

Cross-national disparities in sex differences in life expectancy with and without frailty

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Abstract

Background: with continued ageing, levels of frailty are an increasing concern. Women live longer than men, but how life expectancies (LE) with frailty differ between men and women and whether sex differences are the same for all European countries is unknown.

Objective: to compare sex differences in LE in phenotypic frailty categories and disability at age ≥ 50 between European countries.

Design: the Survey of Health, Ageing and Retirement in Europe (SHARE).

Subjects: a total of 50,351 people aged ≥ 50 from SHARE wave 4 (included countries: Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Hungary, Italy, the Netherlands, Poland, Portugal, Slovenia, Spain, Sweden).

Methods: the *SHARE Frailty Instrument for Primary Care* and the *Global Activity Limitation Indicator* were combined to define four phenotypic frailty and disability categories: robust, pre-frail, frail and severely limited. LEs with each state by sex and country were calculated using Sullivan's method.

Results: at age 70, the LE robust ranged from 4.1 to 10.4 years (men) and 3.0 to 8.9 years (women), LE pre-frail from 0.8–3.1 years (men) and 2.2–5.5 years (women), LE frail from 0.1–1.8 years (men) and 0.4–5.5 years (women) and LE with severe activity limitation from 1.9 to 4.4 years (men) and 2.9 to 7.5 years (women). At all ages and both sexes the fewest years were spent frail.

Conclusions: this study is the first to compare differences in LE in frailty categories across European countries. In most European countries, years spent robust (free of frailty or limitation) are significantly less for women than men, perhaps due to socio-economic as well as biological factors.

Keywords: frail older adults, healthy life expectancy, sex differences, Europe, comparative study, older people

Introduction

Women tend to live longer lives than men, and this sex disparity is consistent regardless of geography, race and ethnicity [1]. However, human ageing is diverse and the association between chronological age and health is highly variable [2]. *Healthy life expectancy* (HLE), an intuitive and meaningful summary measure combining the length and quality of life, has become a standard in the world for measuring and monitoring population health and to address whether increasing life expectancy (LE) is accompanied by more years healthy (compression of morbidity) or fewer (expansion of morbidity) [3].

Frailty in older adults is characterised by cumulative decline in many physiological systems, vulnerability to

stressors and increased risk of adverse outcomes [4]. There are two main approaches to the definition of frailty: the *phenotypic* (which views frailty as a syndrome) and the *cumulative deficit* model (which views frailty as a state) [4]. While the cumulative deficit model includes disability in the definition of frailty [5], the frailty phenotype is a precursor of, a risk factor for, disability [6]. The phenotypic approach defines three frailty categories: *non-frail* (or robust), *pre-frail* and *frail* [7].

As regards the frailty phenotype, few instruments exist for the screening of older adults at the community level. One of the recommended [8–10] is the Frailty Instrument for primary care of the Survey of Health, Ageing and Retirement in Europe (SHARE-FI) [11]. SHARE-FI has been validated against incident disability [12] and mortality [13].

A recent review suggested that women live longer lives but have a greater burden of frailty, in terms of accumulation of health deficits [14]. However, whether the latter applies to the phenotypic definition of frailty has not been studied. The aim of this study was to explore sex differences in HLE using SHARE-FI (i.e. a phenotypic definition of frailty) and disability (i) at different ages and (ii) between European countries with varied overall LE.

Methods

This study uses the fourth wave of the SHARE release 1.0.0 (as of 30 November 2012, <http://www.share-project.org/>), a panel study of the non-institutionalised population aged 50 and older. We used SHARE wave 4, collected in 2010–11, as 15 European Union (EU) countries took part (Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Hungary, Italy, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden) and when combined they can be taken as an approximation for the 27 countries of the EU27 as they represent 75% of the EU27 population [http://epp.eurostat.ec.europa.eu/portal/page/portal/population/data/main_tables (online data code: tps00005)].

To calculate the age-specific prevalence (in 5-year age groups from age 50) of the frailty/disability categories by country and sex, we first applied the published SHARE-FI formulae [11] to SHARE wave 4. SHARE-FI requires the following variables for the definition of frailty:

- *Exhaustion*: ‘In the last month, have you had too little energy to do the things you wanted to do?’
- *Weight loss*: defined as a ‘Diminution in desire for food’ in response to: ‘What has your appetite been like?’ or, in the case of a non-specific or uncodeable response, by responding ‘Less’ to: ‘So, have you been eating more or less than usual?’
- *Weakness*: assessed by handgrip strength (kg) using a hand-held dynamometer. Two consecutive measurements were taken from each hand (the highest was selected).
- *Slowness*: defined as a positive answer to either ‘Because of a health problem, do you have difficulty [expected to last more than 3 months] walking 100 metres?’ or ‘... climbing one flight of stairs without resting?’
- *Low activity*: assessed by the question: ‘How often do you engage in activities that require a low or moderate level of energy such as gardening, cleaning the car, or doing a walk?’ (More than once a week; Once a week; One to three times a month; or Hardly ever or never).

Given any five measurements, the SHARE-FI formulae calculate, for each sex, the frailty score and adjudicate the phenotypic category [11]. The calculators are freely available online (<https://sites.google.com/a/tcd.ie/share-frailty-instrument-calculators/>).

To place frailty within the disablement process as envisaged by Fried *et al.* [7], we identified a further category which comprised all participants who reported *severe limitation*

according to the Global Activity Limitation Indicator [15]. This question is the basis for the European *Healthy Life Years* (HLY, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Healthy_life_years_statistics), an indicator of disability-free LE, although here healthy is defined as the absence of any form of limitation (i.e. severe or not severe). LE robust (i.e. frailty-free), pre-frail, frail and with severe limitation by sex and country were calculated based on cross-sectional data using Sullivan’s method [16]. The Sullivan health expectancy (HE) reflects the current health of a real population adjusted for mortality levels and independent of age structure. HE calculated by Sullivan’s method is the average number of remaining years, at a particular age, spent in a health state (however health may be defined) [17]. The data required are the age-specific prevalence (proportions) of the population in healthy and unhealthy states (often obtained from cross-sectional population-based surveys), and age-specific mortality information taken from a period life table [17].

Here, we applied the age-specific prevalence of the frailty/disability categories (in 5-year age groups from age 50, with the final age group of 85 years and over) to an abridged life table. Individual country single year life tables from age 50 for 2010 were obtained from the *European Health and Life Expectancy Information System* (JA:EHLEIS, www.eurohex.eu). All calculations were performed separately for men and women, and confidence intervals for LE in each category were calculated as detailed in <http://www.scotland.gov.uk/Topics/Statistics/About/Methodology/confinv>.

Ethics

We undertook a secondary analysis of data obtained under the SHARE Data Access Rules (<http://share-dev.mpsoc.mpg.de/data-access-documentation/research-data-center-data-access.html>). SHARE received ethical approval by the University of Mannheim’s Internal Review Board. All participants consented to the study.

Results

The total wave 4 sample size was 50,351 individuals with sample size within countries ranging from 788 women and 701 men (Germany) to 3,809 women and 2,507 men (Estonia) (see Supplementary data, available at *Age and Ageing* online, Appendix Tables S1 and S2). Household response rates for wave 4 were 89% on average, ranging from 78% (Slovenia) to 97% (Hungary). Individual response rates were considerably lower and ranged from 34% (Netherlands) to 61% (Hungary) [18].

Prevalence of frailty and disability

There was considerable variation in the prevalence of the frailty/disability categories, at age 50 and over for country

and sex (see Supplementary data, available at *Age and Ageing* online, Appendix Tables S1 and S2). Prevalence of frailty was lowest in Germany [men: 0.3% (95% CI: 0.3–0.3), women: 0.8% (95% CI: 0.8–0.8)] and highest in Spain [men: 5.6% (95% CI: 5.6–5.6), women: 15.6% (95% CI: 15.5–15.6)]. Prevalence of severe activity limitation was lowest in Spain [men: 7.0% (CI: 7.0–7.0), women: 6.7% (95% CI: 6.7–6.7)] and highest in Hungary for men [24.7% (95% CI: 24.6–24.8)] and in the Netherlands for women [27.6% (95% CI: 27.5–27.6)]. For all men, 74.1% (95% CI: 74.1–74.1) were classified as robust, 7.4% (95% CI: 7.4–7.4) pre-frail, 2.2% (95% CI: 2.2–2.2) frail and 16.3% (95% CI: 16.3–16.3) severely limited; while for women 58.4% (95% CI: 58.4–58.5) were robust, 16.5% (95% CI: 16.5–16.5) pre-frail, 5.5% (95% CI: 5.4–5.5) frail and 19.6% (95% CI: 19.6–19.6) severely limited (see Supplementary data, available at *Age and Ageing* online, Appendix Tables S1 and S2).

LE with frailty/disability by age and sex

Figure 1 shows for men and women (in the 15 EU countries combined) at age 50–85 the expected years in each of the four frailty/disability categories both as an absolute number of years and as a proportion of remaining LE. At age 50, LE for men in the EU27 in 2010 was 29.7 years of which 21.4 years (72.2%) were robust, 2.4 years (8.1%) pre-frail, 0.8 years (2.5%) frail and 5.1 years (17.1%) with severe limitation. In comparison, women’s LE at age 50 was 34.7 years in total but with fewer years robust (19.2 years, 55.4%) and more years pre-frail (5.9 years, 17.1%), frail (2.1 years, 6.1%)

and with severe limitation (7.4 years, 21.4%). At every age women, compared with men, spent more absolute years and a greater proportion of LE severely limited, frail and pre-frail. For men the absolute years spent frail varied little up to the age of 85, being ~0.4–0.8 years. By age 85 women’s LE frail was almost equal to LE robust, while for men this had still not happened by age 85.

LE in the frailty categories at age 70, by sex and country

Taking age 70 as an example, Figure 2 shows the expected years of life for the four frailty/disability categories with 95% confidence intervals, by sex and country. For values at other ages (i.e. 65, 75, 85), please see Appendix Tables three (women) and four (men) in the Supplementary data are available in *Age and Ageing* online. As shown in Figure 2, overall LE robust at age 70 was 8.1 years for men and 6.0 years for women but in men ranged from 4.1 years (36.3% of LE) in Hungary to 10.4 years (71.5% of LE) in Sweden and for women from 3.0 years (19.1% of LE) in Poland to 8.9% (56.5% of LE) in Denmark. LE pre-frail at age 70 was 1.8 years overall for men (from 0.8 years to 3.1 years) and 3.7 years in women overall (from 2.2 years to 5.5 years). Male LE frail at age 70 was 0.7 years overall, greatest in Spain (1.8 years, 12.1% of LE) and least in Germany (0.1 years, 0.7% of LE), though the majority of countries had male LE frail at age 70 of 1 year or less. For women, LE frail at age 70 was 1.8 years overall, again greatest in Spain (5.5 years, 30.1% of LE) and least in Germany (0.4 years, 2.3% of LE). For all

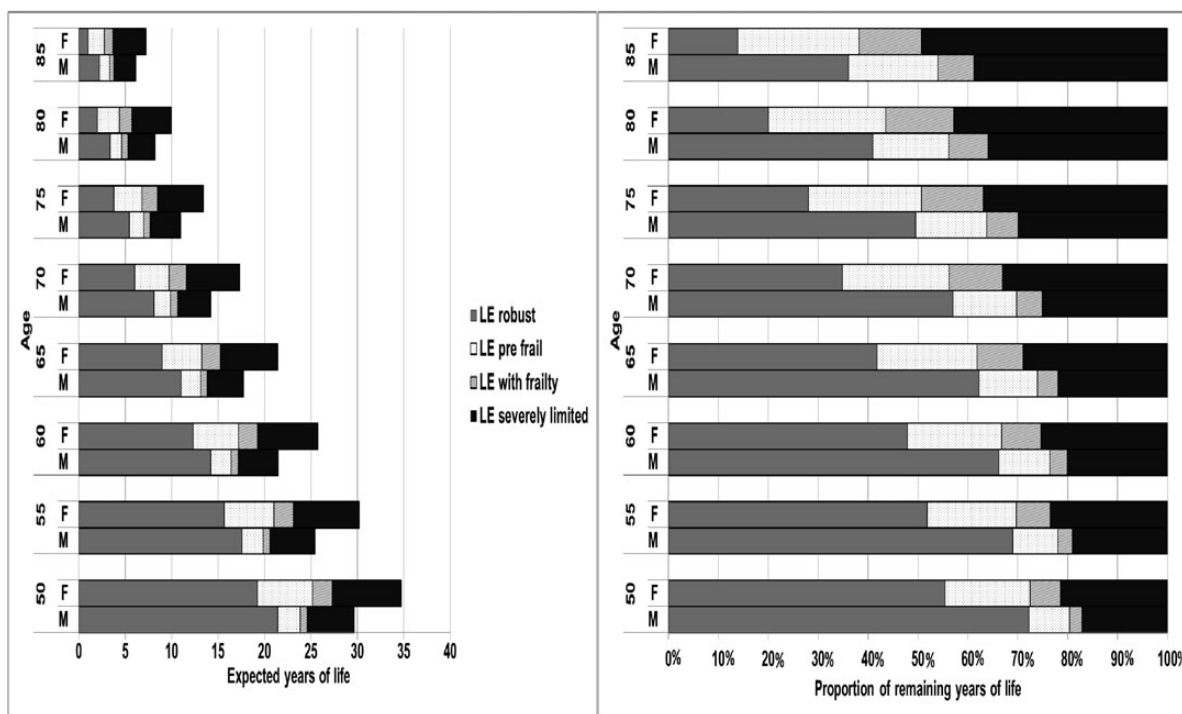


Figure 1. LE in each frailty state: robust, pre-frail, frail, disabled (with severe activity limitation) in absolute years and as a proportion of LE (15 EU countries combined), by sex and age.

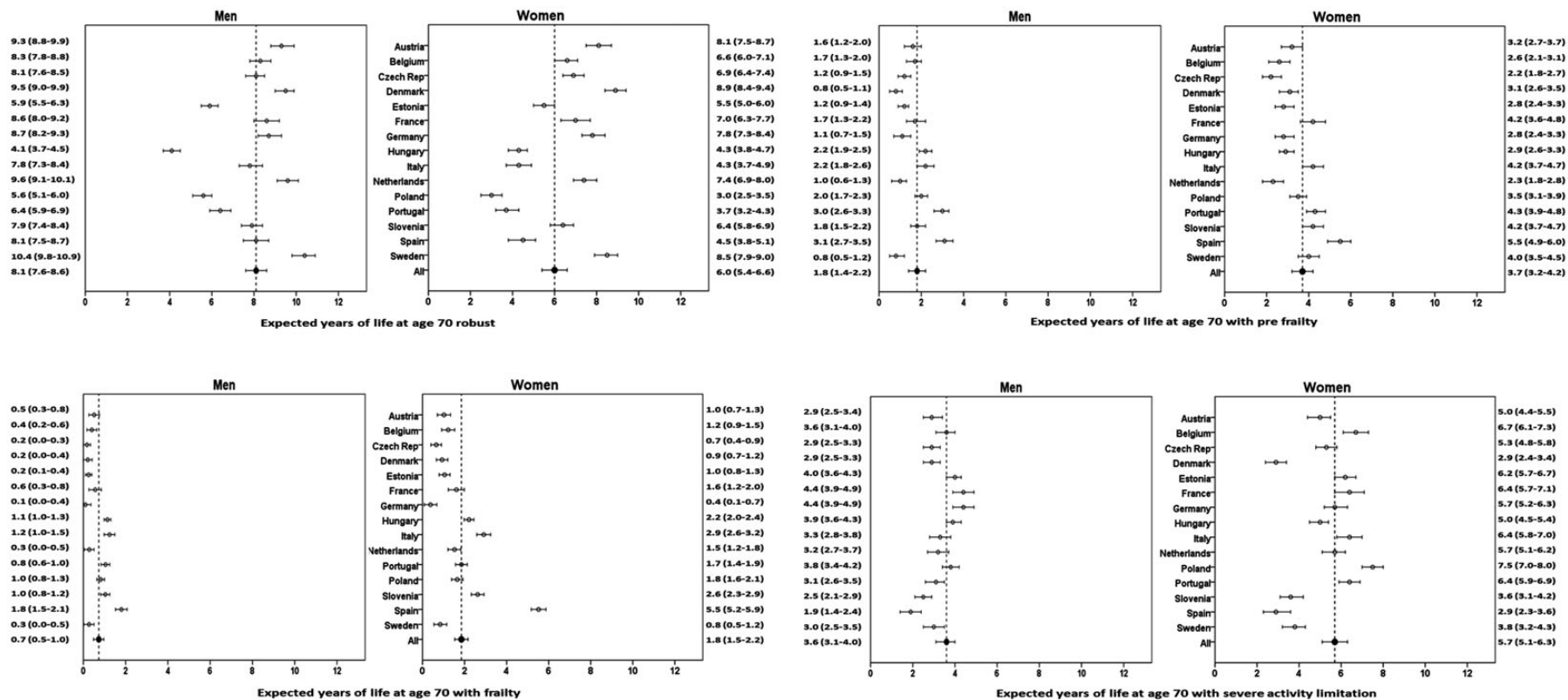


Figure 2. Expected years of life at age 70 robust, pre-frail, frail, disabled (with severe activity limitation) in 2010 with 95% confidence intervals, by sex and country (SHARE wave 4 release 1).

countries combined, years spent with severe activity limitation at age 70 was the longest of the three frailty/disability categories being 3.6 years in men and 5.7 years in women.

Discussion

This study was the first to compare differences in European LE in frailty/disability categories using a phenotypic definition of frailty. The sex differences in frailty prevalence (5.5% in women and 2.2% in men) are consistent with those found in the Cardiovascular Health Study in the USA (7.3% in women and 4.9% in men), which used the original phenotypic definition of frailty [7]. Here, the overall levels of frailty may have been lower because the frailty states were defined only in participants without severe activity limitation.

We showed that European women can expect to live longer than men, but also spend more years and a larger proportion of their remaining LE with pre-frailty, frailty and severe activity limitation at all ages. Indeed at age 85 women's LE frail was approaching their LE robust though this was not true for men even by age 85. Results are consistent with previous studies of disability-free LE showing that women live longer than men, but that they spend more years and a larger proportion of their LE with disability [19–21].

According to the frailty phenotype approach, comorbidity is an aetiological risk factor for, and disability is an outcome of, frailty [7], in keeping with our inclusion of a severe activity limitation (disability) category with frailty. On the other hand, the cumulative deficit model includes disability in the definition of frailty, together with comorbidity [5]. Our study suggests that there is a relatively short time spent frail but without severe activity limitation. The period pre-frail is longer and may provide a window of opportunity for interventions to slow down progression to frailty and then disability.

The proportion of frailty and pre-frailty in our study was higher in southern than in northern European countries, consistent with previous findings of a north–south gradient for other health indicators in SHARE [22]. At the same time, there were considerable sex differences between countries in LE robust, with a north–south gradient as well. For example, at age 70, the difference between male and female LE robust was 0.2 years in Hungary, but >3.5 years in Italy and Spain.

Although there are known differences in which men and women self-report their health [23], frailty scholars have argued that a greater frailty burden in women might represent a male ‘fitness–frailty pleiotropy’ and/or a female ‘fertility–frailty pleiotropy’, resulting in men having lower physiological reserves in old age [14]. Besides potential biological effects, the country and sex differences found in this study could be of socio-economic nature. We found that in low-income countries, people can expect to live more years in a pre-frail and frail state, and fewer years robust. Indeed, the relationship between frailty and socio-economic status has been shown in other cohorts [24, 25]. A recent SHARE

study based on the deficit accumulation approach found that a country's level of frailty is strongly correlated with national economic indicators [26]. Another recent SHARE study revealed the presence of various sources of social inequalities over the life course, where social protection systems would appear to have a major role in preventing or reducing the frailty process, including by targeting subpopulations at risk of frailty – especially women [27].

Our study has limitations. First, the institutionalised population are not included in SHARE. This will not result in biased estimates if those in institutional care are similar to those living in the community. This is unlikely to be true for frailty as those in institutions are more likely to be frail or severely limited. Thus our estimates of LE robust and pre-frail may be slightly over-estimated. Secondly, frailty is not necessarily a progressive syndrome, and transitions between frailty categories over time occur at an individual level [28]. In addition, it should be noted that we calculated LE in frailty/disability categories using mortality from life tables and not from observed mortality in SHARE since SHARE's mortality follow-up underestimates real mortality systematically; on the one hand due to the missing deaths in the mortality follow-up, but also due omission of the institutionalised population in the sample [11, 29].

‘Men die, women suffer’: that is the so-called male–female health paradox

The paradox is likely to be due to multiple causes that include biological, behavioural and social differences between the sexes [30]. Our results contextualise the known gender gap in quality of life disavouring women, although differences were observed in the size of the gap between countries. Understanding the drivers of these cross-national differences and further exploring time trends within countries will aid health and social care planning in Europe.

Key points

- European women live longer than men, but with more disability.
- We compared sex differences in LE in frailty/disability categories at age 50+ between 15 European countries.
- At every age, women can expect fewer years robust and more years and a greater proportion of LE pre-frail, frail and disabled.
- Differences exist in LE robust between higher and lower income countries.
- This may be related not only to biological, but also socio-economic factors.

Conflicts of interest

None declared.

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Supplementary data

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

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Secular changes in at-risk drinking in Sweden: birth cohort comparisons in 75-year-old men and women 1976–2006

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Abstract

Background: little is known about the prevalence of at-risk drinking in older adults.

Objective: to compare rates of at-risk drinking in 75-year-olds examined in 1976–77 and in 2005–06.

Design: cross-sectional survey.

Setting: two samples representative of the general population in Gothenburg, Sweden.

Participants: 75-year-olds born in 1901–02 ($n = 303$) and in 1930 ($n = 753$).

Methods: participants took part in a multidisciplinary study on health and ageing. Protocols regarding alcohol consumption were identical for both cohorts. Total weekly alcohol intake was estimated and at-risk drinking was defined as ≥ 100 g alcohol/week.

Results: the proportion abstaining differed significantly between birth cohorts (18% in 1976–77 versus 9% in 2005, $P < 0.001$). Frequencies of drinking beer and liquor were similar in the two cohorts for men, but were lower for women in the later-born cohort. Proportions drinking wine were higher in the later-born cohort for both sexes. Total weekly alcohol intake was higher for both men and women. At-risk drinking was observed in 19.3% of the men in the earlier-born cohort, and in 27.4% in the later-born cohort ($P = 0.117$). Corresponding figures for women were 0.6 and 10.4% ($P < 0.001$). At-risk drinking was significantly associated with birth cohort in women (OR: 13.77, CI: 1.82–104.0, $P = 0.011$) and the occupational group in men (OR: 1.60, CI: 1.13–2.26, $P = 0.008$).

Conclusions: alcohol consumption in 75-year-olds has changed markedly, especially in women. Studies need to be carried out in varied settings in order to evaluate the clinical and public health implications of changing trends in alcohol consumption.

Keywords: older people, alcohol, at-risk drinking, cohort comparisons