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Original Article

Intergenerational Occupational Mobility and Objective Physical Functioning in Midlife and Older Ages

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Abstract

Objective: This study investigates the relationship between intergenerational occupational mobility and objective physical functioning in later life.

Method: Data come from The Irish Longitudinal Study of Ageing (TILDA), a nationally representative probability sample of 5,985 respondents aged 50 and older. Walking speed and grip strength are the functional health measures. The intergenerational occupational mobility measure characterizes origin and destination position as: professional/managerial, non-manual, skilled manual/semi-skilled, unskilled, never worked, and farmer.

Results: Results indicated no direct association of childhood origin with walking speed or grip strength in later life, except for individuals from farming backgrounds. Those who experienced upward mobility were comparable in speed and strength with those who enjoyed high status (e.g., stable professional/managerial origin and destination) at both time points, whereas the downwardly mobile were comparable with those who were stable across generations at lower occupational positions. The results did not support the central tenets of the accumulation hypothesis. Respondents from farming backgrounds exhibited a clear performance advantage irrespective of destination, which, we speculate, may represent a critical period effect.

Discussion: The mechanisms through which childhood origin affects health in later life are complex, but the position attained in adult life is most important. Intergenerational mobility is important only insofar as it leads to a destination occupation. The present findings suggest that the musculoskeletal system may accommodate environmental modification in adulthood.

Keywords: Ageing—Cohort study—Grip strength—Life course models—Walking speed

A large body of research links disadvantaged socioeconomic position (SEP) during early childhood with poorer health in later life (Hayward & Gorman, 2004; Melchior, Moffitt, Milne, Poulton, & Caspi, 2007; Power et al., 2007). More troublesome is the theoretical import of these findings. Does the association between disadvantaged SEP in early life and poor health in later life reflect a direct physiological scarring effect of early childhood exposures, as espoused by proponents of the critical period hypothesis, or is it simply that disadvantaged SEP in early life serves as a particularly robust marker of continuing socioeconomic disadvantage that erodes health over a span of years (i.e., accumulation)? The pathway or "chains of risk" model suggests that it is not the direct effect of early life SEP that matters, but rather, its indirect effect via adult characteristics that are affected by early life SEP and come in turn to affect health. A related issue is whether social mobility (i.e., change in socioeconomic circumstances over the life course) can compensate for low SEP in childhood or whether there are lingering effects of early childhood exposures that cannot be ameliorated by upward social mobility. This is an important theoretical and empirical issue because recent academic and policy discourse has discussed whether it is more efficacious to intervene in early life to counter the potential long-term effects of growing up in a disadvantaged childhood social environment (Braveman, Sadegh-Nobari, & Egerter, 2008; Heckman & Masterov, 2007).

Birnie and colleagues (2011) examined the impact of intergenerational social class transitions measured by occupational origin and destination on two tests of functional performance in later life—the get-up-and-go test and a balancing task. Although not statistically significant, they found that participants who were upwardly mobile and those who were downwardly mobile had walk times that were 3% and 5% slower, respectively, compared with those who were stable-high across generations. Their results indicated, however, a statistically significant 10% penalty in walk time for participants who were stable-low across generations compared with those who were stable-high. They found similar patterns on the balancing task for the Boyd Orr, but not the Caerphilly cohort. This latter finding is broadly consistent with the accumulation hypothesis over the critical period hypothesis.

Although it is common to explore the critical period hypothesis by examining whether an independent effect of childhood SEP remains after adjusting for SEP and health behaviors in later life, Pudrovska and Anikputa (2014) explicitly tested the counterfactual preposition as to whether high SEP in early life affords any protection against worsening socioeconomic circumstances (i.e., downward mobility). This represents an important test of the critical period hypothesis. If early life is critical to the acquisition of biological capital, one might expect that individuals who experienced high SEP in early life would carry forward a stock of health capital, which may make them more resilient to future adversity. They did not find compelling evidence that a propitious start affords any protection against changing circumstances as men and women who experienced socioeconomic drift downwards had mortality risk that was comparable with those who experienced persistent disadvantage.

Similarly, Ploubidis, Benova, Grundy, Laydon, and DeStavola (2014) examined the explanatory value of different life course models using four waves of data from the English Longitudinal Study of Ageing (ELSA) study. They noted age- and gender-specific differences in results across the sample with current SEP having greater utility in explaining inequalities in physical health (chair rise, respiratory function, and grip strength) and fibrinogen levels in persons younger than 65 years, and early life SEP more prominent in explaining inequalities in persons older than 75 years. They concluded that further research was required to delineate the mechanisms responsible for the social patterning of health to help identify targets for public policy intervention.

The Irish Experience

An obvious reason for exploring these issues in other cohorts and contexts is that patterns of social mobility vary across countries as a consequence of differing economic, social, and cultural circumstances. The Irish experience is potentially informative because Ireland experienced tremendous change in levels of absolute social mobility from the 1950s onward as the pace of transition from agricultural to postindustrial society was accelerated relative to other Western countries (Hout 1989; Whelan & Layte, 2006). This marked transition in Irish economic circumstances occurred when the majority of the TILDA cohort were children or teenagers (~60% of the sample was born between 1945 and 1960). Opportunities arising from this transition will have varied by initial social context and between urban and rural populations, making Ireland an interesting test case for exploring the explanatory value of different life course models for understanding the life course relationship between SEP and health.

The Present Study

The Irish Longitudinal Study on Ageing (TILDA) collects information on origin (i.e., father's) and destination (i.e., respondent's) occupational position, and each respondent is invited to undergo a comprehensive clinic-based evaluation of health allowing us to examine the explanatory value of each of three theoretical frameworks—critical period, accumulation, and pathway—in accounting for social inequalities in functional health. We employ two objective measures of physical health: walking speed and grip strength, which serve as biomarkers of reduced muscle function. Walking speed requires the co-ordinated action of a number of different physical systems including the nervous, musculoskeletal, and cardiopulmonary systems and serves as a useful indicator of health and vitality in older adults (Hornyak, VanSwearingen, & Brach, 2012). Prospective studies have linked a decline in gait speed with increased risk of falls (Verghese, Holtzer, Lipton, & Wang, 2009), higher rates of disability (Guralnik et al., 2000), and mortality (Studenski et al., 2011). We chose grip strength as an outcome measure because muscle function is known to be sensitive to early nutrition (Norman, Stobäus, Gonzalez, Schulzke, & Pirlich, 2011), and grip strength has prognostic value as an indicator of functional decline and mortality (Bohannon, 2008). These outcomes are highly sensitive to life course influences including early life exposures and adult health behaviors (Kuh, Karunananthan, Bergman, & Cooper, 2014).

Of course, choosing between these different theoretical models implies that we have some means to weigh the evidence. Hallqvist, Lynch, Bartley, Lang, & Blane (2004) have cautioned that it is difficult to empirically disentangle the different life course models because they share elements in common with each other, a view shared by other researchers who argue that the challenge lies in the appropriate parameterization of each hypothesis (DeStavola &

Daniel, 2012; Ploubidis et al., 2014). We therefore formally explicate support for each of the life course models if the following conditions are satisfied, bearing in mind that they are not mutually exclusive.

Evidence for the *critical period hypothesis* exists if:

(1) An independent association of childhood SEP with functional health in later life exists, controlling for SEP in adulthood.
(2) Social mobility does not compensate for the effects of disadvantaged childhood SEP, and advantaged childhood SEP provides a buffer against downward social mobility.

Evidence for the *accumulation hypothesis* exists if:

(3) The duration of socioeconomic exposure affects outcomes (i.e., those who spend most/least time disadvantaged have the worst/best outcomes.

Evidence for the *pathway hypothesis* exists if:

(4) Childhood SEP does not directly affect health in later life.
(5) Childhood SEP is associated with adulthood SEP, and adulthood SEP influences the risk of engaging in lifestyle-related behaviors that are deleterious to health.

Method

Study Design and Participants

The Irish Longitudinal Study on Ageing (TILDA) is a large prospective cohort study examining the social, economic, and health circumstances of 8,175 community-dwelling adults aged 50 years and older resident in the Republic of Ireland. Sampling involved use of a three-stage selection process with the Irish Geodirectory as the sampling frame. Whelan and Savva (2013) provide a detailed description of TILDA study design and sampling. The household response rate was 62.0%. We utilize two components of TILDA in this analysis: a computer-assisted personal interview (n = 8,175) completed in the respondent's home and a clinic-based health assessment. At the initial interview, respondents were invited to undergo a detailed health assessment at one of the two national centers in Dublin and Cork using trained nursing staff. If a respondent could not attend the health center but was agreeable to completing a health assessment, a trained nurse administered a subset of the tests in the respondent's home. Walking speed was only measured in the health center, but grip strength was measured for those who completed either a center- or home-based assessment. The final sample size for each analysis is presented in the methodology section. The Trinity College Dublin Research Ethics Committee granted ethical approval for the study.

Health Outcomes

Walking speed

TILDA measured speed of ambulation using a 4.88-m computerized walkway with embedded pressure sensors (GAITRite, CIR Systems Inc., New York, NY). Participants completed two walks along the mat at their normal walking speed. Each trial started 2.5 m before and ended 2 m after the walkway in order to allow room for acceleration and deceleration. We used the average of the two readings as the overall walking speed measure expressed as meters travelled per second (m/s).

Grip strength

TILDA measured grip strength using a Baseline Hydraulic Hand Dynamometer, which consisted of a gripping handle with a strain gauge and an analogue reading scale that increased in 2-kg increments. Respondents were instructed to hold the device in their dominant hand with the forearm at a right angle to their upper arm. The participant was then instructed to squeeze as hard as they could for a few seconds. We rounded results to the nearest whole number (i.e., if the dial fell between 22 and 24 kg, grip strength was recorded as 23 kg). This procedure was repeated twice; we used the higher of the two measures

Measures of SEP in Childhood and Adult Life

British and European sociological research has a long tradition of using occupation to measure SEP (Davey Smith et al., 1998; Krieger, Williams, & Moss, 1997). Occupation is often favored as a indicator of SEP in life course research because it is an individual-level measure that is correlated with other measures of socioeconomic status (e.g., income, education, and environmental exposures) and is transferable as the occupational position of the head of household can be used to describe the likely socioeconomic circumstances of dependents (Galobardes, Shaw, Lawlor, & Lynch, 2006). The household interview collected data on the respondent's father's occupation when they were growing up, before the age of 14. If their father had more than one occupation during this time, TILDA collected data on the most important job (i.e., the one with the highest pay).

The coding of occupations followed the Irish Central Statistics Office (CSO) social class schema: (1) *professional*; (2) *managerial*; (3) *non-manual*; (4) *skilled manual*; (5) *semi-skilled*; (6) *unskilled*; and (7) *all others gainfully occupied but unknown*. A further 7.7% of the sample reported that their father never worked. We aggregated the original CSO categories to create a manageable number of distinct groupings that reflect an underlying socioeconomic hierarchy: *professional/managerial*, *non-manual*, *skilled manual/semi-skilled*, *unskilled*, and *parent never worked*. A large proportion of the sample reported that their father was a farmer (25.7%), but TILDA did not collect data on the size (i.e., acreage) of the farm, which the Irish CSO use in their determination of social class. Hence we treated farmers as a separate group in the analysis. We treated respondents who could not recall or refused to disclose their father's occupation (4.2%) or their own occupation (3.3%) as missing.

TILDA collected data on the respondent's current occupation (or historic occupation—defined as the job title of the highest paying job they ever held—if they had retired). Occupational information was not collected at Wave 1 for respondents who were self-employed (excluding farmers), unemployed, on home duties, in education or training, or those who were sick or disabled, but this information was subsequently obtained at Wave 2. The information collected at the Wave 2 sweep is therefore used to derive all respondents' destination SEP following the same criteria used to categorize fathers' SEP, and we used Wave 1 occupation for Wave 2 nonrespondents.

Covariates

Any association between SEP and the functional health measures might be due to common correlation with other factors that either precede or are produced by SEP, or even by health. Even though it is not possible to unequivocally establish relative timing for most of these variables because they were measured contemporaneously, it is still informative to examine the degree to which their common association reduces the association of SEP with health. We chose covariates on the basis of their association with walking speed and/or grip strength in the literature and because we suspected that the distribution of these variables may differ across occupational groups. Two covariates, height and ever smoked, have a relatively clear position in event timing and lie between origin and destination SEP though there remains some timing uncertainty because of possible differential loss of height through aging or later smoking cessation.

In addition to age, age^2, and sex, we control for height because it is an important determinant of walking speed and grip strength and most height growth is complete by 18 years of age so it is likely to be affected by origin SEP but unlikely to be affected directly by destination SEP; rather there is a substantial literature showing that taller adults tend to end up in higher status positions in the labor market (Case & Paxson, 2008). Height was measured to the nearest 0.1 cm using a SECA 240 wall-mounted measuring rod.

We also control for smoking, which is represented as a binary indicator (never smoked vs ever smoked). Smoking is an important contributor to declines in physical health over the life span (Abate, Vanni, Pantalone, & Salini, 2013). It is also a good life course variable because studies have shown that the vast majority of people who smoke tend to begin smoking in their teenage years (Hymowitz, 2012). Although destination SEP is therefore unlikely to affect the decision to start smoking, it may positively influence the decision to stop smoking (Reid et al., 2010). We do not measure smoking cessation because its relative timing is uncertain.

The remainder of our covariates have an ambiguous position in a causal chain. For example, destination SEP could affect the incidence of disease during adulthood, but the presence of disease during adulthood may also place constraints on destination SEP. Moreover, extended lack of physical activity associated with walking speed might even affect cardiovascular disease or weight gain. Yet we still control for a number of these adulthood health conditions to examine whether the SEP association with walking speed or grip strength remains when health conditions are held constant. We measured physical health status with a set of questions asking whether the respondent had ever received a doctor diagnosis of disease for these chronic disease categories: cardiovascular disease, lung disease, cancer diabetes, arthritis, and osteoporosis. We also controlled for weight as it is inversely associated with walking speed and positively associated with grip strength.

Statistical Analysis Plan

We used Stata, version 12.0 (Stata, College Station, TX) for all analyses. We estimated models using ordinary least squares regression because visual inspection showed that the regression residuals for each outcome measure closely followed a normal distribution. We fit a number of different models to the data to test the different life course models that have been advanced to explain the link between childhood SEP and later life health.

We explore the critical period hypothesis by examining whether there is an association of origin SEP with walking speed and grip strength in later life adjusting for age, age^2, and sex. We then add destination SEP to the model to see whether there exists an independent association of origin SEP with health in later life adjusting for destination SEP. This analysis represents a simultaneous test of the critical period and pathway model. If origin SEP is associated with health controlling for destination SEP, this implies support for the critical period hypothesis. If the hypothesized relationship between origin SEP and health becomes nonsignificant when adjusted for destination SEP, this implies support for the pathway model as it indicates that the effect of origin is indirect and mediated via its relationship with destination SEP. Even if origin occupation does not directly affect functional health, it may still be important because it influences destination occupation, which may itself be related to later life health.

We test the accumulation model by fitting a two-way interaction term between origin and destination SEP with respect to each of our outcome measures to determine whether the relationship with functional health in later life is additive or multiplicative. Two findings would provide support for the accumulation model: First, a significant interaction between origin and destination SEP such that those who enjoyed high SEP at both time points are in the best health, those who experienced low SEP at both time points are in the worst health, and those who were upwardly or downwardly mobile across generations rank somewhere in between; or second, a finding that implies mobility per se affects health; that is, that adult health is more than the additive effect of origin and destination SEP and that the association of destination SEP with health depends on origin SEP. We tested for effect modification by fitting Origin SEP * Sex and Destination SEP * Sex interaction terms for each of the outcome measures. The overall F-tests were nonsignificant.

Missing Cases and Survey Weights

A total of 5,895 people attended the clinic-based (n = 5,035) or home-based (n = 860) health assessment. Of those who attended the clinic, 4,954 completed the walking speed assessment and 5,811 completed the grip strength assessment. Three hundred and fifty-six cases are missing information on origin/destination occupation with respect to walking speed, and 420 cases are missing information on origin/destination occupation with respect to grip strength. Taking account of missingness on other covariates reduces the final cases base to 4,588 for the walking speed analysis and 5,366 for the grip strength analysis. We weighted the data prior to analysis using survey weights to account for initial stratification and clustering and for the fact that respondents who attended the health assessment center were younger, better educated, and tended to be in better health (Whelan & Savva, 2013). Separate survey weights were used to adjust for respondents who attended the home-based and center-based health center assessments.

Results

Table 1 describes the characteristics of the sample. Mean age was 63.1 years (SD = 9.3), and 51.7% were women. Mean walking speed and grip strength for the sample was 1.33 m/s (SD = 0.22) and 27.0 kg (SD = 10.4), respectively. Table 1 also describes the percentage of the sample within each occupational grouping separately with respect to origin (i.e., fathers') and destination (i.e., respondents') SEP. The results show a large intergenerational decline in the proportion of people engaged in agricultural and unskilled work as Ireland transitioned from an agricultural to a postindustrial economy. The proportion of the sample engaged in farming activities declined from 25.7% among cohort members fathers' generation to 7.3% among respondents' own cohort. The proportion of unskilled workers declined from 16.9% to 5.2% of the workforce between generations. The proportion of the workforce employed in professional/managerial and non-manual occupations more than doubled between father's and respondents generation.

Table 2 (panel A) shows that there was a large degree of social mobility among cohort members, much of it "required" by the change in occupational distribution over time. We exclude respondents who were intergenerationally mobile out of farming origins when considering mobility effects because of the inherent difficulty in characterizing their mobility trajectory. In total, 46.6% of the cohort experienced upward mobility, 16.0% experienced downward mobility, and 37.4% remained non-mobile (i.e., stable within their origin SEP across generations). A higher proportion of women were downwardly mobile compared with men (20.0% vs 12.1%). The younger members of the cohort aged 50–59 years were slightly more likely to experience mobility compared with those aged 70 years and older. 42.3% of those in the 70+ age group were non-mobile compared with 34.7% of those in the 50–59 year age group. Table 2 (panel B) also shows that there is a correlation between mobility and health. Mean walking speed for the upwardly mobile was 1.34 m/s compared with 1.31 m/s for the non-mobile and 1.29 m/s for the downwardly mobile. Grip strength exhibited no large differences between mobility groups.

Table 1. Characteristics of the Sample

Variable	Mean (SD) or %
Outcome variables	
Walking speed (m/s)	1.33 (0.22)
Grip strength (kg)	27.0 (10.4)
Demographic	
Female	51.7%
Age (years)	63.1 (9.3)
Origin SEP	
Professional/managerial	11.0%
Non-manual	7.3%
Skilled manual/semi-skilled	31.3%
Unskilled	16.9%
Parent never worked	7.8%
Farmer	25.7%
Destination SEP	
Professional/managerial	22.1%
Non-manual	23.7%
Skilled manual/semi-skilled	34.5%
Unskilled	5.2%
Not working	7.1%
Farmer	7.3%
Anthropometric measures	
Height (cm)	165.6 (9.5)
Weight (kg)	79.3 (16.5)
Smoking status	
Never smoked	43.4%
Ever smoked	56.6%
Chronic conditions	
CVD	18.9%
Lung disease	4.5%
Cancers	6.4%
Diabetes	7.8%
Arthritis	28.9%
Osteoporosis	9.8%

Note: CVD = cardiovascular disease; SEP = socioeconomic position.

Main Effects Model

Table 3 (Model 1) reports the association of origin occupational position with walking speed and grip strength in later life adjusting for age, age^2, and sex. The main effects

Table 2. Percentage of the Sample Within Each Mobility Category by Sex and Age Group and Mean Walking Speed (m/s) and Grip Strength by Intergenerational Mobility Status

	Panel A						Panel B	
	Intergenerational mobility						Mobility effect on health	
	All sample	Sex		Age (years)			Walking speed	Grip strength
		Male	Female	50–59	60–69	70+	(m/s)	(kg)
Mobility group	%	%	%	%	%	%	Mean	Mean
Downwardly mobile	16.0	12.1	20.0	17.4	15.9	13.9	1.29	26.8
Non-mobile	37.4	44.4	30.2	34.7	36.5	42.3	1.31	27.3
Professional/managerial	7.1	7.5	6.7	7.3	7.8	6.1	1.35	27.9
Non-manual	3.3	1.8	4.8	2.9	3.2	3.9	1.34	26.9
Skilled manual/semi-skilled	16.7	20.7	12.6	17.9	16.6	15.1	1.29	26.6
Unskilled	2.3	1.7	3.0	1.1	2.4	4.2	1.29	27.1
Parent never worked/not working	0.9	0.1	1.8	0.3	0.6	2.2	1.26	29.4
Farmer	7.0	12.6	1.4	5.3	5.9	10.8	1.36	28.2
Upwardly mobile	46.6	43.5	49.8	47.9	47.7	43.8	1.34	27.1
N cases	4,259	2,038	2,221	1,778	1,427	1,047	3,597	4,182

Notes: Reported means are the conditional marginal means adjusted for age, age^2, and sex. Respondents who were intergenerationally mobile out of farming origins are excluded from Table 2 due to the difficulty in characterizing their mobility trajectory.

are contrasts with the Professional/Managerial group, the group considered most advantaged, as the reference category. Table 3 reports the conditional mean adjusted values, unstandardized beta coefficients, and associated 95% confidence intervals. We used Wald tests to compare differences between occupational groups after fitting the regression models. With the notable exception of farmers, the results indicate little evidence to suggest that origin directly affects functional performance in later life. In general, the main occupational groupings were not significantly different from each other in terms of walking speed or grip strength. Although those from skilled-manual/semi-skilled backgrounds walked significantly slower ($p < .05$) compared with those with professional/managerial origins, adjustment for destination SEP in Model 2 completely attenuated this relationship. Those with farm origins, however, exhibited a clear performance advantage on the functional ability tests that remained even when adjusted for destination SEP in Model 2. They walked significantly faster and recorded grip strengths that were significantly higher compared with the other occupational groupings.

Turning next to the results for destination SEP (Model 2), we find a significant penalty in walking speed and grip strength associated with lower occupational positions. Participants from non-manual, skilled manual/semi-skilled, and unskilled backgrounds walked −0.03 ($p < .01$), −0.06 ($p < .001$), and −0.10 m/s ($p < .001$) slower respectively, compared with participants from professional/managerial backgrounds. They also showed poorer performance on the grip strength measure averaging between −0.93 and −1.12 kg lower than the professional/managerial group. The significant performance advantage in walking speed and grip strength observed among participants with farming backgrounds occurred only for origin and not for destination SEP. Participants whose destination SEP was farming walked −0.03 m/s ($p < .05$) slower and had a grip strength that was −0.48 kg (n.s) lower on average compared with the professional/managerial group.

Interaction Model

The two-way interaction term between origin and destination occupational position was nonsignificant with respect to both walking speed ($F = 25, 592 = 1.18$; $p = .254$) and grip strength ($F = 25, 596 = 1.33$; $p = 0.129$). This result implies that the linear combination of origin and destination occupation is sufficient to describe the effects of life course SEP on health in later life. This relationship can also be readily adduced from Supplementary Tables S1 and S2, which report the conditional marginal means adjusting for age, age^2, and sex, for walking speed and grip strength resulting from the cross-classification of origin and destination occupational position. Cells on the diagonal describe performance for individuals who were non-mobile across generations, cells below the diagonal summarize performance for those who were upwardly mobile across generations, and cells above the diagonal summarize performance for those who were downwardly mobile. Within levels of origin, higher destinations lead to better health. Within levels of destination, origin makes no difference, with the obvious exception of individuals with farm origins. In the vast majority of cases, those who were upwardly mobile and those who are stable at the higher position are indistinguishable. Similarly, those who were downwardly mobile are indistinguishable from those who were stable at lower occupational positions.

Pathway

We found a significant association between origin and destination SEP. Supplementary Figure S1 shows that 52.0% of

Table 3. Association of Origin SEP with Walking Speed (m/s) and Grip Strength (kg) in Later Life (Model 1) and Adjusted for Destination SEP (Model 2)

	Model 1		Model 2	
	Mean	*B* [95% CI]	Mean	*B* [95% CI]
Walking speed (*n* = 4,588)				
Socioeconomic position				
Origin				
Professional/managerial	1.33	Reference	1.32	Reference
Non-manual	1.32	−0.01 [−0.04, 0.01]	1.31	−0.00 [−0.03, 0.02]
Skilled manual/semi-skilled	1.31	−0.02 [−0.04, −0.00]*	1.31	−0.00 [−0.02, 0.02]
Unskilled	1.32	−0.01 [−0.04, 0.01]	1.33	0.02 [−0.01, 0.04]
Parent never worked	1.32	−0.01 [−0.05, 0.02]	1.32	0.00 [−0.03, 0.04]
Farmer	1.36	0.03 [0.01, 0.05]*	1.36	0.04 [0.02, 0.06]***
Destination				
Professional/managerial			1.37	Reference
Non-manual			1.34	−0.03 [−0.04, −0.01]**
Skilled manual/semi-skilled			1.31	−0.06 [−0.07, −0.04]***
Unskilled			1.26	−0.10 [−0.15, −0.06]***
Not working			1.29	−0.07 [−0.11, −0.04]***
Farmer			1.33	−0.03 [−0.07, −0.00]*
Grip strength (*n* = 5,366)				
Origin				
Professional/managerial	27.2	Reference	27.0	Reference
Non-manual	26.3	−0.85 [−1.73, 0.03]	26.3	−0.64 [−1.54, 0.26]
Skilled manual/semi-skilled	26.5	−0.66 [−1.24, −0.07]*	26.6	−0.35 [−0.96, 0.26]
Unskilled	26.5	−0.66 [−1.36, 0.05]	26.6	−0.32 [−1.06, 0.43]
Parent never worked	27.0	−0.18 [−0.94, 0.57]	26.9	−0.01 [−0.78, 0.77]
Farmer	27.9	0.68 [0.05, 1.30]*	27.8	0.86 [0.21, 1.51]**
Destination				
Professional/managerial			27.7	Reference
Non-manual			26.6	−1.02 [−1.52, −0.52]***
Skilled manual/semi-skilled			26.7	−0.93 [−1.49, −0.36]***
Unskilled			26.5	−1.12 [−2.12, −0.13]*
Not working			27.1	−0.52 [−1.31, 0.28]
Farmer			27.2	−0.48 [−1.42, 0.46]

Notes: SEP = socioeconomic position.
Model 1: Adjusted for age, age^2, and sex.
Model 2: Adjusted for age, age^2, sex, and destination SEP.
Reported means are the conditional marginal means
*p < .05. **p < .01. ***p < .001.

participants with professional/managerial origins had a professional/managerial destination. In general, those who were mobile tended to be mobile by ±1 occupational position around their origin. This result suggests that origin places some constraints on destination SEP. We undertook additional analyses to help understand the pathways through which intergenerational mobility comes to affect functional health in later life by examining the health risk profile of those who were upwardly and downwardly mobile relative to those who were stable non-mobile across generations within each occupational class. We excluded farmers when considering mobility effects because of the inherent difficulty in characterizing mobility out of farming origins. Supplementary Table S3 shows that individuals who were upwardly mobile across generations were comparable in terms of their health risk profile with those in stable higher occupational positions, ranking somewhere between the stable professional/managerial and the stable non-manual classes. By contrast, individuals who were downwardly mobile were comparable in terms of their health risk profile to those who were stable at lower occupational positions, ranking somewhere between the stable skilled manual/semi-skilled and the stable unskilled. This table confirms the result of the main effects and interaction model: The health of the mobile is a function of their destination occupation.

Covariate Analysis

The interaction model showed that there was no mobility effect per se (i.e., the effect of destination does not depend on origin), and the main effects model showed that destination SEP (rather than origin SEP) is the more important determinant of functional health in later life. We therefore undertook a covariate analysis to help understand the pathways through which destination SEP comes to affect functional health in later life.

We estimated three equations using ordinary least squares regression with hierarchical entry of predictors and present the results in Tables 4 (for gait speed) and 5 (for grip strength). Model 1 is the base model describing the relationship between destination SEP and the two outcome measures adjusting for age, age^2, and sex. The second model adds height and smoking as it is reasonable to assume that these precede destination SEP as discussed earlier. Model 3 adjusts additionally for body weight and whether the respondent has ever received a doctor diagnosis of disease across multiple disease types (cardiovascular disease, cancer, diabetes, lung disease, arthritis, and osteoporosis) to explore whether there is an SEP–walking speed or SEP–grip strength association holding constant the existence of these conditions.

As before, the professional/managerial group constitute the reference category. We tested for effect modification by fitting interaction terms between destination SEP and age group. We found no significant SEP by age group interactions with respect to gait speed, but there were two for grip strength. Specifically, farmers aged 60–69 years and those older than 70 years had significantly lower grip strength compared with farmers aged 50–59 years. As these were the only significant comparisons, we decided to pool the analyses.

Table 4 (Model 1) shows that there is an occupational gradient in walking speed. Participants with a professional/managerial destination walk significantly faster compared with the other occupational groups, with the exception of farmers. The associations were attenuated somewhat when we adjust for height and smoking in Model 2 and when we adjust for adulthood health conditions in Model 3. We replicated these analyses for grip strength (Table 5). Again, the professional/managerial group showed significantly higher grip strength compared with the other occupational groups (Model 1), except farmers. With the exception of the non-manual group, for whom the grip strength penalty was evident across all models, the differences in grip strength for lower occupational groups compared with the professional/managerial became nonsignificant when we adjusted for height and smoking in Model 2. Further investigation revealed that height on its own was sufficient to account for the differences in strength between different occupational groups. Height is a strong predictor of grip strength, and individuals from professional/managerial backgrounds are taller on average compared with other occupational groupings. In both instances, the results of Model 3 suggest that the association of destination SEP with the two outcome variables is not simply a function of poorer health among those with low SEP. Measured conditions, whether they precede or follow destination SEP, do not fully attenuate the relationship between SEP and our functional performance measures.

Table 4. Association of Destination SEP with Walking Speed (m/s) in Ordinary Least Squares Regression Analysis (n = 4,588)

	Model 1	Model 2	Model 3
	B (95% CI)	*B* (95% CI)	*B* (95% CI)
Professional/managerial	Reference	Reference	Reference
Non-manual	−0.03 [−0.04, −0.01]**	−0.02 [−0.04, −0.01]**	−0.02 [−0.04, −0.00]*
Skilled manual/semi-skilled	−0.05 [−0.07, −0.04]***	−0.04 [−0.06, −0.03]***	−0.04 [−0.05, −0.02]***
Unskilled	−0.10 [−0.14, −0.06]***	−0.09 [−0.13, −0.05]***	−0.08 [−0.12, −0.03]***
Not working	−0.06 [−0.10, −0.03]***	−0.06 [−0.10, −0.03]***	−0.05 [−0.08, −0.02]**
Farmer	−0.01 [−0.04, −0.02]	−0.02 [−0.05, 0.01]	−0.02 [−0.05, 0.01]
Age (years) (×10)	0.13 [0.04, 0.23]**	0.13 [0.03, 0.23]**	0.19 [0.09, 0.29]***
Age^2 (years) (×100)	−0.02 [−0.03, −0.01]***	−0.02 [−0.03, −0.01]***	−0.02 [−0.03, −0.01]***
Female	−0.04 [−0.05, −0.03]***	0.00 [−0.01, 0.02]	−0.01 [−0.03, 0.01]
Height (cm)		0.004 [0.003, 0.005]***	0.005 [0.004, 0.007]***
Ever smoked (vs never)		−0.03 [−0.04, −0.02]***	−0.03 [−0.04, −0.01]***
CVD			−0.05 [−0.07, −0.03]***
Lung disease			−0.04 [−0.07, −0.01]**
Cancer			0.00 [−0.02, 0.03]
Diabetes			−0.07 [−0.10, −0.05]***
Arthritis			−0.04 [−0.06, −0.03]***
Osteoporosis			−0.00 [−0.03, 0.02]
Weight (kg)			−0.003 [−0.003, −0.002]***

Notes: CVD = cardiovascular disease; SEP = socioeconomic position.
The coefficients and standard errors for the age and age^2 terms have been rescaled by multiplying by 10 and 100, respectively.
*p < .05. **p < .01. ***p < .001.

Table 5. Association of Destination SEP with Grip Strength (kg) in Ordinary Least Squares Regression Analysis (n = 5,366)

	Model 1	Model 2	Model 3
	B (95% CI)	*B* (95% CI)	*B* (95% CI)
Professional/managerial	Reference	Reference	Reference
Non-manual	−1.07 [−1.56, −0.58]***	−0.85 [−1.31, −0.38]***	−0.80 [−1.27, −0.34]***
Skilled manual/semi-skilled	−1.00 [−1.54, −0.45]***	−0.21 [−0.72, 0.29]	−0.18 [−0.68, 0.33]
Unskilled	−1.26 [−2.23, −0.30]*	−0.23 [−1.17, 0.71]	−0.09 [−1.02, 0.83]
Not working	−0.33 [−1.13, 0.46]	0.06 [−0.67, 0.79]	0.02 [−0.70, 0.74]
Farmer	0.12 [−0.79, 1.03]	0.02 [−0.83, 0.88]	−0.04 [−0.89, 0.81]
Age (years) (×10)	1.44 [−1.04, 3.91]	1.57 [−0.83, 3.97]	1.98 [−0.43, 4.40]
Age^2 (years) (×100)	−0.36 [−0.54, −0.17]***	−0.31 [−0.50, −0.13]***	−0.32 [−0.50 −0.15]***
Female	−14.00 [−14.43, −13.56]***	−9.42 [−10.02, −8.82]***	−9.28 [−9.90, −8.66]***
Height (cm)		0.35 [0.31, 0.38]***	0.32 [0.28, 0.35]***
Ever smoked (vs never)		−0.49 [−0.87, −0.12]*	−0.42 [−0.80, −0.04]*
CVD			−0.61 [−1.08, −0.14]*
Lung disease			−0.11 [−1.11, 0.89]
Cancer			−0.27 [−1.01, 0.47]
Diabetes			−0.95 [−1.72, −0.18]*
Arthritis			−1.18 [−1.60, −0.75]***
Osteoporosis			−0.13 [−0.68, 0.42]
Weight (kg)			0.03 [0.01, 0.04]***

Notes: CVD = cardiovascular disease; SEP = socioeconomic position.
The coefficients and standard errors for the age and age^2 terms have been rescaled by multiplying by 10 and 100, respectively.
*p < .05. **p < .01. ***p < .001.

Discussion

Critical Period Hypothesis

We found mixed support for the critical period hypothesis. The main effects model showed no direct association between origin SEP and either of the functional health measures when adjusted for adulthood SEP (excepting individuals from farming backgrounds). This result suggests that there are no direct physiological scarring effects of earlier childhood socioeconomic exposures, and if childhood SEP does exert an influence, it does so by operating through other pathways. An interesting result to emerge from the analysis was the consistent advantage on the physical performance tests for respondents with farm origins. Adjusting for SEP in later life, respondents from farming backgrounds walked 0.04 m/s faster (p < .001) and had grip strengths that were between 0.86 and 1.5 kg higher on average compared with the other occupational groups. This advantage persisted irrespective of destination SEP and may represent a critical period effect.

What Explains Better Functional Health Among Participants From Farming Backgrounds?

That the beneficial effect of coming from a farming background persists even when adjusted for SEP in later life suggests the existence of some protective factor in early life that was not shared by those from other occupational backgrounds. It is unlikely that this represents an income effect because the productivity of Irish farms was low during this period, and tens of thousands of farms were considered uneconomic (O'Grada, 2008). Nevertheless, participants from farming backgrounds accounted for 25.9% of all those who described themselves as growing up "pretty well off" (Supplementary Table S4). As a sensitivity check, we re-estimated the main effects model and controlled for childhood self-reported income status, but the advantage for respondents from farming backgrounds persisted. Historical evidence from the Irish National Nutrition Survey of 1946–1948 suggests, however, that people from farming backgrounds benefitted from better quality nutrition. They had higher daily consumption of potatoes, milk, and eggs per capita compared with Dublin working class and middle class families, and their vegetable consumption was comparable with that of Dublin middle class families. "Artisan" and "slum" urban families experienced the poorest nutrition (Jessop, 1950).

A study involving the Boyd Orr cohort reported that childhood milk consumption was associated with faster walking speed in later life and that childhood protein intake reduced the odds of poor balance (Birnie et al., 2012). It is not inconceivable therefore that better nutritional intake among the children of farmers would translate into a performance advantage on functional measures more than 50 years later. According to historical data, children from rural backgrounds had greater life expectancy at time of birth over the period 1935–1962 compared with children from urban backgrounds (Kennedy, 1973). Delaney, McGovern, and Smith (2011) documented higher rates of infant mortality in Ireland among urban compared with rural dwellers between the decades of the 1930s to the mid-1950s.

Accumulation Hypothesis

The accumulation hypothesis suggests greater wear and tear resulting from socioeconomic exposures working synergistically across the life course explains musculoskeletal deterioration among more socially disadvantaged groups. We found no support for this hypothesis as the interaction term between origin and destination occupation was nonsignificant. Furthermore, the the intergenerational mobility analyses revealed that participants who were upwardly mobile were comparable in walking speed with those who were stable at higher occupational positions across generations. Similarly, those who were downwardly mobile were similar in terms of walking speed and grip strength to those who were stable at lower occupational positions. This finding is important because it suggests that the outcome does not correspond to the amount of time spent in a status. These results also imply that there are no direct physiological "scarring" effects of the early childhood socioeconomic environment, at least not with respect to walking speed or grip strength. Nor indeed does it seem that an auspicious start in life affords any protection against changing socioeconomic circumstances, a result that is consistent with previous findings (Pudrovska & Anikputa, 2014). The main effects model (Table 3, Model 2) showed that adulthood SEP dominates childhood SEP and is therefore a more likely candidate pathway through which the effects of childhood SEP are propagated across the life course.

The Pathway "Chains of Risk" Hypothesis

Childhood SEP was not directly associated with either of the functional health measures. We did find, however, a strong association between origin and destination SEP. This association occurred despite the fact that the majority of people moved upwards over generations as a consequence of the exogenous change in occupational structure that forced structural mobility in a mostly upward direction. More than 50% of those with professional/managerial origins had a professional/managerial destination, and analysis of mobility patterns showed that short moves were more common than long moves, which indicates that origin sets some limits on destination SEP. Nevertheless, our analysis revealed that the pathway in life is important as individuals who were upwardly mobile were comparable in terms of their health risk profile and health behaviors with those who were stable at higher occupational positions. By contrast, and consistent with the chains of risk model, those who were downwardly mobile were similar to those who were stable at lower occupational positions. Taken together, this pattern of results suggests that the pathway model has some traction as an explanatory framework for illuminating the indirect pathways through which early life SEP influences later life health.

Does the Covariate Analysis Provide Evidence for any of the Theoretical Models?

The covariate analysis indicates the life course events associated with walking speed and grip strength allowing us to examine whether the association of destination SEP with the two functional health measures remains holding the covariates constant. Differences in height largely accounted for the association of destination SEP with grip strength, although non-manual workers had significantly lower grip strength compared with the professional/managerial group even in the final multivariable adjusted model. The association of destination SEP with walking speed by contrast remained sizeable even in the final model. However, these life course events cannot be unambiguously tied to a particular conceptual process. For example, height measured at the TILDA respondents' ages might reflect nutrition during a critical period in childhood; height selection into a mobility group; or differences in occupational stress leading to differential loss of height with aging. Similarly, smoking, at least current smoking, may reflect the effect of early status, selection of nonsmokers to a mobility group, or accumulation/pathway, as some social class *milieux* lead to different rates of quitting during adulthood (Reid et al., 2010). Similarly, the various diseases included in the covariates may reflect an early critical period, accumulation resulting from material exposures occurring across the life course, or a complex causal pathway linking SEP with lifestyle behaviors that are known to be deleterious to health (e.g., smoking and lung disease). This uncertainty is consistent with the general emphasis in life course research that the mechanisms linking early socioeconomic exposures with health in later life are complex, reflect multiple underlying processes, and are difficult to empirically disentangle (Hallqvist et al., 2004) Hence any attribution must remain speculative.

What Role Does Mobility Play?

Mobility is correlated with adult health, but it is not an explanatory concept. Mobility is correlated with adult health because there is a health gradient across destination occupations. Those who are upwardly mobile join a group with better health than at their origin, and the downwardly mobile join a group with worse health. The destination occupation achieved exhausts the importance of mobility. The evidence for this conclusion is the lack of an interaction between origin and destination, so that the effect of destination is not related to whether one has moved.

Could Mobility Still be Important Because it Indicates Childhood Health Selection?

If the occupationally mobile exhibit the adulthood health of those who were stable in the destination occupation, might health selection account for the result? Yet, it does not appear that those who experienced downward social mobility were in worse childhood health. The first wave of the TILDA survey asked participants to retrospectively report on their health when they were about 14 years of age, allowing us to directly address this issue. A similar proportion of those who were downwardly mobile rated their childhood health as fair/poor (8.9%) compared with 7.3% of those who were upwardly mobile. This affirms findings from other studies that social drift has limited explanatory power as a theoretical framework for understanding social inequalities in health (Chandola, Clarke, Morris, & Blane, 2006; Ploubidis et al., 2014). There are other types of selection that we cannot evaluate, such as parental expectations. However, the rapidly changing occupational structure in Ireland at the time the TILDA respondents became adults ensured that the predominant mobility patterns would be stability or upward mobility.

Limitations

An obvious limitation of the current study is that SEP was measured at only two time points over the life course within a cross-sectional study, which necessarily constrains the types of life course analyses we can undertake. It could be argued that the present study may not represent a particularly robust test of the accumulation hypothesis given measurement of SEP at only two time points, and this may not be sufficiently sensitive to detect dose–response variations. Intraindividual variability in patterns of social mobility over time and a lack of data for the intervening years may have limited our ability to adequately test the hypotheses linking socioeconomic exposures and transitions across the life course with later life health. Misclassification of SEP categories could also be an issue as childhood SEP was based on a retrospective report of father's occupation. We undertook a validation exercise to determine whether class at origin was associated with other self-reported measures of childhood socioeconomic circumstances (Supplementary Table S4). This analysis provides support for the use of fathers' occupational position as a meaningful and valid measure of early life SEP. For example, respondents with professional/managerial origins comprised 70.7% of all cases where the father's highest level of educational attainment was third level. Likewise, respondents from professional backgrounds comprised 37.7% of all those who reported that they grew up "pretty well off.". Finally, 97.2% of respondents with farming backgrounds reported that they grew up in a rural environment compared with 36.6% of those from professional/managerial backgrounds.

Strengths

Balanced against these limitations are a number of significant strengths. Strengths of the study include the use of a national probability sample with a large sample size and broad age range, and the use of two clinically evaluated measures of physical functioning that have criterion validity as markers of later life vitality administered using trained nursing staff and standardized assessment protocols. Moreover, many of the studies that have previously examined this issue have utilized U.K.- or U.S.-based data, and this study expands this focus to other ecological and historical contexts. Another important feature of the analysis is that we included a separate category for individuals from farming backgrounds. This coding is potentially important in the context of testing the critical period hypothesis as there is evidence to suggest that children growing up in rural Ireland were in better health compared with their urban-based peers.

Conclusions

A number of different theoretical models have been proposed to explain the association between early life social circumstances and health in later life. We find strong support for the idea that changing social circumstances can positively or negatively impact upon health, at least in the context of walking speed and grip strength. We also find some support for a critical period among respondents with farming origins that may be linked to the quality of nutrition in childhood. There was no support for the accumulation hypothesis though our ability to test this model comprehensively is constrained by the data. Finally, we find good support for the pathway model as SEP in early life was associated with SEP in later life, and those who experienced mobility (either upwards or downwards) resembled their destination group in terms of their health risk profile in later life. Future research should endeavor to examine which aspects of health are subject to environmental modification and whether there are critical or sensitive periods during the life course when intervention is most advantageous.

Supplementary Material

Please visit the article online at http://gerontologist.oxfordjournals.org/ to view supplementary material.

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L. O'Connell contributed to the analysis of the data. All authors contributed to interpretation of the results and critical evaluation of the paper.

References

Abate, M., Vanni, D., Pantalone, A., & Salini, V. (2013). Cigarette smoking and musculoskeletal disorders. *Muscles, Ligaments and Tendons Journal*, **3**, 63. doi:10.11138/mltj/2013.3.2.063

Birnie, K., Ben-Shlomo, Y., Gunnell, D., Ebrahim, S., Bayer, A., Gallacher, J., … Martin, R. M. (2012). Childhood milk consumption is associated with better physical performance in old age. *Age and Ageing*, **41**, 776–784. doi:10.1093/ageing/afs052

Birnie, K., Martin, R. M., Gallacher, J., Bayer, A., Gunnell, D., Ebrahim, S., & Ben-Shlomo, Y. (2011). Socio-economic disadvantage from childhood to adulthood and locomotor function in old age: A lifecourse analysis of the Boyd Orr and Caerphilly prospective studies. *Journal of Epidemiology and Community Health*, **65**, 1014–1023. doi:10.1136/jech.2009.103648

Bohannon, R. W. (2008). Hand-grip dynamometry predicts future outcomes in aging adults. *Journal of Geriatric Physical Therapy*, **31**, 3–10. doi:10.1519/00139143-200831010-00002

Braveman, P., Sadegh-Nobari, T., & Egerter, S. (2008). Early childhood experiences: Laying the foundation for health across a lifetime. hdl.handle.net/10244/613

Case, A., & Paxson, C. (2008). *Stature and status: Height, ability, and labor market outcomes (No. w12466)*. National Bureau of Economic Research. doi:10.3386/w12466

Chandola, T., Clarke, P., Morris, J., & Blane, D. (2006). Pathways between education and health: A causal modelling approach. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, **169**, 337–359. doi:10.1111/j.1467-985X.2006.00411.x

Davey Smith, G., Hart, C., Hole, D., MacKinnon, P., Gillis, C., Watt, G., … Hawthorne, V. (1998). Education and occupational social class: Which is the more important indicator of mortality risk? *Journal of Epidemiology and Community Health*, **52**, 153–160. doi:10.1136/jech.52.3.153

De Stavola, B. L., & Daniel, R. M. (2012). Marginal structural models: The way forward for life-course epidemiology? *Epidemiology*, **23**, 233–237. doi:10.1097/EDE.0b013e318245847e

Delaney, L., McGovern, M., & Smith, J. P. (2011). From Angela's ashes to the Celtic tiger: Early life conditions and adult health in Ireland. *Journal of Health Economics*, **30**, 1–10. doi;10.1016/j.jhealeco.2010.10.002

Galobardes, B., Shaw, M., Lawlor, D. A., & Lynch, J. W. (2006). Indicators of socioeconomic position (part 1). *Journal of Epidemiology and Community Health*, **60**, 7–12. doi:10.1136/jech.2004.023531

Guralnik, J. M., Ferrucci, L., Pieper, C. F., Leveille, S. G., Markides, K. S., Ostir, G. V., … Wallace, R. B. (2000). Lower extremity function and subsequent disability: Consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **55**, M221–M231. doi:10.1093/gerona/55.4.M221

Hallqvist, J., Lynch, J., Bartley, M., Lang, T., & Blane, D. (2004). Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socio-economic positions and myocardial infarction in the Stockholm Heart Epidemiology Program. *Social Science & Medicine*, **58**, 1555–1562. doi:10.1016/S0277-9536(03)00344-7

Hayward, M., & Gorman, B. (2004). The long arm of childhood: The influence of early-life social conditions on men's mortality. *Demography*, **41**, 87–107. doi:10.1353/dem.2004.0005

Heckman, J. J., & Masterov, D. V. (2007). The productivity argument for investing in young children. *Applied Economic Perspectives and Policy*, **29**, 446–493. doi:10.1111/j.1467-9353.2007.00359.x

Hornyak, V., VanSwearingen, J. M., & Brach, J. S. (2012). Measurement of gait speed. *Topics in Geriatric Rehabilitation*, **28**, 27–32. doi:10.1097/TGR.0b013e318233e75b

Hout, M. (1989). *Following in father's footsteps: Social mobility in Ireland*. Cambridge: Harvard University Press.

Hymowitz, N. (2012). Cigarette smoking and lung cancer: Pediatric roots. *Lung Cancer International*. doi:10.1155/2012/790841

Jessop, W. (1950). The results of the Irish National Nutrition Survey. *British Journal of Nutrition*, **4**, 281–284. doi:10.1079/BJN19500046

Kennedy, R. E. (1973). *The Irish; emigration, marriage, and fertility*. Berkeley, CA: University of California Press.

Krieger, N., Williams, D. R., & Moss, N. E. (1997). Measuring social class in US public health research: Concepts, methodologies, and guidelines. *Annual Review of Public Health*, **18**, 341–378. doi:10.1146/annurev.publhealth.18.1.341

Kuh, D., Karunananthan, S., Bergman, H., & Cooper, R. (2014). A life-course approach to healthy ageing: Maintaining physical capability. *Proceedings of the Nutrition Society*, **73**, 237–248. doi:10.1017/S0029665113003923

Melchior, M., Moffitt, T. E., Milne, B. J., Poulton, R., & Caspi, A. (2007). Why do children from socioeconomically disadvantaged families suffer from poor health when they reach adulthood? A life-course study. *American Journal of Epidemiology*, **166**, 966–974. doi:10.1093/aje/kwm155

Norman, K., Stobäus, N., Gonzalez, M. C., Schulzke, J.-D., & Pirlich, M. (2011). Hand grip strength: Outcome predictor and marker of nutritional status. *Clinical Nutrition*, **30**, 135–142. doi:10.1016/j.clnu.2010.09.010

O'Grada, C. (2008). *The Irish Economy half a century ago*. UCD Centre for Economic Studies: Working Paper Series (WP08/18).

Ploubidis, G. B., Benova, L., Grundy, E., Laydon, D., & DeStavola, B. (2014). Lifelong socio economic position and biomarkers of later life health: Testing the contribution of competing hypotheses. *Social Science & Medicine*, **119**, 258–265. doi:10.1016/j.socscimed.2014.02.018

Power, C., Atherton, K., Strachan, D. P., Shepherd, P., Fuller, E., Davis, A., … Macfarlane, G. J. (2007). Life-course influences on health in British adults: Effects of socio-economic position in childhood and adulthood. *International Journal of Epidemiology*, **36**, 532–539. doi:10.1093/ije/dyl310

Pudrovska, T., & Anikputa, B. (2014). Early-life socioeconomic status and mortality in later life: An integration of four life-course mechanisms. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **69**, 451–60. doi:10.1093/geronb/gbt122

Reid, J. L., Hammond, D., Boudreau, C., Fong, G. T., Siahpush, M., & ITC Collaboration. (2010). Socioeconomic disparities in quit intentions, quit attempts, and smoking abstinence among smokers in four western countries: Findings from the International Tobacco Control Four Country Survey. *Nicotine & Tobacco Research*, **12**(Suppl. 1), S20–S33. doi:10.1093/ntr/ntq051

Studenski, S., Perera, S., Patel, K., Rosano, C., Faulkner, K., Inzitari, M., … Guralnik, J. (2011). Gait speed and survival in older adults. *JAMA*, **305**, 50–58. doi:10.1001/jama.2010.1923

Verghese, J., Holtzer, R., Lipton, R. B., & Wang, C. (2009). Quantitative gait markers and incident fall risk in older adults. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **64**, 896–901. doi:10.1093/gerona/glp033

Whelan, B. J., & Savva, G. M. (2013). Design and methodology of the Irish Longitudinal Study on Ageing. *Journal of the American Geriatrics Society*, **61**, 65–68. doi:10.1111/jgs.12199

Whelan, C. T., & Layte, R. (2006). Economic boom and social mobility: The Irish experience. *Research in Social Stratification and Mobility*, **24**, 193–208. doi:10.1016/j.rssm.2005.05.001