attention, which can lead to an increased effort required to execute other tasks (Dick *et al.* 2002) and thus plausibly to more exhaustion. Pain is also related with sleep disturbance (Finan & Smith 2013) and PPGP during pregnancy is associated with sleep deprivation (Dorheim *et al.* 2012). In the context of chronic pain, reduced sleep may become a perpetuating factor. Moreover, a lack of sleep is linked with depression, which in turn is linked with chronic pain (Finan & Smith 2013).

This added exhaustion and impact of PPGP on sleep that many women in this study experienced, also have been described by women with PPGP during pregnancy (Persson *et al.* 2013). This may be one of the reasons why some women in this study said they 'still felt pregnant'.

Cognitive components of pain: Why me?

Although women said they put up with the pain, all questioned why the pain was there and expressed thoughts of worry about their pain. Patients with chronic pain have been shown to ruminate upon the potential causes of their symptoms, especially if the exact cause is unknown (Eccleston *et al.* 2001), as is the case with PPGP. Worrying about chronic pain is a normal process related to an increased awareness of somatic sensations, and pain-related worries have been shown to be more attention-demanding and more distressing than non-pain related worries (Eccleston *et al.* 2001). However, this cognitive focus may involve catastrophising thoughts, which can be seen as an extreme occurrence of worry of pain and future events (Eccleston 2001). Although only one woman said she expected her symptoms to get worse, others also expressed what could be considered catastrophising thoughts; for example, that their PPGP might aggravate when their child would be older or with subsequent pregnancies.

The attention to and worry about their PPGP could also be interpreted as a lack of acceptance of their pain. Acceptance is associated with less attention to pain, less fear and better efficacy to perform daily activities (Viane *et al.* 2004). Acceptance of pain is inversely related to pain levels, disability, depressive symptoms and pain-related anxiety in people with chronic pain (McCracken & Eccleston 2003, McCracken 2007). In this study most women said they were attentive of their pain, which could be a sign of non-acceptance, but on the other hand they did say they were generally coping with daily activities. This may be because acceptance is only associated with some subsets of coping and is not captured in most proposed coping models (McCracken & Eccleston 2003). Moreover, women did frequently need the support from others.

Although both acceptance and catastrophising include an acknowledgment that the pain will continue, catastrophising is characterised by a sense of

helplessness while in acceptance this acknowledgement is neutrally framed as a willingness to live with the pain (McCracken & Eccleston 2003). PPGP commonly resolves postpartum (Albert *et al.* 2002), hence the described attention to their pain is understandable.

Affective components of pain

Pain is also intimately related to a person's emotional well-being. The extent of suffering depends on the affective response to the cognitive appraisal of the symptoms, and worrying thoughts may subsequently lead to anxiety, distress and low mood (Liu & Chen 2014). The questioning about the cause and uncertainty about the progression of women's persistent PPGP may have contributed to the negative impact on their mood and patience that women in this study described. The level of anxiety sensitivity and negative affectivity (personality traits) may also influence the extent to which women experience negative emotions (Watson *et al.* 1994, Asmundson & Norton 1995). Other qualitative studies (Elden *et al.* 2013a, Persson *et al.* 2013, Elden *et al.* 2014) showed that, during pregnancy, women with PPGP described the same feeling of having less patience and being moody and quick to complain. Mogren *et al.* (2010) also found this to be an emerging theme that midwives had experienced when working with pregnant women with PPGP. During pregnancy this could, to some extent, be put down to the hormonal changes occurring (Steiner *et al.* 2003), but as postpartum women are still experiencing this, it is plausible that the moodiness be pain-related, particularly since frustration and anger have been associated with chronic pain and have been found to contribute to dysphoric moods (Okifuji *et al.* 1999).

The sense of frustration expressed by the mothers in this study is similar to what women experienced during pregnancy (Persson *et al.* 2013, Elden *et al.* 2014) because they were not able to do the physical activities they wanted and had to deal with these losses because of their PPGP. This in turn comes back to the 'meaning' and cognitive appraisal of pain i.e. symptoms are interpreted in the context of how they impact daily life and this will dictate the emotional response.

7.4.3 'They didn't ask, I didn't tell'

Lack of follow-up after birth

Women described limited opportunities to discuss any problems (including their PPGP) postnatally compared to antenatally. Existing literature into postnatal care highlights this challenge of giving individualised information at the right time to parents, particularly with the increasing trend of early discharge (Danbjorg *et al.* 2014), although the impact of early discharge on many maternal and infant outcomes remains unclear (Brown *et al.* 2002). Home visits seems to increase maternal satisfaction with postnatal care (Yonemoto *et al.* 2013), but some women in the present study wanted to be able to go back to the hospital for a longer period of time postpartum as they experienced symptoms far beyond their six week check-up. However, this is only based on the experiences of a small sample of women, hence no conclusions can be drawn in terms of appropriate postnatal care services.

Healthcare professionals ignore it

Most women said that healthcare professionals (usually GPs and public health nurses) did not ask any questions regarding PPGP and that the focus was on the baby. This is perhaps not surprising, given the public health nurse's explicit role in Ireland in providing services to a wide variety of client groups (Hanafin *et al.* 2002). Only two of the 29 duties and responsibilities of public health nurses outlined by the Department of Health relate to postnatal care (DOHC 2000). Studies of the public health nurses' role and workload in the western part of Ireland show that the postnatal care group accounts for only 6.4% of public health nurses' clients, with 50% only given a needs score of 2 by the public health nurse when rated on a scale of 1-5 (1 being low need and 5 high need). Only 7% of the public health nurses' time is spent providing postnatal care, while the rest of the time is spent with other, sometimes 'higher need' groups, with public health nurses responding to their workload on a needs basis (Begley *et al.* 2004). Similar to public health nurses, GPs are 'generalists' in healthcare practice; however, under the Maternity and Infant Care Scheme, they are responsible for the wellbeing of mother and child. The combined care model of maternity hospital and GP services that currently constitutes ante- and

postnatal care (HSE 2013) thus combines a field-specific service (maternity hospital) with more 'generalist' services (GP and public health nurse). This may be why women said they wanted to be able to go back to the maternity hospital for a longer period of time as they felt reassured by the specialisation of healthcare practitioners in the hospital. A more structured approach to postnatal consultations might address this perceived lack of attention to, and knowledge about, their complaints.

It is also important to view this perceived lack of attention to their problem in the context of the concept of rapport between the women and the healthcare professional. Positive rapport contributes to a stronger 'therapeutic alliance', a key component for success of a consultation and treatment (Pinto *et al.* 2012). Establishing such a positive relationship allows the healthcare professional to elicit pertinent information for clinical decision-making (Ross 2013). This may have contributed to women not sharing their symptoms with healthcare professionals, while the woman who described a very good relationship with the public health nurse, had shared any problems with the nurse who enquired about her health. This demonstrates the role of rapport in communication (Norfolk *et al.* 2007) and the mutual dimension of the therapeutic alliance. However, the purpose of funding GPs to conduct antenatal and postnatal care under the Maternity and Infant Care Scheme is that, during the six antenatal visits, a relationship is developed between the GP and woman that should allow for a therapeutic relationship to be already present in the two postnatal visits. Nevertheless, feelings of a lack of attention to their complaint dominated in women's accounts of their two and six week postnatal follow-ups.

Attachment styles can bring another perspective on these findings as well. Maladaptive/insecure attachment styles result from early encounters with caregivers that are unresponsive, inconsistent or rejecting (Ciechanowski *et al.* 2003). The theme 'They didn't ask' could be seen as 'unresponsive', potentially contributing to the development of insecure attachment styles. 'I didn't tell' could present women adopting a dismissing or fearful (both insecure) attachment style. Although attachment styles are relatively stable across the lifespan, they remain open to revision resulting from experiences

(Waters *et al.* 2000). Hence, for the women in the study who said they felt rejected/ignored or received inconsistent advice during past encounters with healthcare professionals, this could provoke a preoccupied (insecure) attachment style, which may explain why women expressed worry about their symptoms in future.

When women mentioned their PPGP symptoms during the consultation, they felt ignored. Similarly, in Elden *et al.* (2014), pregnant women with PPGP described how they were met with a lack of knowledge and understanding. Fredriksen *et al.* (2008) examined online discussions between pregnant women about PPGP and found a similar theme of a lack of acknowledgment. In a study exploring midwives' experiences of dealing with women with PPGP, the time limit during visits was considered a restricted factor on what issues could be addressed in relation to PPGP (Mogren *et al.* 2010). This lack of time during postpartum follow-up was also perceived by women in this study. The fact that women who had discussed their symptoms with a healthcare professional often felt their complaint being minimised, might be related to healthcare professionals trying to avoid catastrophising thoughts in their patients, but this being interpreted by the women as an ignoring of their symptoms. This could create a mismatch with women's expectations regarding what is appropriate information. Expectations influence the experience of and satisfaction with care and contribute to the long-term therapeutic effect of the consultation (Stones *et al.* 2006). Lower current levels of pain at follow-up is also associated with a more favourable recall of the original consultation (Stones *et al.* 2006), and thus, in the context of this study, the fact that women were still in pain at the time of the interview might have impacted on their perception and memory, and in turn satisfaction, of past encounters with healthcare professionals.

Finally, putting the perceived lack of attention to their PPGP symptoms in context of the modified Calgary–Cambridge framework for consultation (Kurtz *et al.* 2003), gives insight into which aspects of the consultation women felt were mostly missing. This framework provides an approach for healthcare professionals to medical encounters, and involves six components; (1) Initiating the session, (2) Gathering information, (3)

Providing structure to the consultation, (4) Building relationship, (5) Explanation and planning, (6) Closing the session. In this study, women seem to feel a deficiency in 'gathering information' and 'explanation and planning', which in turn can interfere with building relationship.

7.4.4 Seeking advice & Support

Talking to others

Most women had mentioned their persistent PPGP symptoms to their husband, although they did not often talk about it. For females with chronic pain, talking about their pain with their spouses has been associated with more satisfaction with general communication with their spouse and greater marital satisfaction, whereas this is not the case for their spouses (Newton-John & Williams 2006). The latter may explain why most women did not often speak about their pain to their husband, if they perceived his satisfaction as more important than their own.

Talking to family members and other mothers was mostly considered helpful; a finding which coincides with qualitative studies of peer support in pain management groups (Haraldseid *et al.* 2014). However, the lack of understanding by women who did not experience persistent PPGP may be because PPGP subsides after birth for many women and thus there is a lack of awareness that for some women PPGP may persist. Putting this in context of the concept of empathy, this fits in the idea of "embodied simulation" in which an observer lacking the specific representation of a certain feeling might struggle to empathise with someone experiencing that feeling (Singer 2006). Recent functional MRI studies, however, have found that even people with congenital insensitivity to pain can feel empathy for someone else's pain (Danziger *et al.* 2009).

Triggers and Barriers to seeking help

Women who had sought additional help sometimes encountered conflicting diagnoses and advice. Similarly, in internet discussions regarding PPGP, women said that conflicting labels were given by different healthcare professionals (Fredriksen *et al.* 2008). Mogren *et al.* (2010) reported that midwives expressed doubts about whether women were sometimes falsely

diagnosed with PPGP by themselves or others. Continuity and consistency of information in maternity care is important to women, especially to first-time mothers (Jenkins *et al.* 2015). When problems persist beyond the end of standard maternity care, information becomes more prone to inconsistency due to the absence of information transfer, particularly when a woman seeks help from healthcare professionals who have not been involved in the woman's care before and who do not have access to maternity care records.

7.4.5 'Unexpected'

Thought it would be gone by now–previous expectations

During pregnancy, many women thought their PPGP symptoms were just 'part of pregnancy'. As a result, they expected their PPGP to resolve soon after birth, or they had had no expectations during pregnancy about what would happen postpartum with regards to their symptoms. Persson *et al.* (2013), interviewing women with PPGP during pregnancy, found that these women often endured the pain and looked forward to the birth, thinking that symptoms would subside. Although, PPGP commonly resolves postpartum (Albert *et al.* 2002, Gutke *et al.* 2008b), when this expectation is not met, it may add to women's negative appraisal of their symptoms due to the cognitive nature of expectations and its link with affective and behavioural aspects of the pain experience. Patient beliefs and expectations are also at the heart of the consultation process (Main *et al.* 2010) and thus, if expectations were based on the advice from healthcare professionals, this may lead to disintegration of trust and rapport.

Lack of information

These described unmet expectations of what would happen to women's PPGP symptoms postpartum, may be linked to the feeling of a lack of information postpartum, which is similar to what 27 women with severe PPGP experience during pregnancy in Sweden (Elden *et al.* 2014). However, for women with persistent PPGP postpartum in this study, this lack of knowledge seemed to evoke more worry about its progression, whereas during pregnancy, women were more concerned about the nature of symptoms (Elden *et al.* 2014). In the context of the current trend of increasing sources of information, the challenge of identifying and selecting

accurate information keeps growing. The internet plays a key role in this, although this was not mentioned as a source of information by many women in this study. Furthermore, internet-based peer support does not replace support and information offered by healthcare professionals (Niela-Vilen *et al.* 2014). It is the latter that women expressed a lack of in relation to their persistent PPGP.

7.4.6 'What next?'

Changing pain

The changes in pain over time from pregnancy to the time of the interview described by the women in this study could have been due to various reasons. Maladaptive postures or deconditioning due to reduced physical activity may have contributed to changing pain locations within the pelvic girdle and beyond, as well as to the worsening of symptoms described by some women. Other women's symptoms had improved somewhat, which might represent a progressive resolution of their PPGP. Birth-related factors and unsuccessful adjustment to a normal gravitational posture could have contributed to the changes in their pain. No clear differences emerged between interviewees in this study related to pain location or time since the birth. Instead, any improvement or worsening of their symptoms seemed to have a bigger impact on women's experiences of persistent PGP, particularly on women's expectations and subsequent hope or frustration.

Tulman *et al.* (1990), assessing women's functional status after birth, found that a woman's readiness to assume infant care increases between three weeks and three months postpartum, which may explain why the women in this study said the first few weeks after the birth were overwhelming, hiding their PPGP.

Uncertainty & hope for the future

Episodes of pain-related worry are likely to be triggered by increased pain (Eccleston *et al.* 2001). For a minority of women interviewed, their symptoms had worsened since pregnancy, and most women hoped their symptoms would improve; however, they expressed doubt and uncertainty. Knowing how long a pain will last improves the reaction to pain, as it reduces uncertainty (Eccleston *et al.* 2001). Moreover, praying and hoping

have been associated with greater pain and less healthy functioning, whilst acceptance is negatively associated with praying and hoping (McCracken & Eccleston 2003). In that way, women's hoping could be counterproductive in terms of resolution of symptoms. On the other hand, their PPGP may well resolve and their hope could be interpreted as an absence of depressive thoughts. The extent of illness/injury sensitivity (personality trait related to negative expectations about the future) may also contribute to individual women's expectations about the progression of their symptoms (Reiss 1991). In the context of self-efficacy, i.e. the confidence that one can control the pain, women who expressed greater uncertainty about the progression of their symptoms seemed to be less confident controlling their pain.

Women expressed concern about going back to work, and one woman was on sick leave. Having persistent PPGP may thus add to 'work' being an area or disruption in the transition to motherhood (Nelson 2003) (Figure 4-4). Placing these findings in context of the literature on sick leave postpartum, in a cohort of 204 mothers (15 employers) in the Netherlands, PPGP was the most common reason for sick leave (van Beukering 2002). The desire to have exemption from work could also be a 'secondary gain' from having PPGP, although this was not examined in this study, which was focussed on presenting women's perspectives.

The fact that women felt they had to take action and take responsibility to do something about their PPGP demonstrates an active coping style which is positive (Mercado *et al.* 2005); however, they expressed uncertainty about what they should do, which may indicate lower self-efficacy. Moreover, placing all responsibility on themselves could lead to self-blame and subsequent lower self-esteem when their symptoms persist.

Having another baby; I'm worried but it would not stop me.

Women with a history of pelvic girdle pain or low back pain are more likely to develop PPGP when becoming pregnant (Kovacs *et al.* 2012); hence, the worry that women described of their symptoms worsening when becoming pregnant again is understandable. Elden *et al.* (2013a) found that, during

pregnancy, women with PPGP are 'not looking forward to another pregnancy' because of their PPGP, whereas postpartum, feelings of worry and anxiety about another pregnancy seemed to be stronger, although it did not stop them wanting more children.

7.4.7 Comparison with Engeset *et al.* (2014)

In October 2014, following the completion of the analysis of this study, a qualitative study was published exploring the experiences of women with persistent PPGP postpartum (Engeset *et al.* 2014). This study involved semi-structured interviews with five women in Norway between 4 months and 11 years postpartum. The participants had already contacted the health services concerning their persistent PPGP and were receiving treatment. The aim of the study was to explore how women with postpartum PPGP experience living with the pain and its influence on their daily life, and did not include exploring their health-seeking behaviours. Moreover, the study included two multiparous women (of the five), which may give rise to different experiences. Despite these differences between Engeset *et al.* (2014) and this study, making a comparison is of interest.

Three main themes arose in Engeset *et al.* (2014); activity and pain, lack of acknowledgement of pain and disability, and changed roles. The physical pain and limitations, feelings of exhaustion, and frustration related to their persistent PPGP, described by women (Engeset *et al.* 2014), show clear similarity to the categories 'Everyday challenges', 'Balancing activities', and the theme of 'I don't feel back to normal' in this study. Moreover, the content of the themes 'They didn't ask, I didn't tell' and 'Unexpected' seemed apparent in Engeset *et al.* (2014)'s work as a lack of acknowledgement, a perceived lack of information, and unmet postpartum expectations. The importance of support from the husband and family in the theme 'Changed roles' (Engeset *et al.* (2014), also matches what women described in this study. However, cognitive components of the pain experience that emerged from this study did not come up in their study. They also did not describe any thoughts about future pregnancies, and, although they expressed hope for the future, similar to this study, any uncertainty about the future is not noted in Engeset *et al.* (2014).

7.5 Member checking

Fourteen (61%) of the 23 women who had participated in an interview returned the member checking questionnaire. Six of the 14 women said they no longer had pelvic girdle pain symptoms, while seven said they still had persistent PPGP (1 missing).

7.5.1.1 Results of Member Checking

Quantitative Member Checking Questions

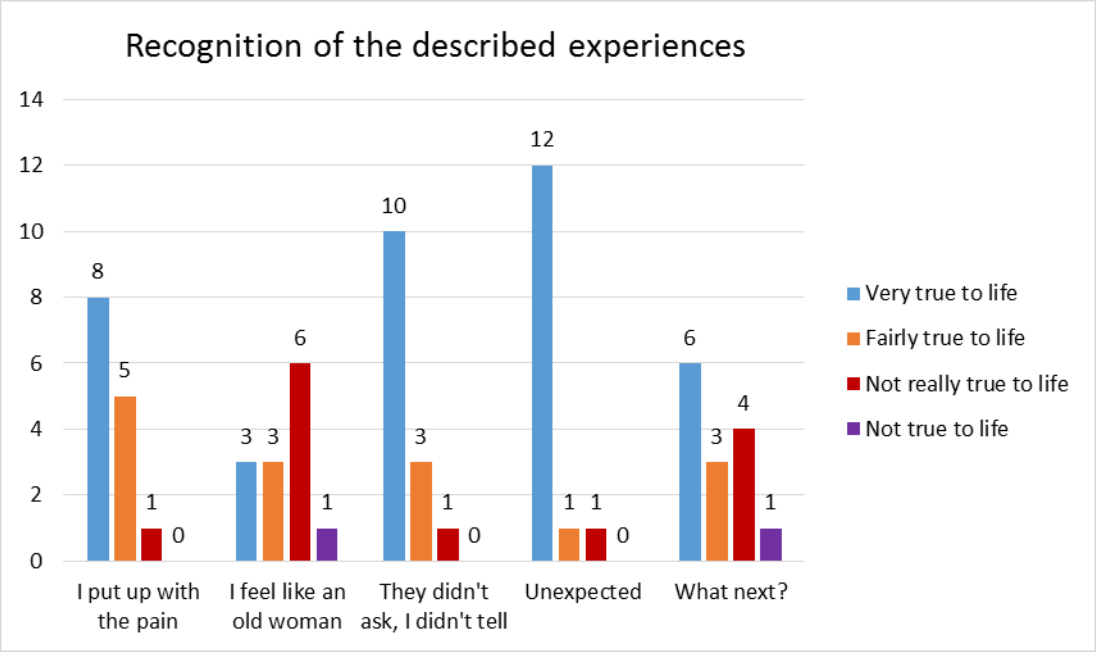

Figure 7-6 Member checking answers to the question 'Do you recognise any of your experiences in the following descriptions of living with pelvic girdle pain after the birth?'

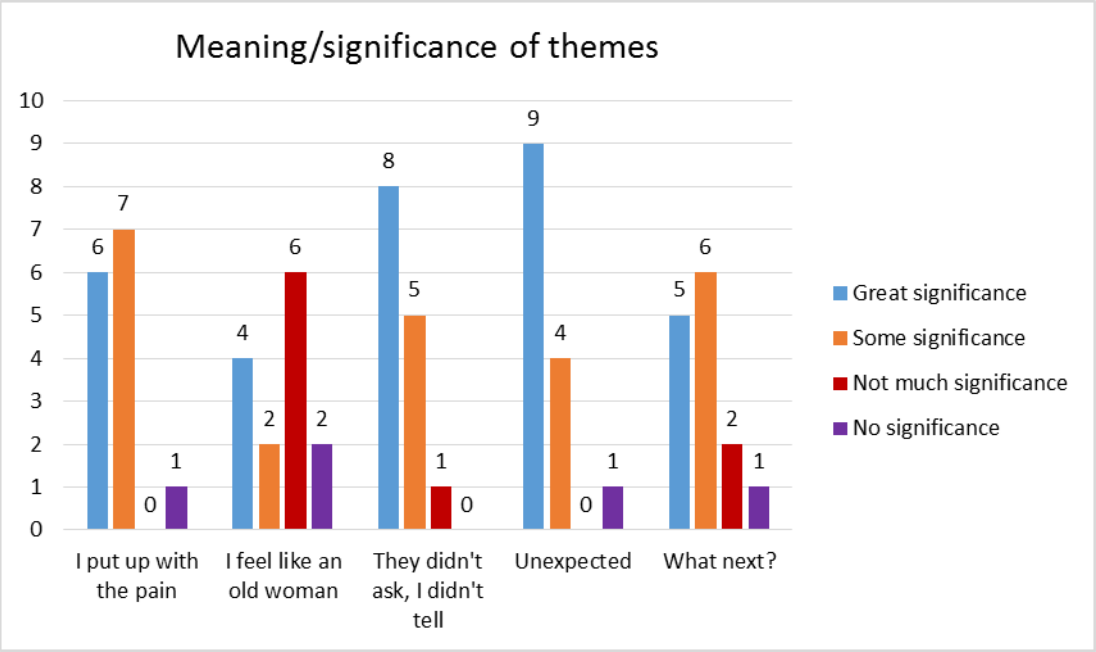

Figure 7-7 Member checking answers to the question 'Do the following descriptions of living with pelvic girdle pain after the birth have meaning/significance to you?'

For the first theme 'Putting up with it', only one of the 14 women who replied said this was 'not very true to life'. She was also the only women who marked that this theme had 'no significance' to her. However, re-examining the transcript of the interview, this theme was clearly present (see example quote below). This ambiguity may be because this woman no longer had pain when completing the member checking form.

> *Once he's asleep I start to clean up the place and picking up things from the floor and I try instead of bending I try to bend my legs but it's hard to get up. But, like as said before; it's not that strong that it stops me to do things but it's always there. And then, I can feel it when I pass the vacuum cleaner, or when I wash the bathroom or yeah, doing the dishes and all these things yeah. (25)*

The second theme 'I feel like an old women' did not resonate with about half of the women returning the member checking questionnaire. Exploring this further, looking back at the original interview transcripts, seven women had used this expression. Three of these seven women confirmed in their member checking questionnaire that this theme was 'very/fairly true to life' and had 'much/some significance', while one woman now indicated that it

was 'not really true to life' and had 'not much significance'. Interestingly, the two other women marked on the member checking questionnaire that the theme 'I feel like an old women' had 'no significance at all', yet they had said the following statements in their interviews:

> *If I'm sitting in the couch that evening and I want to go in to the kitchen, I get up slowly and I'm shuffling like an old women in to the kitchen (9).*
>
> *Well, sometimes I tend to think that it means that I'm becoming old, but I really hope that with a little bit of exercise and ehm yeah…that it will go away. (25)*

Only one woman commented specifically on this theme in the member checking form saying: 'Based on my experiences the expression 'I feel like an old woman expression' is too much and inadequate' (11). However, this same woman also said in a final comment that 'every aspect is very well covered in my opinion'. Although seven women had used this expression in the interview, it seemed that 'I feel like an old woman', as the name for that theme, was not most appropriate and was a too specific metaphor to which not all women could relate. Nevertheless, the content/categories of this theme clearly emerged from all interviews. For this reason the name was changed to 'I don't feel back to normal', but the content of the theme remained the same.

For the third theme 'They didn't ask, I didn't tell', only one of the 14 women said this was 'not really true to life' and had 'not much significance'. This might be because she had mentioned her symptoms in the hospital during pregnancy and had been referred at the time to a physiotherapy class. Still, in the interview she had expressed a wish for more attention to and advice for her PPGP.

For the fourth theme 'Unexpected', only participant 25 marked it was 'not true to life' and had 'no significance'. She was one of the four women who in the interview had said she did not expect the pain to go away immediately after the birth.

Well, I didn't expect it to pass, to go away…but I was expecting that that would ease at least. And actually it's still there; it's disappointing. I mean it's four months now and it's still there, yeah…It's frustrating as I said before. (25)

In the summary of the findings of the interviews that was sent to the women along with the member checking questionnaire (Appendix 71), I did not include this specifically, which could explains why this women could identify less with this theme.

The fifth theme 'What next?', again most women thought this was 'very/fairly true to life' and had 'great/some significance'. Only one woman said this theme was 'not true to life at all', yet in her interview she made clear statements that are captured in this theme, for example the following two quotes under the category 'A changing pain':

Yes it was definitely worse during pregnancy; it was all the time, every day, so you know, every time I stood up, every time I walked, it was there. So I has improved post-pregnancy, it's if I exert myself it comes back. (9)

I guess for the first 2 weeks after he was born, I probably didn't notice it so much in that there were so many other bits and pieces coming back together. (9)

Four women also marked that this theme was 'not really true to life'. All these four women did no longer have symptoms when completing the member checking, which may particularly affect how they perceived this theme because it includes categories that expressed uncertainty about the future progression of their symptoms, feelings that they had described at the time of the interview:

Well, sometimes I think that it will always stay there and I would like to know what I could do, if I could take some massage or if pilates can improve it, you know. (25)

I would love it if there was a check by the like of a midwife, you know, by somebody afterwards to see; am I doing anything wrong with myself? That if I ever wanted to have

another baby, you know; am I wrong not to be seeking help? Like if I was to become pregnant again, am I causing damage to, you know? (26)

Additional Qualitative Comments

A few women described what had happened since the time of the interview with regards to their symptoms in the comments sections at the end of the member checking questionnaire. For example, one woman said she had become pregnant again and expressed concern about how the PPGP would affect her current pregnancy. Some other comments reiterated some of the findings of the interviews:

I feel some healthcare professionals should enquire after the health of the mother, public health nurse or doctor, both see the baby (albeit not often) but should ask about mother's health; would greatly help; give advice or support. (16)

I really agree with the example quote where someone spoke about the emphasis on pelvic floor and none on pelvic girdle pain. For me pelvic floor was/is not an issue- definitely more joints- hips, pelvic girdle, low back. (7)

I think the results reflect my experience. Definitely the main thing I struggled with was being 'dropped' by the hospital after having the baby and not feeling like there was anywhere to go for help. (19)

Finally, some comments just confirmed they could identify with the findings.

Every aspect is very well covered in my opinion. (11)

I think the main aspects have been captured here. (19)

Realistic description of experience given. (16)

In conclusion, member checking revealed that the women who participated in the interviews seemed to be able to relate to the findings of this phase of this study. The name of one theme was changed from 'I feel like an old woman', to 'I don't feel back to normal'. This was the only edit made based on the member checking.

7.6 Peer-reviewed publication

The findings of this qualitative phase of this study were submitted for publication in February 2015. Due to wordcount restrictions in journals, the findings were split into two papers, mirroring the two objectives of this chapter; one paper focussing on women's experiences of the impact of persistent PPGP on their lives and the other paper on their health-seeking behaviours. During the peer-review process a minor change was made to enhance consistency of categories and themes. The categories 'Talking to others', 'Triggers to seek help' and 'Barriers to getting help', which were originally under to theme 'They didn't ask, I didn't tell', were moved under a new theme 'Seeking help & support' since a peer-reviewer rightly pointed out they did not fit under the first theme. Both papers have now been published (Wuytack *et al.* 2015a, 2015b) (Appendix 83).

7.7 Conclusion

The qualitative phase (2) of this study shows that persistent PPGP affects women's everyday lives (Objective 4). In terms of women's health-seeking behaviour (Objective 5), there is a perceived lack of information concerning PPGP, and a lack of attention to and advice given about their complaint by healthcare professionals. This also creates unawareness and unmet expectations about the nature of their symptoms that in turn may be related to the described frustration and uncertainty about the future of their PPGP that women expressed. This qualitative information gives 'meaning' from the women's perspective to the quantitative results on the prevalence of persistent PPGP (Chapter 6). Findings of both phases are integrated in chapter 8 through an in-depth discussion, drawing meta-inferences and implications for practice and research.

Chapter 8 Discussion & Conclusion

8.1 Introduction

The overall aim of this study was to identify the prevalence and factors associated with PPGP antenatally and up to 12 months postpartum in primiparous women in Ireland, and to explore the experiences and health-seeking behaviours of women with persistent PPGP postpartum. This was achieved using a Partially Mixed, Sequential, Equal Status study design. The findings of phase 1 and phase 2 of this study have already been discussed separately in the context of existing literature in chapter 6 (Section 6.6 and 6.17) and chapter 7 (Section 7.4). In this final chapter, the findings of both the quantitative phase (1) and qualitative phase (2) are brought together and meta-interferences are drawn. In section 8.3, the strengths and limitations of this study are discussed. Recommendations for practice, education and research are made in section 8.4. The conclusion (section 8.5) reiterates the key findings and implications of this study and outlines post-doctoral work and dissemination strategies that will follow on from this study.

8.2 Discussion of this Partially Mixed, Sequential, Equal Status study

This study had five objectives. Each objective is discussed taking into account the findings of both phase 1 and phase 2 of this study, and is set in the context of the theoretical framework, where applicable. An in-depth comparison of the findings of this study with existing literature regarding the prevalence and experiences of, and risk and prognostic factors for, PPGP, was already conducted in chapter 6 (Section 6.6.2) and chapter 7 (Section 7.4), and is not repeated here, but references to the relevant sections are provided. Instead, in these sections, the findings are discussed more broadly and possible reasons for the findings are discussed; however, these are merely suggestions that are plausible and may, in part, explain the findings in the context of the current understanding of PPGP (Chapter 2) and the theoretical framework (Chapter 4).

8.2.1 Objective (1): To identify the existence and prevalence of self-reported PPGP during pregnancy and 0-3, 3-6, 6-9 and 9-12 months postpartum in 1478 nulliparous women in Ireland

Just under two thirds of women reported PPGP in early/mid pregnancy (60.1%; n=886), increasing to 69.7% (n=821) in the last month of pregnancy. Most women experienced posterior PPGP (48.9%; n=722), 8.8% reported combined anterior and posterior PPGP, and only 2.3% had anterior PPGP. In the last month of pregnancy, combined anterior and posterior PPGP (21.3%; n=251) and anterior PPGP (4.5%; n=53) became relatively more common, whilst 43.7% (n=517) still reported posterior PPGP. Compared to these findings, the prevalence in the hospital records was very low (5.8%; n=78). Similarly, according to the latest annual report of the site hospital, only 11.1% (n=1206) of women attending were referred to physiotherapy services for PPGP or PLBP (The Rotunda Hospital 2014). The fact that the prevalence obtained from the surveys in this study included 'any' PPGP and did not include a physical examination or set criteria according to pain severity or disability may, in part, explain some of the discrepancy, but certainly not all. Previous cohort studies that set tighter criteria and included a physical examination for inclusion of women in the PPGP group, still report a prevalence much higher than a 5.8% period prevalence during pregnancy, varying from 14% to 52% depending on the specific criteria and time of measurement (Larsen *et al.* 1999, Albert *et al.* 2002, Gutke *et al.* 2008a, Robinson *et al.* 2010a). Hence, underreporting is the most plausible explanation for this sharp contrast between the self-reported prevalence of PPGP and the prevalence according to hospital records.

Phase 2 of this study (qualitative) focussed on persistent PPGP postpartum, but previous qualitative studies exploring the experiences of women with PPGP during pregnancy found that women felt 'unprepared for PPGP' (Elden *et al.* 2014) and had not been informed about the condition (Persson *et al.* 2013). Women also said they were met with a lack of knowledge from healthcare professionals, sometimes receiving different diagnoses (Elden *et al.* 2014). These qualitative findings, suggesting a lack of knowledge

amongst primary contact healthcare professionals, may help understand the underreporting of PPGP in the hospital. In addition, in phase 2 of this study, some women said they had mentioned their symptoms during pregnancy but were given little or no support at the time, which they gave as a reason for not talking to their doctor about their persistent PPGP postpartum. This demonstrates the important link between antenatal and postnatal care. If PPGP during pregnancy is already underreported and receives minimal care and attention, then it is not surprising that persistent PPGP is even more a 'hidden' morbidity.

In the first three months after the birth, 68.8% (n=566) of women who had PPGP during pregnancy reported persistent symptoms. This declined to 51.2% (n=367) 3 to 6 months postpartum, 40.5% (n=250) 6 to 9 months postpartum, and 33.3 % (n=171) 9 to 12 months postpartum. In the theme 'unexpected', 18 of the 23 women interviewed in phase 2 of this study said they had expected the symptoms to resolve with giving birth, yet phase 1 findings showed that only about half of women with PPGP had recovered six months after the birth, and a third had not yet fully recovered a year on. This contrast presents a case for antenatal education to manage expectations better; a need that was expressed by the women interviewed who said there was a 'lack of information' about the postpartum course of common pregnancy-related conditions. Similar to the perceived lack of knowledge about PPGP by healthcare professionals during pregnancy (Persson *et al.* 2013, Elden *et al.* 2014), participants of phase 2 of this study felt there was a 'lack of follow-up after the birth' and that 'healthcare professionals ignored it'. In addition, there was the focus on the baby that also added to diversion of attention away from maternal complaints. The significant number of women for whom PPGP persists postpartum and the experiences of women with persistent PPGP, call for a shift in care from the theme 'they didn't ask, I didn't tell' to one of clear information and follow-up regarding PPGP.

8.2.2 Objective (2): To identify pre-pregnancy risk factors for self-reported PPGP in (a) early/mid pregnancy and (b) the last months of pregnancy

This objective was addressed in phase 1 (quantitative) of this study, since the qualitative phase (2) involved only women with persistent PPGP interviewed in the postpartum period. Pain theory, part of the theoretical framework of this study (Chapter 4), was used to structure this discussion according to the physical, cognitive, emotional, behavioural and social 'layers' of the biopsychosocial model of pain. Early motherhood theory, the second part of the theoretical framework of this study, was not applicable to this objective, since the women had not yet given birth at this stage of the study.

Various potential physical risk factors were examined in this study. Women who were older were less likely to have PPGP in early/mid pregnancy and in the last month of pregnancy, which was consistent with most previous studies (Chapter 3, section 3.6.1.3). It is unclear why age might have a protective effect, but it could be related to a reduction in joint mobility with age (Medeiros *et al.* 2013). Similar to previous studies (Chapter 3, section 3.6.1.1), women with a high BMI were more likely to have PPGP. It is plausible that increased loading of the spine and pelvis as a result of the increased body weight, puts greater strain on the form and force closure mechanisms to maintain stability. A history of any low back and/or pelvic girdle pain before pregnancy and a history of any injury to the back were also risk factors for PPGP. This again is in agreement with existing literature (Chapter 3, section 3.6.1.1) and could be related to pre-existing sub-optimal lumbopelvic stability. Women with a history of severe period pain were more likely to have combined anterior and posterior PPGP in early/mid pregnancy, but no previous studies examined this factor. Although the mechanism of this association is unclear, in the systematic review, Wang *et al.* (2004) found a history of low back pain during menstruation to be a significant risk factor for PLBP, although they did not adjust for confounders (Chapter 3, section 3.7.5.1). Ansari *et al.* (2010) and Melzack & Belanger (1989) also examined low back pain during menstruation as a potential risk factor for PLPP, of which one study found it to be significant (Chapter 3,

section 3.8.1.1). The link between menstrual symptoms and low back pain (Smith *et al.* 2009), and, in this study, between period pain and PPGP, remains not well understood. Experiencing severe period pain could perhaps lead to pain sensitisation that results in increased sensitivity to pain and, in turn, susceptibility to PPGP. Hormonal factors could provide another possible explanation, but neither of these potential explanations are supported by empirical evidence at present.

Ethnicity, smoking and a history of heavy periods, were not significant risk factors for PPGP. In the systematic review (Chapter 3, section 3.6.1.1), parity (i.e. already having a child) was a significant risk factor for PPGP in subsequent pregnancies. This study included only first-time mothers; however, the women who were interviewed in phase 2 expressed concern that their symptoms would get worse in subsequent pregnancies in the category 'Having another baby; I'm worried but it would not stop me'.

In terms of cognitive and emotional factors, a history of anxiety and depression/low mood were assessed in this study. Anxiety, obtained by asking women whether they had experienced 'intense anxiety, such as panic attacks', was not a significant risk factor. A history of depressive feelings or low mood was also not significantly associated with PPGP, despite a previous study that used a more comprehensive method of assessing depression, reporting a positive association (Kovacs *et al.* 2012). As discussed before, the method of assessment may explain this discrepancy in findings. The way that one appraises pain and what one believes the meaning of their pain to be, influences the experience of pain (Beecher 1956) and, in turn, the affective and behavioural response to pain (Jensen *et al.* 1994, Smith *et al.* 1998). Worry about the nature or consequences of pain; for example, catastrophising thoughts, may increase pain severity and disability (Leeuw *et al.* 2007). In this study, only a history of anxiety and depression/low mood before pregnancy were examined to see if they contributed to the development of PPGP. However, it may be that they are co-morbid factors that influence women's experience of PPGP in terms of severity and coping, instead of being risk factors. A larger sample may help to further assess any contribution of these factors and possible interactions between variables.

No specific behavioural concepts present in the pain literature (Chapter 4, section 4.2.1.5d) were assessed as potential risk factors for PPGP. Again, as for many cognitive and emotional factors, they generally form part of the response to pain and can modulate pain, rather than being risk factors. The study of such factors was beyond the remit of the present study.

The social factors educational level, employment status, and marital status were not significantly associated with PPGP. The lack of impact of these social factors on the development of PPGP, supports the finding of Bjorklund & Bergstrom (2000) that PPGP is not a welfare complaint, since they found no significant geographical differences in PPGP prevalence between Sweden, Finland, Tanzania and Zanzibar. Other, more specific social concepts, such as attachment styles (Chapter 4, section 4.2.1.5e), were not examined in this study.

8.2.3 Objective (3): To identify pre-pregnancy, pregnancy-related, birth-related and postnatal prognostic factors for self-reported PPGP that persists 0-3, 3-6, 6-9 and 9-12 months postpartum

The discussion of objective 3, although primarily addressed in phase 1 of the study, includes some links with qualitative data from phase 2 and is set in the context of the theoretical framework of this study (pain theory and early motherhood theory; Chapter 4). The women who took part in phase 2, had persistent PPGP for at least three months postpartum, which can be considered chronic pain (Airaksinen *et al.* 2006). Pain theory sets out the complexity of the various factors that influence the perception of pain. In this study, 24 factors were examined as potential prognostic factors that relate to the five layers of the biopsychosocial model of pain (physical, cognitive, emotional, behavioural and social). However, these were certainly not exhaustive.

Various physical potential prognostic factors were examined in this study. Although age was a risk factor for developing PPGP, it did not affect the prognosis of PPGP. BMI was a significant prognostic factor, with women who

were obese or very obese being less likely to recover. Despite differences in BMI categorisation and outcome measurement, this finding seems consistent with previous studies (Chapter 3, section 3.9.2.1). Two women who were interviewed in phase 2 said they were trying to lose weight as a strategy to help resolve their persistent PPGP. Women with a history of any low back and/or pelvic girdle pain in the year before pregnancy were more likely to have persistent symptoms postpartum, which was again in agreement with previous studies (Chapter 3, section 3.9.2.1). Phase 2 only included women with no history of any low back or pelvic girdle pain, hence no qualitative data was available concerning this factor. A history of any injury to the back was a significant prognostic factor in univariate analysis, but not in multivariable analysis. Ethnicity, smoking and a history of heavy periods did not significantly impact recovery from PPGP after the birth. Surgery to the back and diabetes could not be assessed because they were rare in the sample. A history of severe period pain was significantly associated with persistent PPGP in the first three months after the birth but not beyond. No participants of phase 2 raised this issue, but they were interviewed three or more months after the birth. One women did say in the interview that she had noticed that her persistent PPGP flared up mid menstrual cycle. Breastfeeding was not significantly associated with persistent PPGP in phase 1; yet, one women interviewed in phase 2 of this study had read somewhere that the fact that she was still breastfeeding was a contributing factor for the persistence of her symptoms. This highlights the importance of providing accurate information to women, in a time with ever growing resources that might not contain reliable information (Eysenbach *et al.* 2002). Similar to previous studies (Chapter 3, section 3.9.2.1) pain location of PPGP during pregnancy was a strong prognostic factor and particularly women with combined anterior and posterior PPGP, but also women with posterior PPGP, were more likely to have persistent PPGP. This again demonstrates the importance of having adequate diagnosis and care during pregnancy to identify women who are more at risk of persistent symptoms postpartum. Even though the data from phase 2 did not explore this specifically, women said their symptoms had sometimes changed since the birth; for example, in terms of location.

Women who gave birth by vacuum or kiwi were less likely to have persistent PPGP up to six months postpartum. Forceps birth also had a protective effect 3 to 6 months postpartum, but mode of birth was not significantly associated with persistent PPGP 6 to 12 months postpartum. It is unclear why this might be and no previous studies had a similar finding (Chapter 3, section 3.9.4.1). Moreover, six women in phase 2 thought that, what they described as a difficult birth, might have contributed to their persistent PPGP postpartum.

Concerning emotional and cognitive factors, anxiety, depression and stress during pregnancy and in the first three months postpartum were assessed as potential prognostic factors. During pregnancy, women felt 'unprepared for PPGP' (Elden *et al.* 2014) and had difficulty in 'grasping the incomprehensible' (Persson *et al.* 2013). They did not know much about PPGP, which came as a surprise (Persson *et al.* 2013). This could perhaps give rise to feelings of anxiety; however, anxiety during pregnancy was not significantly associated with persistent PPGP postpartum in this study. Anxiety in the first three months after the birth was also not a significant prognostic factor. Similarly, depression during pregnancy or in the first three months postpartum was not associated with persistent PPGP. As for risk factors for PPGP (objective 2), anxiety and depression may be co-morbid factors, rather than prognostic factors, particularly because of the previously observed link between pain and emotional factors such as anxiety and depression (McCracken & Gross 1998, Dersh *et al.* 2006). In other words, women with persistent PPGP may have depressive feelings or anxiety as a result of having pain, but they do not necessarily affect their recovery from PPGP. This requires further investigation. Stress during pregnancy was not a significant prognostic factor, but moderate or more severe stress in the first three months after the birth was linked to persistent PPGP 6 to 9 months and 9 to 12 months postpartum. In phase 2, the women interviewed described various reasons why they thought their PPGP persisted in the category 'cognitive components of pain: Why me?'. They also said how they were unsure about how their symptoms would progress in the category 'uncertainty and hope for the future'. Although participants of phase 2 were more than three months postpartum, this

questioning of the cause of the persistence of their symptoms and the uncertainty about the progression might give rise to stress, which could, according to the findings of phase 1, delay recovery. In addition, life transitions, such as becoming a mother, are inherently characterised by increased levels of stress (Rasmussen *et al.* 2013). In phase 2, women also described how the initial period following the birth was 'overwhelming', hiding persistent PPGP sometimes. The relation between stress and persistent PPGP had not been examined before (Chapter 3, section 3.9) and deserves further investigation.

Specific behavioural factors/concepts such as fear avoidance behaviour, conditioning etc. (Chapter 4, section 4.2.1.5d), were not quantitatively measured in phase 1 of this study; however, women interviewed in phase 2 described a number of behavioural responses to and strategies to cope with their pain. They tried to avoid or adapt provocative activities where possible and some women exercised to relieve their symptoms. Resting between activities, stretching and applying pressure on tender muscles were other behaviours that women adopted in response to their pain.

Specific social factors assessed in phase 1 included educational level, employment status, marital status and return to work. Marital status and employment status did not significantly impact on the prognosis of PPGP. Women who did not have a university qualification were more likely to have persistent PPGP 6 to 9 months postpartum, and women on unpaid maternity leave were less likely to have persistent PPGP 9 to 12 months postpartum, but these factors were not significant at the other follow-up periods. Regardless of the impact of social factors on the prognosis of PPGP, the social context in which pain is experienced has an impact on coping and perceiving pain (Krahe *et al.* 2013). Women in phase 2 of this study described how 'talking to others' and having 'additional support' from family and friends was important in coping with their persistent PPGP.

8.2.4 Objective (4): To explore women's experiences with regard to the impact of self-reported persistent PPGP postpartum on their life, in particular on the care of their infant and parental role

To address objective 4, bringing quantitative and qualitative findings of this study together was particularly insightful. Phase 1 provided quantitative data on symptoms and activity limitations, measured on the Pelvic Girdle Questionnaire, of women with persistent PPGP 6 to 9 months postpartum (survey 4) and 9 to 12 months postpartum (survey 5). Phase 2 complemented these findings with in-depth data of women's experiences of how their persistent PPGP affected their lives as new mothers.

The mean percentage score on the symptom subscale of the Pelvic Girdle Questionnaire was 26% (SD 17.3%) for women with persistent PPGP 6 to 9 months postpartum, and 25.3% (SD 18%), 9 to 12 months postpartum. This subscale includes questions concerning pain severity in the morning and evening, legs giving way, having to do things more slowly and interruption of their sleep. In phase 2, women described their pain in different ways in the category 'Physical feelings of pain'. Nine women said that their PPGP slowed them down and their PPGP made them feel weaker and more restricted. In the Pelvic Girdle Questionnaire, 63.3% (n=153) and 56.7% (n=94) said that their PPGP slowed them down to at least some extent, 6 to 9 months and 9 to 12 months postpartum. Some women interviewed had dull pain and others had sharp severe pain, for some it was a more constant pain, whilst for others it was activity specific. Nine women also said that their PPGP was very draining and made them feel more tired. This variation in how women experience PPGP symptom is not all captured in the Pelvic Girdle Questionnaire. It is important to be aware that women with persistent PPGP, despite having certain similarities that define PPGP, can have quite different presentations.

The mean percentage score on the activity subscale was 18.8% (SD 15.7%) and 19.2% (SD 15.8%) for women with persistent PPGP 6 to 9 months and 9 to 12 months postpartum. The activity subscale covers 20 different activities that women rate in terms of how problematic they are for them.

In phase 2, women described similar activities that were affected by their persistent PPGP such household activities, walking, sitting, climbing up the stairs, etc. However, what was problematic for one woman, might not have been for another woman. This was reflected in phase 1, with only eight (2.5%) women reporting having some difficulty doing all 20 activities included in the Pelvic Girdle Questionnaire activity subscale, 6 to 9 months postpartum, and only four (2.4%) women with persistent PPGP 9 to 12 months postpartum. Similarly, in a Swedish cohort of 272 women with persistent PPGP three months postpartum, 48% rated their condition to be rather to extremely troublesome (Gutke *et al.* 2011). A total of 26.7% (n=65) and 30.1% (n=50) of women ticked that their PPGP affected their sex life in survey 4 and survey 5. Two women interviewed described how sexual intercourse triggered their persistent PPGP. Exercise was somewhat ambiguous and women felt that some exercise was beneficial, but too much could worsen symptoms; a boundary that was sometime difficult to predict. On the Pelvic Girdle Questionnaire, 49% (n=119) and 44.6% (n=72) had at least some difficulty running because of their persistent PPGP. Moreover, 57.2% (n=139) and 49.3% (n=82) said that sporting activities were affected in survey 4 and 5. However, exercise before pregnancy and in early/mid pregnancy have been associated with a decreased risk of PPGP (Andersen *et al.* 2015, Owe *et al.* 2015). The qualitative data of this study illustrates that exercise could be both a problematic and remedial activity.

The question concerning the extent to which women's persistent PPGP affected lifting/handling their baby was added to phase 1 to gain more information about the way persistent PPGP affected taking care of their child. A total of 72.2% (n=176) of women with persistent PPGP 6 to 9 months postpartum, and 71.7% (=119) 9 to 12 months postpartum, said that their PPGP affected lifting or handling their baby at least to some extent. In the category 'everyday challenges', the women interviewed in phase 2 said that, even though other household activities were also difficult because of their PPGP, taking care of their baby was considered much more important. All women described how lifting or carrying their baby, or getting down on the floor with him/her was sometimes difficult and painful. In the Pelvic Girdle Questionnaire, for 59.1% (n=144) of women 6 to 9 months

postpartum, and for 60.3% (n=100) 9 to 12 months postpartum, bending down was problematic to some extent. In addition, 42.0% (n=102) and 43.9% (n=73) of women said that getting up/sitting down was problematic in survey 4 and 5. However, this does not capture the meaning of pain that was stressed by the women interviewed in phase 2 who said that, if it involved taking care of their child, it was much more important and, in turn, more frustrating to them if they had difficulty doing it.

The Pelvic Girdle Questionnaire examines the physical pain experience of women with persistent PPGP. It does not cover women's cognitive, emotional or social well-being, nor does it assess behavioural responses to pain and coping. The qualitative data add richness by describing women's account of their thoughts and feelings about, and response to, their symptoms. Women wondered why the pain had not gone away and were worried about not being able to keep up with their child. Women felt frustrated by their pain, especially when doing activities that involved their child. They said it sometimes impacted on their mood and made them less patient. Health-seeking behaviours are further discussed in section 8.2.5.

Although clear categories of PPGP severity based on the Pelvic Girdle Questionnaire have not yet been proposed in the literature, the mean scores of women with persistent PPGP were quite low, with only 10% (n=24) of women with persistent PPGP 6 to 9 months postpartum, and 11.4% (n=19) with persistent PPGP 9 to 12 months postpartum, having a score above 30 (0 to 75 scale). The qualitative data support these findings with most women feeling that they were able to cope and just 'put up with the pain', despite it affecting their daily life. However, Malmqvist *et al.* (2015) found PPGP to be a common cause of sick leave during pregnancy with about a third being sick listed due to PPGP. Low back and pelvic girdle complaints were also the most common reasons for sick leave postpartum in a cohort of 204 women in the Netherlands (van Beukering 2002). On the other hand, Bergstrom *et al.* (2016) found that 14 months postpartum only 7.6% (n=142) had been on sick leave because of persistent PPGP in the prior six months, but this study was conducted in Sweden, where paid maternity leave is much longer than in Ireland.

8.2.5 Objective (5): To explore the health-seeking behaviours of women with PPGP that persists postpartum

Data from phase 1 gave information about the number of women who had taken any medication and whether or not they had discussed their symptoms with family, friends and/or healthcare professionals. The qualitative data (phase 2) adds depth by exploring experiences of the help and support they received, as well as triggers for and barriers to seeking help.

A total of 33.9% (n=83) of women with persistent PPGP 6 to 9 months postpartum, and 36.1% (n=60) 9 to 12 months postpartum, had taken some pain medication to relieve their symptoms; most commonly paracetamol and nurofen/isobrufen. In phase 2, nine women said that they used some analgesia. Three women said they were not taking any medication, or no stronger medication, because they were breastfeeding.

Of the women with persistent PPGP 6 to 9 months postpartum and 9 to 12 months postpartum, 44.1% (n=108) and 33.3% (n=57) had discussed their symptoms with their partner. Most women interviewed in phase 2 had mentioned their persisting symptoms to their partner, but did not really want to talk about it much. They also valued talking to other family members, particularly their mother or sister. This is reflected in the quantitative data, which shows that 22.8% (n=56) and 13.5% (n=33) had discussed their PPGP with their mother and sister between 6 and 9 months postpartum. This decreased to 15.2% (n=26) and 7.6% (n=13) between 9 and 12 months postpartum. In addition, 19.2% (n=47) had talked to a friend between 6 and 9 months postpartum, and 8.8% (n=15) between 9 and 12 months postpartum. Talking to family and friends about their PPGP was important in terms of advice, but women did not want it to become 'the thing'. This may, in part, explain why fewer women had brought it up with family and friends 9 to 12 months postpartum, compared to 6 to 9 months postpartum.

Only a minority of women with persistent PPGP had sought advice from a healthcare professional, most commonly their GP or a physiotherapist. A total of 9.3% (n=23) and 4.7% (n=8) of women had consulted their GP, 6 to 9 months postpartum and 9 to 12 months postpartum. In addition, 10.2% (n=25) and 7.6% (n=13) had consulted a physiotherapist. The qualitative data from phase 2 helps understand some of the barriers for women to seek help. Women described how many practical barriers, such as finding the time, having someone mind the baby, getting through to the physiotherapy services in the hospital, and the cost of private care. On the other hand, women who had sought help, had done so because they experienced a flare-up of symptoms, were advised to do so by family, or the MAMMI study surveys had encouraged them to seek help. 'Problem recognition' is one of the antecedents of seeking help (Cornally & McCarthy 2011b), hence the fact that women described that their persistent PPGP was 'unexpected' and that it often took time to recognise it, may also explain why many had not sought help yet. In addition, the theme 'they didn't ask, I didn't tell' illustrates how healthcare professionals during postnatal follow-up appointments generally did not enquire after any persisting symptoms, nor did women raise the issue. Some women felt they were not given the opportunity to discuss their persistent PPGP and the focus was on the baby, others said their own focus was on the baby, especially those first few months that were often described as 'overwhelming'. Women can attend postnatal physiotherapy classes at the site hospital up to six weeks after vaginal delivery and up to eight weeks after caesarean section. Women interviewed said this was too short and they would like to be able to go back for longer, since symptoms had not resolved. Moreover, they said that they had not expected symptoms to persist postpartum and that it took some time to acknowledge them and by then postnatal care had ended.

Questions concerning self-management strategies were not included in phase 1; however, exploring health-seeking behaviours of women in depth in phase 2, revealed a range of strategies that women used to help them cope and be able to 'get on with it'. These included adapting activities, exercise, being mindful of their posture, stretching, applying pressure on muscles, or simply 'trying not to think about it'.

8.3 Strengths & limitations of the study

This is the first longitudinal study that examines PPGP during pregnancy and postpartum in Ireland. Despite the recent publication of national guidelines for PPGP (Hogan *et al.* 2012), the prevalence of PPGP in Ireland was unclear. With a lack of connectivity between maternity hospital records and any services that women may access after discharge from maternity care, there is a knowledge gap, which makes the retrieval of information regarding the progression of any pregnancy-related problems after the birth impossible. The MAMMI study, and in this case specifically the PPGP strand, provides unique information in the Irish context.

This study was a survey-based longitudinal study and PPGP was defined as any pain in the pelvic girdle areas, as marked on a pain diagram. No physical examination was conducted. To diagnose PPGP, ideally specific clinical tests, including pain provocation and functional tests, are done (Vleeming *et al.* 2008). Unfortunately, this was not practically possible in this study. On the other hand, the observed underreporting of PPGP in hospital records would mean that only a small group of women would be examined clinically if inclusion would depend a physical examination performed by the clinical staff at the site hospital, and would potentially lead a less representative sample. Moreover, using self-report allowed for assessment of health-seeking behaviours of all women, since they did not have to be in contact with the health services regarding their PPGP to participate in either phases of this study. This way, phase 2 in particular, gives a unique insight into women's experiences of their care or the lack of it.

In addition, the pain diagram labels could have led to some overlap with PLBP, since the sacral and coccygeal area were labelled as 'low back'. This was printed in the first survey prior to the start of this PPGP strand of the MAMMI study; hence, the decision was made to keep the diagram consistent across the surveys. This limitation was not applicable to phase 2 of this study, since women completed a blank pain diagram prior to the interview. Moreover, data concerning any symptoms or health issues

before pregnancy may have been subject to recall bias. Finally, women over 30 years of age were overrepresented while women younger than 25 were somewhat underrepresented compared to the women attending the site hospital (The Rotunda Hospital 2014).

8.4 Implications and recommendations from this study for practice, research and education

This study was set in a pragmatic paradigm and data were collected by 'what works' to address the research objectives (Biesta 2010). The purpose of this study was to increase understanding of PPGP in Ireland, to ultimately guide and optimise the care that is provided. This section includes recommendations for practice, education, and for further research to increase our understanding of PPGP during pregnancy and postpartum purposefully and strategically, which, in turn, feeds back into clinical practice.

8.4.1 Recommendations from the systematic review (Chapter 3)

A comprehensive systematic review was conducted concerning risk and prognostic factors for PPGP, PLBP and PLPP. There was significant clinical and methodological heterogeneity between studies which may contribute to the variation in the findings of studies. The extent of such variation can only be adequately assessed if there is transparency and clear reporting. Importantly, observational studies should follow the STROBE guidelines (von Elm *et al.* 2007) to ensure complete reporting. The terminology proposed in the European guidelines for pelvic girdle pain (Vleeming *et al.* 2008) should be applied. Understandably, studies published before, used a wide variety of terms, but future studies should have increased consistence in terminology, which will assist in collating data in a systematic review to provide stronger evidence.

The majority of studies were 'phase 1' of investigation studies according to the framework of phases of investigation in prognostic research by Hayden *et al.* (2008). In future, progression to more studies in 'phase 2' (testing

independent associations) and 'phase 3' (understanding prognostic pathways) of investigation should take place. Compared to risk factor research, relatively few studies followed-up women postpartum and examined prognostic factors, which emphasises that the postpartum period is under-researched (World Health Organisation 2010). There is a need for further longitudinal research to address this gap.

8.4.2 Recommendations from Phase 1 (Quantitative)

This phase examined the prevalence of PPGP during pregnancy and up to a year postpartum. Risk and prognostic factors for PPGP were also assessed in a preliminary sample of 1478 women. PPGP is very common and about a third of women continued to have persistent symptoms a year after the birth. PPGP is underreported, even during pregnancy and before discharge when women are frequently in contact with the maternity services. In addition, the lack of connectivity between data pre and post discharge from maternity services means that persistent PPGP is 'invisible', even if women do seek help. An integrated, standardised data collection system during pregnancy and postpartum is needed to obtain accurate data throughout and enhance communication between all healthcare professionals involved in maternity care.

A history of any low back or pelvic girdle pain in the year before pregnancy was an important risk factor for PPGP and all PPGP sub-outcomes. Healthcare professionals should enquire if women have had episodes of low back and/or pelvic girdle pain before becoming pregnant. This also emphasises the importance of antenatal education in providing advice concerning PPGP. Even though PPGP is a pregnancy-related complaint, the significance of a history of low back and/or pelvic girdle pain as a risk factor demonstrates that pre-existing sub-optimal lumbopelvic stability is likely to make women more prone to PPGP. Other significant risk factors for some, but not all sub-outcomes, were; a BMI over 30 kg/m^2 and a history of severe period pain. An age of 35 or older had a protective effect.

A history of any low back and/or pelvic girdle pain was also an important prognostic factor, stressing the importance of identifying women with this factor early on. Obese and very obese women (BMI ≥30) were more likely to have persistent PPGP. Continuing the efforts to address obesity is thus also relevant to addressing PPGP, with it being a significant risk as well as prognostic factor. Breastfeeding did not negatively impact recovery from PPGP, if anything, it had a small positive effect in univariate analysis, but a larger sample is required to examine this factor further in multivariable analysis.

Moderate to severe stress in the first three months after the birth was significantly associated with persistent PPGP 6 to 12 months postpartum. Previous studies have not examined stress as a prognostic factor. Future studies should more specifically investigate important cognitive, emotional, behavioural and social concepts in relation to PPGP to get a more complete picture of the factors that influence women's pain experience and further understand its complexity.

This study examined a range of factors, but some factors, including ethnicity, diabetes, a history of surgery to the back, could not be adequately tested due to limited data. Moreover, no multivariable analysis for the sub-outcome anterior PPGP could be carried out for the same reason. These will be assessed in the final cohort of 2600 women, at post-doctoral level. Further study of risk and prognostic factors can support the development of preventative strategies, since no effective preventative interventions have been identified at present (Liddle & Pennick 2015).

8.4.3 Recommendations from Phase 2 (Qualitative)

This phase of the study explored women's experiences of how their persistent PPGP impacted on their lives as new mothers and their health-seeking behaviours in depth.

The findings stress the importance of adequate information concerning PPGP throughout maternity care and the need for postpartum follow-up. Although many women recover from PPGP soon after the birth, this should not be

assumed by healthcare professionals, so that it does not come 'unexpected' to women. Even though an integrated data collection system is recommended (section 8.4.2), it still largely would depend on healthcare professionals to enquire after and adequately report and manage PPGP. The theme 'They didn't ask, I didn't tell' that emerged from this study thus presents an additional challenge; a need for professional education. The findings suggest that healthcare professionals should be more informed that PPGP is not 'just part of pregnancy' and that for some women symptoms persist postpartum. This seems to be particularly the case for primary contact practitioners such as midwives, general practitioners, public health nurses, who are not expected to be experts concerning musculoskeletal complaints, but should possess the relevant knowledge to conduct a preliminary assessment and refer when appropriate. A more structured approach to postnatal care may also assist healthcare professionals in providing adequate information and follow-up.

More qualitative studies in other countries with different maternity care systems might provide further insight into contextual influences on the experiences and health-seeking behaviours of women with persistent PPGP. This study only included first-time mothers. Future studies might explore the experience of multiparous women with persistent PPGP for comparison.

8.4.4 Recommendations from the overall study

The overall recommendations for this study can be summarised as follows:

a. *The accepted length of postnatal care needs to be flexible to meet all women's needs.*

   In Ireland, maternity care ends at six to eight weeks postpartum, yet about a third of women continue to have persistent PPGP a year after the birth, and women's accounts from their experiences tell us that the early postpartum period can be overwhelming and that they might not acknowledge they need additional help until later.

b. *Clear and consistent information concerning the management and course of PPGP needs to be provided to women.*

   Women described persistent PPGP as 'unexpected'. This also has strong implications for antenatal care, when expectations are set. Hence, providing clear information and advice from the start of maternity care is essential and is a requisite for adequate postnatal care, since this will provide women with the knowledge of when to seek further help.

c. *Records of maternity care and primary care should be connected.*

d. *Healthcare professionals should routinely enquire after PPGP symptoms, and should regard such symptoms seriously.*

   Healthcare professionals should routinely enquire about any PPGP symptoms or persistent symptoms postpartum to minimise barriers to help-seeking. This will also facilitate the identification of women who are at increased risk for PPGP and/or persistent PPGP to provide early management.

e. *Women with obesity should be encouraged and supported to lose weight before becoming pregnant.*

f. *Management strategies should be provided to women based on the best available evidence.*

   There is evidence in support of pelvic belts and acupuncture, and weaker evidence for specific exercises (Gutke *et al.* 2015, Liddle & Pennick 2015). Evidence on preventative interventions for PPGP is nearly non-existent, but adequate information and early detection of women at increased risk of (persistent) PPGP can help manage expectations, give reassurance, and assist early management.

g. *Further research is needed regarding (persistent) PPGP.*

   Further robust research is needed to enhance understanding about the course of and contributing factors to PPGP, particularly in the postpartum period. Exploring the experiences of women with (persistent) PPGP, alongside collecting quantitative data, can provide insight into the 'why' of findings, which may in turn help understand the complexity and formulate recommendations. Ultimately, observational research will feed into the development of prevention and treatment interventions.

8.5 Conclusion of this PhD study and post-doctoral objectives

This study identified the prevalence and factors associated with PPGP antenatally and up to 12 months postpartum in nulliparous women in Ireland, and explored the experiences and health-seeking behaviours of women with persistent PPGP postpartum. It showed that PPGP is a common maternal morbidity in Ireland during pregnancy and postpartum, which is underreported and largely unaddressed in maternity care. This presents a challenge for practice and education to meet the needs of women with PPGP. Every effort will be made to disseminate the findings of this study to all stakeholders involved in the care of women during pregnancy and postpartum.

The post-doctoral objectives related to this study, in the near future, include:

a. Assessing the prevalence of PPGP and persistent PPGP in the full sample of 2600 women recruited from three hospitals.
b. Analysis of risk and prognostic factors for PPGP in the full sample of 2600 women. This larger sample will allow detection of smaller effects and a more accurate assessment of less common factors. In addition, analysis will be conducted with the subgroup of women with no history of pelvic girdle pain in the year before becoming pregnant. Further, more advanced analysis, using mixed-effects modelling will be used to take into account changes in certain factors during the course of the study (repeated measures).
c. Findings of the qualitative phase of this study have already been published in the peer-reviewed journals *Physical Therapy* and *Midwifery* (Appendix 83). The systematic review of risk and prognostic factors and the findings of the quantitative phase will also be submitted for publication.

Dissemination strategies for this study include:

a. Publishing the findings in peer-reviewed journals.
b. Distributing the findings to healthcare professionals involved in maternity care, including midwives, obstetricians, physiotherapists, general practitioners, public health nurses, and other allied healthcare professionals, in Ireland and overseas. This will be done through professional associations (their publications) and oral presentations locally.
c. Continued presentation of the findings at key international conferences such as the World Congress on Low Back & Pelvic Girdle Pain and professional conferences.
d. Dissemination of the findings to participants of the study and other women through the study website (www.mammi.ie) and quarterly newsletters, patient organisations and advocacy groups.

In concluding this thesis, I would again like to thank all the women who participated in this study. I hope that this work will benefit women with PPGP during pregnancy and postpartum, which is ultimately the aim of this study.

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