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Research Article

Intergenerational Social Mobility and Allostatic Load in Midlife and Older Ages: A Diagonal Reference Modeling Approach

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Abstract

Objectives: This study aims to understand the association of life-course intergenerational social mobility with allostatic load (AL) burden in midlife and older ages in Ireland.
Methods: The study involved biological data for 3,987 older adults participating in The Irish Longitudinal Study on Ageing (TILDA). Intergenerational social mobility was characterized using the cross-classification of origin socioeconomic position (SEP; i.e., father's occupation) and destination SEP (i.e., own occupation). AL was operationalized using 12 biomarkers tapping cardiovascular, metabolic, renal, and immune system dysregulation. Diagonal reference modeling (DRM) and ordinary least square regression techniques were applied to explore the effect of social mobility on AL burden.
Results: A total of 55.5% experienced intergenerational mobility: 37.5% were upwardly mobile, 18.0% were downwardly mobile. A social gradient in AL was observed among the socially non-mobile. Destination SEP (b = 0.74, 95% CI = 0.57, 0.92) predominated in influence over origin, although both life stages exerted significant influence on later-life AL. Social mobility in either direction was not associated with AL burden. Mobility coefficients were substantially small across a large variety of model specifications.
Discussion: Findings provide evidence for an accumulation model of social inequalities in which disparities in health are diluted rather than increased by social mobility (i.e., gradient constraint), with the socially mobile having an AL score that is intermediate between their origin class and destination class. This implies that the effects of origin SEP on health are not immutable, but are instead responsive to changing socioeconomic circumstances across the life course.

Keywords: Diagonal reference modeling, Life course, Socioeconomic position

There exists a gradient in health across socioeconomic groups, such that the most disadvantaged experience the highest risk of morbidity and mortality (Snyder-mackler et al., 2020). It has been proposed that this social gradient in health comes about in large part because persons of less advantaged socioeconomic position (SEP) experience greater stress exposure than their more advantaged SEP counterparts (Matthews & Gallo, 2011), with the long-term effects of such insults culminating in a multisystem physiological burden known as allostatic load (AL; McEwen, 1998). AL has been posited as a potential explanatory framework for understanding the biological embedding of SEP over the life course. Despite the consistent link between less advantaged SEP and high AL burden demonstrated to date (Johnson et al., 2017), the relationship is complex, and how the experience of socioeconomic dis/advantage moderates trajectories of physiological dysregulation remains to be determined.

Although life-course models are closely interrelated and difficult to disentangle statistically (Hallqvist et al., 2004), a life-course approach enables a more dynamic view of the impact of SEP on physiological functioning, recognizing the complex pathways between early-life and later-life health (Ben-Shlomo & Kuh, 2002). For instance, does the timing of socioeconomic disadvantage matter in the context of AL, such that childhood exposure results in "permanent and irreversible" scarring effects on biological systems as implied by the critical period model (Ben-Shlomo & Kuh, 2002, p. 286), or do the negative impacts of SEP disadvantage compound over time, with each additional life stage spent in less advantaged SEP adding to an ever growing health disadvantage, as suggested by the accumulation model? (Shuey & Willson, 2014). Perhaps the negative effects of disadvantaged SEP are reversible and mitigated through intergenerational or intragenerational changes, as suggested by the social mobility model (Iveson & Deary, 2017; Pudrovska & Anikputa, 2014). The classic "dissociation" hypothesis stipulates that social mobility—irrespective of upwards or downwards—is disruptive and detrimental to the well-being of individuals, leading to reduced social integration, weakened social ties, and feelings of alienation (Sorokin, 1927). These relational rifts may be experienced as stressful, thus exerting negative health implications. The "falling from grace" thesis argues that the experience of downward mobility is a more distressing experience than upward mobility, as failing to maintain the educational or occupational attainment of their parents leads to feelings of insecurity (Newman, 1999). On the other hand, the "rising from rags" thesis suggests that the positive effects of upward mobility may outweigh any negative consequences (Gugushvili et al., 2019). "Acculturation" similarly suggests that the influence of destination class on health will be stronger than that of origin (Blau, 1956). These theories have the potential to expand our understanding of how SEP impacts on biological risk over the life course.

Research to date examining the relation of different life-course models with AL has shown mixed findings, especially regarding whether origin SEP (i.e., SEP in early life), is directly associated with later-life AL. For instance, data from a Northern Swedish cohort (n = 855; 51.8% male) found that life-course socioeconomic disadvantage was related to a greater burden of AL. This study also revealed that origin SEP, measured using parental occupation at age 16, was a particularly sensitive period for the embedding of socioeconomic disadvantage on AL at midlife (age 43) among women, but not men after controlling for contemporanoues lifestyle behaviors and incorporating medication use (Gustafsson et al., 2011). Data from the Midlife in the United States (MIDUS; n = 1,008; 45.2% male; age range: 35–85) supported an independent effect of a composite origin SEP variable on later-life AL, adjusting for destination SEP, although the magnitude of the association was almost twice that for destination, holding age, sex and race/ethnicity constant (Gruenewald et al., 2012). In line with this, results from a longitudinal analysis of the Multi-Ethnic Study of Atherosclerosis (MESA; n = 6135; 47.8% male; age range 45–84) reported that the association of SEP and AL was primarily driven by destination SEP, after adjusting sociodemographic confounders and medication use (Merkin et al., 2014).

One factor that may play a role in the observed nuances across studies relates to the choice of statistical model. To date, investigations of the relative contribution of origin and destination SEP on AL have been dominated by simple linear models, estimated in a stepwise fashion. Typically, a baseline model estimates the direct effect of origin SEP on AL, and a second model controls for destination SEP (Gruenewald et al., 2012; Gustafsson et al., 2011). However, Green and Popham (2019) caution that it may be problematic to compare the effects for multiple measures of SEP on AL as independent effects, as the possible causal effects of distal SEP measures may be biased with adjustment for proximate SEP measures. The effect estimates from these models are often presented simultaneously in one table, giving the impression of equivalent interpretation, leading to the so-called "Table 2 fallacy" (Green & Popham, 2019).

Eschewing the multiple adjustment method, Robertson et al. (2014) utilized structural equation modeling (SEM) to compare the fit of different life-course models linking SEP with AL across three age cohorts (ages 35, 55, 75) using data from the West of Scotland study. When allowing effect sizes to vary between life stages, it was the accumulation model that provided the best fit to the data (Robertson et al., 2014). In relation to the social mobility model, they found that intergenerational upward mobility was associated with higher AL burden in early (n = 740), but not in mid (n = 817) or late adulthood (n = 483; Robertson et al., 2014), possibly due to survival bias. However, neither linear models nor SEM techniques are able to isolate the relative effects of origin and destination SEP on AL, as the influence of social mobility cannot be estimated unless the effects of past and current SEP can be separated from mobility itself (Billingsley et al., 2018).

Diagonal reference models (DRMs; Sobel, 1981) were developed to overcome the linear dependency between origin and destination SEP. The notable feature of these models is their attempt to examine the independent effect of *moving* between SEP groups after accounting for *being* in different SEP's across the life course, with the guiding assumption that socially immobile individuals constitute the core of a social position and therefore best reflect its characteristics (Sorokin, 1959). Präg and Richards (2019) employed this technique to explicitly examine the effects of intergenerational social mobility on AL using data from *Understanding Society*, the UK Household Longitudinal Study (n = 9851; mean age 52.6, 44.4% male). They reported no significant associations of mobility with AL burden, a result that suggests that mobility in and of itself does not directly impact physiological dysregulation, and the weighting led to a conclusion that neither origin nor destination SEP predominate in their impact on AL (Präg & Richards, 2019). A recent U.S. based study of young adults aged 25–32 that also used DRM's arrived at a similar conclusion regarding the relative weight to be afforded to origin and destination SEP (measured using a composite of education and occupational attainment), but contrary to the UK study, there was some evidence of a mobility effect for the upwardly mobile (Gugushvili et al., 2021).

The Present Study

Aside from methodological differences, the association of social mobility with AL may differ in varying social-economic-historic environments. The Republic of Ireland provides an interesting test case for the examination of social mobility effects on physiological dysregulation as it has a strong class-based structure (Whelan & Layte, 2004, 2006). The country has undergone radical economic development in recent decades, resulting in high levels of absolute social mobility as Ireland transitioned from a predominantly agrarian to a post-industrial economy. The 1950s saw a peak in emigration and virtual stagnation of real national income, yet the decade that followed saw rapid growth as economic policy incorporated a more export-oriented strategy, attracting foreign investment and leading to the "Celtic Tiger" era at the start of the 21st century (Whelan & Layte, 2006). Opportunities for middle-class and skilled-manual work increased concomitant with diminishing agricultural trade, which impacted on the occupational structure of the country (Ó Gráda & O'Rourke, 2022). Analyzing trends in social mobility, Whelan and Layte (2002) noted that the proportion of smallholders in Ireland, or individuals who owned small farms, decreased from 20% to 10% between 1973 and 1987 (Whelan and Layte, 2002). Although the economy underperformed relative to its European counterparts who were experiencing the "Golden Age" up until the 1970s, Irish national income grew more rapidly and more dramatically, catching up with the performance of neighboring economies by the 1980s. Gross National Income (GNI) growth averaged 1.1% between 1938 and 1950, rising to 3.9% between 1960 and 1973.

Educational achievement continues to be a key mechanism in the transmission of intergenerational disadvantage (C. T. Whelan & Layte, 2002). The educational system in Ireland went through a general restructure around the time that the current older generation of individuals were navigating their own educational attainment, including the introduction of free-secondary education. This notable reform, alongside the demand for employees with higher levels of education as the economy transformed to one based on skills and educational attainment, increased educational participation (Callan & Harmon, 1999), assisting individuals from less advantaged SEP background to be socially mobile. From 1973 to 2000, the proportion of individuals with secondary school education who held non-manual positions increased twofold, indicating a reduced capacity of higher qualifications to guarantee more advantaged positions (C. T. Whelan & Layte, 2006). The high levels of upward mobility within an aging cohort therefore allows an in-depth investigation of the long run implications of transitioning out of origin dis/advantage for AL in later life.

Method

Data Source

The Irish Longitudinal Study on Ageing (TILDA) is a nationally representative prospective cohort study of community-dwelling older persons aged 50 years or more and their spouses living in the Republic of Ireland. The sample was generated using a two-stage clustered sampling process and the Irish Geodirectory as the sampling frame, which comprises all addresses in the Republic of Ireland. The primary sampling units were 640 geographic regions selected by random selection, stratified on proportion of head of households in the professional class, proportion of the population aged ≥65 and older, and geographical location. The second stage involved the selection of a random sample of 40 addresses from within each primary sampling unit, resulting in an initial sample of 25,600 addresses, which were assessed for eligible participants aged ≥50 and older. A response rate of 62.0% was achieved at the household level, which was defined as the proportion of sampled households, including an eligible participant from whom an interview was successfully obtained. The sampling fraction is approximately 1/150 of all community-dwelling adults aged 50 years and over resident in the Republic of Ireland. Baseline data were collected between 2009 and 2011, via computer-assisted personal interviews (CAPI), leave-behind paper and pen self-completion questionnaires (SCQ; response rate = 84.6%), and a health assessment (response rate = 61.6%) comprising the collection of blood samples (n = 5,655) and other physiological parameters. Additional details of the study design are available elsewhere (B. J. Whelan & Savva, 2013). Ethical approval for this study was approved by the Faculty of Health Science Research Ethics board in Trinity College Dublin, while informed consent was obtained from all participants during data collection. TILDA data are publicly available from the Irish Social Sciences Data Archive (ISSDA; https://www.ucd.ie/issda/data/tilda/), whereas access to the restricted researcher microdata file is available upon application (https://tilda.tcd.ie/data/accessing-data/).

Measurements

Outcome variable—allostatic load

Consensus is lacking regarding the optimal biomarker panel for use in the generation of AL indices, leading to large heterogeneity in biomarkers employed to date (Johnson et al., 2017). This study incorporates twelve biomarkers selected from available data based upon their representation of multiple physiological systems pertinent to disease risk, and their known association with age-related health outcomes in this cohort (McLoughlin et al., 2020). This includes the *cardiovascular system*; systolic blood pressure, diastolic blood pressure, resting heart rate, pulse wave velocity, the *metabolic system*; waist–hip ratio, body mass index, glycosylated hemoglobin, high-density lipoprotein, total cholesterol, the *renal system*; creatinine, Cystatin-C and the *immune system*; C-reactive protein. Log transformations were applied to C-reactive protein and pulse wave velocity to account for right-skewed distributions, and high-density lipoprotein was reverse coded such that higher values represented increased risk. Detailed measurement techniques for each biomarker are available elsewhere (McLoughlin et al., 2020). Each biomarker was standardized to a mean of 0 and an *SD* of 1 and summed to generate an overall AL score expressed in standard deviation units. Finally, this overall AL score was standardized to a mean of 0 and a *SD* of 1.

Exposure variable

Occupational class was drawn from retrospective data on father's occupation from childhood (age 14), and used to estimate origin SEP. Current occupation, or highest paid job if retired, was used to estimate contemporaneous or destination SEP. Following the Irish Central Statistics Office (CSO) social class coding schema and in line with previous research on Irish data, occupations for both time points were classified into five categories: professional/managerial, non-manual, skilled manual/semiskilled, unskilled and parent never worked. Participants who reported farming as origin or destination occupation were asked to provide acreage, and if they had any other paid work, and were coded into the appropriate occupation categories based on CSO criteria: farmers with 0–29 acres were assigned to the semiskilled group, 30–49 acres were assigned to the skilled manual group, 5–99 acres were assigned to the non-manual group, 100+ acres were assigned to the professional/managerial group. Farmers with unknown acreage were coded as missing. Due to small cell sizes, class was further collapsed into three categories: (a) professional/managerial, (b) non-manual/skilled manual, and (c) semiskilled/unskilled/never worked. A series of dummy variables was generated to capture mobility trajectories (i.e., upwardly mobile, downwardly mobile, one step up, two steps up, one step down, two steps down).

Irish sociological research has a long tradition of using occupation to measure SEP because Ireland has a strong underlying social class structure (C. T. Whelan & Layte, 2004, 2006), which is correlated with other socioeconomic indicators (i.e., income, education). Occupation is often favored in social mobility research because it is an individual-level measure of SEP. Occupation serves as a key determinant of life chances and is also a measure that is in some sense transferable. As such, parental social class can be used to characterize the likely socioeconomic circumstances of children within the household growing up (Galobardes et al., 2004). Although income has been used in studies elsewhere (Gruenewald et al., 2012; Hickson et al., 2012), it is a less useful indicator in older cohorts as it may be affected by retirement status. Moreover, obtaining reliable information on the income status of the parent's generation is problematic. Education has also been used to characterize intergenerational mobility in many U.S.-based studies (Allen et al., 2019; Kubzansky et al., 1999; Seeman et al., 2008), but is arguably a less sensitive indicator in the Irish context because Ireland experienced massive educational upgrading between the 1960s and 1970s as a consequence of two educational reform acts, meaning that later-born cohorts generally have more education than earlier born cohorts. Nevertheless, we perform robustness checks on our results using education as an alternative measure of intergenerational social mobility.

Sample Exclusions

Of the baseline sample over the age of 50 (n = 8,175), 5,655 of these participants successfully provided blood samples and 4,477 participants had complete biological data on the biomarkers needed to construct the AL index. Of these, 490 were missing on life-course SEP variables; 319 were missing on origin SEP (including 174 farmers with unknown acreage), while 171 were missing destination SEP (including 15 farmers with unknown acreage), while 30 participants were missing SEP data on both life stages. The final analytical sample comprised 3,987 respondents. A flow chart detailing eligibility criteria and final analytical sample is detailed in Supplementary Figure 1. Individuals excluded from the analyses differed to the extent that they tended to be older, with higher proportions within less advantaged SEP groups.

Analytical Strategy

Diagonal Reference Models

DRMs were estimated to test whether AL is affected by social mobility besides origin and destination (Zang et al., 2022). DRMs model the outcome of interest (AL) as the weighted sum of the estimated mean values in the socially immobile origin group and the socially immobile destination group. We adjust in the models for age (years) and sex (male, female) as patterns of intergenerational mobility and AL burden may vary across these important demographic characteristics. We also control for a childhood self-reported health indicator (excellent, very good, good, fair, poor), as poor childhood health could set restraints on social mobility and directly affect later-life AL burden (Miller et al., 2011; Präg et al., 2022).

For ease of interpretation in the DRM analysis, age was centered around the sample mean. The constant represents the average AL burden for male respondents of average age, while the class coefficients represent the deviations from that constant. The weight parameters express the relative importance of origin and destination on AL and are constrained to range between 0 and 1. A high value of the destination weight value indicates that the relative importance of one's current SEP is greater than origin SEP with respect to AL. To test for mobility effects in DRMs, we created a series of dummy variables to represent (a) upward and downward mobility and (b) the magnitude of mobility (i.e., number of positions by which the respondent was mobile relative to origin class). For the sake of uniformity in nomenclature with the extant social mobility literature, we make use of the term "mobility effects" (Präg et al., 2022). Note that this term is used to describe a statistical association rather than imply the existence of any causal relationships. We compared the fit of these nested models with the base model using the Akaike and Bayesian Information Criteria (AIC and BIC). The DRMs were implemented in Stata using the "drm" module developed by Kaiser (2018).

Ordinary Least Square Models

To enable comparison with prior research, we also estimated a series of ordinary least square models. In separate models, we estimate first the independent associations of origin SEP and destination SEP with AL burden while adjusting for age, sex and childhood self-reported health. We then include origin and destination SEP in the same model to test for mediation (i.e. mutual adjustment). We fit a two-way interaction term between origin and destination SEP to determine whether the relationship with AL over the life course is additive or multiplicative. We examined mobility effects in ordinary least square (OLS) models using the method typified by Luo & Waite (2005) by characterizing the study population into five social mobility trajectories: stable professional/managerial, stable non-manual/skilled manual, stable semiskilled/unskilled, upwardly mobile, downwardly mobile; and comparing the conditional mean AL scores across groups (Luo & Waite, 2005). All analyses were conducted in Stata (V.15; [StataCorp, 2017]).

Results

The mean and *SD* values for each of the 12 biomarkers comprising the AL index are described in Supplementary Table S2. Table 1 reports the characteristics of the sample and the degree of intergenerational social mobility within the TILDA cohort. The mean age of the sample ($n = 3987$) was 61.8 ($SD = 8.3$), and 53.5% were female. The majority of the sample reported their childhood health to be excellent (56.4%), very good (25.3%), or good (12.7%), with <6% reporting fair or poor health. Table 1 also shows that the experience of intergenerational social mobility was common, with 37.5% of the sample upwardly mobile and 18.0% of the sample downwardly mobile, leaving 44.5% non-mobile. In general, those who were mobile tended to be mobile within ±1 occupational position around their destination, with smaller proportions mobile by ±2 occupational positions, suggesting origin places some constraints on destination. Table 2 shows the conditional means resulting from the cross-classification of origin and destination. Cells on the diagonal describe performance for individuals who were non-mobile across generations, cells below the diagonal describe those who were upwardly mobile, and cells above the diagonal describe those who were downwardly mobile. Upward mobility is associated with lower AL scores compared with class of origin, and downward mobility is associated with higher AL scores compared with class of origin.

Diagonal Reference Models

Table 3 reports the parameter estimates from the DRM analysis estimating mobility effects on AL burden. The baseline model reveals that the coefficients for AL burden are smaller for people in the higher social classes, reflecting the social gradient in health amongst the socially immobile. The coefficients for the confounding variables reveal that AL burden is lower for women than men, and is positively associated with age. Poorer childhood health was associated with greater AL burden, but these effects were not significant. The subsequent models test for the effects of intergenerational mobility over and above the effects of origin and destination, allowing mobility effects to be separated from level effects. The weight parameters from Table 3 indicate that the level of AL burden is closer to their non-mobile counterparts in the destination group. No significant associations of mobility trajectories with AL are reported, which is in line with the AIC and BIC values indicating that the parsimonious base model fits the data best.

Sensitivity analyses

We undertook a series of sensitivity analyses to test the robustness of the DRM findings, the rationale for which is summarized in detail in Supplementary Table S1, and briefly described here. We tested for interactions of the origin weight with age, sex, and mobility status in the DRMs

Table 1. Sample Characteristics According to Origin and Destination Social Class Position and Intergenerational Social Class Mobility

	Included (n = 3,987)		Excluded (n = 4,186)	
	n	%	n	%
Age (mean, *SD*)	61.8	8.3	65.8	10.7
Female	2,134	53.5	2,296	54.9
Allostatic Load Index (mean, *SD*)	0.0	1.0	—	—
Childhood health				
Excellent	2,249	56.4	2194	52.4
Very good	1,009	25.3	1187	28.4
Good	497	12.5	531	12.7
Fair	172	4.3	195	4.66
Poor	60	1.50	77	1.84
Origin socioeconomic position				
Professional/managerial	871	21.9	474	14.7
Non-manual/skilled manual	1,738	43.6	1,298	40.3
Semiskilled/unskilled/never worked	1,378	34.6	1,452	45.0
Destination socioeconomic position				
Professional/managerial	1,378	34.6	818	21.8
Non-manual/skilled manual	1,785	44.8	1,509	40.1
Semiskilled/unskilled/never worked	824	20.7	1,434	38.1
Social mobility trajectories				
Downwardly mobile	716	18.0	571	19.5
Non-mobile				
Stable professional/managerial	478	12.0	197	6.7
Stable non-manual/skilled manual	881	22.1	545	18.7
Stable semiskilled/unskilled/never worked	417	10.5	654	22.4
Upwardly mobile	1,495	37.5	956	32.7
Degree of intergenerational social mobility				
Upwardly mobile 1 position	84	2.1	65	2.2
Upwardly mobile 2 positions	632	15.9	506	17.3
Downwardly mobile 1 position	1,129	28.3	786	26.9
Downwardly mobile 2 positions	366	9.2	170	5.8

Note: SD = standard deviation.

(Supplementary Table S3), but none of the interaction terms were statistically significant at conventional levels, suggesting that origin plays a similar role for AL burden across the life course, for the two sexes, and for those who experience mobility in their lives. To examine whether particular physiological systems were driving the observed associations and to enable comparison with previous studies, a series of separate DRM models was estimated across each of the subsystems comprising the AL composite score (i.e., cardiovascular, immune, renal, metabolic). Destination SEP exerted more influence than origin on later-life dysregulation across all systems (Supplementary Table S4).

Parameter estimates from DRMs estimating intergenerational mobility effects on a clinically derived AL index are reported in Supplementary Table S5. This alternate index was generated by summing the number of high-risk biomarkers using clinical-risk cut-points and standardizing the overall index (Supplementary Table S2). This measure incorporated medication usage in the AL score by manually scoring a biomarker as high risk if individual is taking a doctor diagnosed medication as ascertained at time of interview. Comparison of estimates with Table 3 revealed little difference, although the weights for origin were larger in magnitude when using this alternative AL index.

Educational attainment was introduced as an alternative measure of SEP to examine whether results were dependent on the socioeconomic measure used in the analysis (Bulczak et al., 2021). Results were ostensibly similar, although the weights for destination were slightly larger in magnitude when examining education over occupational in Table 3 (Supplementary Table S6). Additionally, to assess the robustness of the 3-level SEP measure, parallel analyses were undertaken using a five-level measure (i.e., professional/managerial, non-manual, skilled manual/semiskilled, unskilled, never worked; Supplementary Table S7). On this occasion, a significant negative association was observed for each step upward from origin, suggesting that results may be sensitive to the manner in which social class groups are aggregated.

To allow a more accurate comparison to results from *Understanding Society* (Präg & Richards, 2019) and to allay suspicion that the choice of biomarkers used to

Table 2. Conditional Means for Allostatic Load Resulting From the Cross-classification of Origin and Destination Social Class Position

	Destination		
	Professional/managerial	Non-manual/skilled manual	Semiskilled/unskilled/never worked
Origin	*Conditional mean*	*Conditional mean*	*Conditional mean*
Professional/Managerial	−0.10	−0.01 (DM)	0.08 (DM)
Non-manual/skilled manual	−0.11 (UM)	0.06	0.10 (DM)
Semiskilled/unskilled/never worked	0.03 (UM)	0.18 (UM)	0.23

Notes: Adjusting for age, sex and childhood self-reported health. DM = downwardly mobile; UM = upwardly mobile. Diagonal cells reference the socially non-mobile.

generate the AL index were responsible for the different pattern of results observed between studies, an alternate measure of AL was constructed using a sum of standardized biomarkers comparable to the *Understanding Society* measure (systolic blood pressure, diastolic blood pressure, resting heart rate, waist circumference, BMI, triglycerides, total cholesterol, high-density lipoprotein, HbA1c, C-reactive protein—missing fibrinogen). Destination SEP continued to exert approximately three times the influence of origin SEP on later-life AL, and no significant associations of mobility trajectories with AL are reported (Supplementary Table S8).

To examine whether results were biased due to unmeasured confounding, additional contemporaneous sociodemographic and behavioral health variables potentially associated with both social mobility and AL burden were adjusted for in Supplementary Table S10. These included the Berkman–Syme social network index (0–4, higher values indicate higher social connectedness, derived from marital status, sociability (number and frequency of contacts with children, close relatives, and close friends); church group membership and membership in other community organizations; Berkman and Syme, 1979). Behavioral health variables included smoking status (never smoked, former smoker, current smoker), alcohol consumption frequency, and physical activity (low, moderate, high), measured using the international physical activity questionnaire (IPAQ; Craig et al., 2003). The weights for destination were larger in magnitude with the inclusion of these contemporaneous variables, and there was no association of social mobility with AL burden.

Finally, we test the robustness of our findings by taking a conservative approach to the missing biomarker data. This alternate index was generated by summing the number of high-risk biomarkers based on the 75th percentile of risk based on the sample distribution and standardizing the overall index. Participants who attended the health assessment but who were missing on <7/12 of the biomarkers were manually coded as not at risk. Supplementary Table S11 illustrates that destination SEP continued to predominate over origin SEP in terms of AL burden, and no significant associations of mobility trajectories with AL are reported.

Linear Models

The OLS models reveal a social gradient in AL burden according to both origin (Table 4A) and destination (Table 4B) class. The mutually adjusted model (Table 4C) reveals that destination mediates a substantial proportion of the effect of origin on AL burden. We examined whether the effects of origin and destination social class on AL burden were additive or multiplicative by fitting a origin × destination interaction term, but none of the individual contrasts nor the overall interaction term were significant [$F(4, 3972) = 0.61$; $p = .656$]. This result suggests that the linear combination of origin and destination social class is sufficient to describe the effects of life-course social class position on AL burden in later life. This is consistent with what we observe when we examine the conditional mean AL score for the upwardly and downwardly mobile compared with those who remained intergenerationally stable in their class position in OLS models. Figure 1 shows that the upwardly mobile (M = −0.05) rank intermediate between the stable professional/managerial class (M = −0.17) and the stable non-manual/skilled manual class (M = 0.01), while the downwardly mobile (M = 0.06) rank intermediate between the stable non-manual/skilled manual class (M = 0.01) and the stable semiskilled/unskilled class (M = 0.24).

Discussion

This study sought to examine the association of intergenerational social mobility with AL burden at midlife and older ages using a methodological technique—DRMs—that has been underutilized in public health research despite its obvious advantages relative to alternative approaches such as mutual adjustment (Green & Popham, 2019), or differentiating groups based on combinations of their origin and destination social class positions (van der Waal et al., 2017). In line with previous studies using this technique (Gugushvili et al., 2021; Präg & Richards, 2019), we observed a pronounced social gradient in AL burden among the socially immobile. The professional/managerial group had the lowest burden of AL, while the unskilled/never worked group had the highest burden of AL, with the semiskilled/non-manual group intermediate between

Table 3. Parameter Estimates From Diagonal Reference Models Estimating Mobility Effects on Allostatic Load Burden

	Base model		Upward mobility		Downward mobility		Upward steps		Downward steps	
	b	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI
Constant	1.14***	(1.05, 1.24)	1.16***	(1.05, 1.26)	1.14***	(1.04, 1.24)	1.15***	(1.05, 1.26)	1.14***	(1.04, 1.24)
Socially immobile										
Professional/managerial	−0.19***	(−0.24, −0.14)	−0.19***	(−0.24, −0.13)	−0.19***	(−0.24, −0.14)	−0.19***	(−0.24, −0.13)	−0.19***	(−0.24, −0.14)
Non-manual/skilled manual	−0.00	(−0.05, 0.04)	−0.01	(−0.06, 0.04)	−0.00	(−0.05, 0.04)	−0.00	(−0.07, 0.07)	−0.00	(−0.05, 0.04)
Semiskilled/unskilled/never worked	0.19***	(0.13, 0.25)	0.20***	(0.14, 0.25)	0.19***	(0.13, 0.25)	0.19***	(0.13, 0.26)	0.19***	(0.13, 0.25)
Controls										
Female	−0.74***	(−0.80, −0.68)	−0.74***	(−0.80, −0.68)	−0.74***	(−0.80, −0.68)	−0.74***	(−0.79, −0.68)	−0.74***	(−0.79, −0.68)
Age*	0.03***	(0.03, 0.03)	0.03***	(0.03, 0.03)	0.03***	(0.03, 0.03)	0.03***	(0.03, 0.03)	0.03***	(0.03, 0.03)
Childhood health										
Excellent	Ref		Ref		Ref		Ref		Ref	
Very good	0.01	(−0.06, 0.07)	0.01	(−0.06, 0.07)	0.01	(−0.06, 0.07)	0.01	(−0.06, 0.07)	0.01	(−0.06, 0.07)
Good	0.03	(−0.06, 0.11)	0.03	(−0.06, 0.11)	0.03	(−0.06, 0.11)	0.03	(−0.06, 0.11)	0.03	(−0.06, 0.11)
Fair	−0.03	(−0.17, 0.10)	−0.03	(−0.17, 0.10)	−0.03	(−0.17, 0.10)	−0.03	(−0.17, 0.10)	−0.03	(−0.17, 0.10)
Poor	0.21	(−0.02, 0.44)	0.21	(−0.02, 0.44)	0.21	(−0.02, 0.44)	0.21	(−0.02, 0.44)	0.21	(−0.02, 0.44)
Weights										
Origin	0.26**	(0.08, 0.43)	0.37*	(0.06, 0.69)	0.25*	(0.01, 0.49)	0.33	(−0.15, 0.80)	0.24*	(0.00, 0.49)
Destination	0.74***	(0.57, 0.92)	0.63***	(0.31, 0.94)	0.75***	(0.51, 0.99)	0.67**	(0.20, 1.15)	0.76***	(0.51, 1.00)
Mobility status										
Upward			−0.05	(−0.16, 0.06)						
One step upward					−0.01	(−0.11, 0.10)				
Two steps upward							−0.04	(−0.17, 0.09)		
Downward							−0.02	(−0.28, 0.25)		
One step downward									−0.00	(−0.11, 0.10)
Two steps downward									−0.03	(−0.25, 0.20)
AIC	10,392.8		10,394.1		10,394.8		10,396.1		10,396.8	
BIC	10,462.0		10,469.6		10,470.3		10,477.8		10,478.5	
Degrees of freedom	11		12		12		13		13	

Notes: AIC = Akaike information criteria. BIC = Bayesian information criteria. 95% Confidence intervals in brackets. Age is centered around the sample mean.
*$p < .05$, **$p < .01$, ***$p < .001$.

the two. We found significant weights of both origin and destination SEP with AL burden, indicating independent influences from both life stages on later-life physiological dysregulation. However, the relative importance of destination SEP on AL burden predominated, as approximately three times as much variance in AL burden was explained by destination compared with origin class. Social mobility was not associated with AL burden when accounting for SEP at both time points. The model fit statistics confirmed that the base model, that is, the one containing no mobility effects, provided the best fit to the data. A finding which implies that the linear combination of origin and destination is sufficient to characterize the impact of differing intergenerational social class trajectories on later-life physiological dysregulation. This interpretation is supported by the lack of a significant interaction between origin and destination in the OLS models.

The higher weights for destination compared with origin class in the DRMs, the absence of mobility effects, the stronger associations of destination compared with origin in the OLS models, and the fact that the upwardly and downwardly mobile have AL burden intermediate between their class of origin and class of destination in OLS are all consistent with an accumulation model of social inequalities in AL burden and the concept of "gradient constraint" (Blane et al., 1999). Gradient constraint refers to a process of assortment whereby social mobility moderates rather than creates or amplifies, the size of the social class differential (Blane et al. 1999). The central idea is that mobile individuals rank somewhere intermediate between the class they left and the class they join as they share characteristics in common with both. The fact that the downwardly mobile have higher AL burden than the upwardly mobile may simply reflect the greater number of years spent at a more disadvantaged level relative to class of origin, although they are still in better health than those stable at less advantaged social class positions across the span. Consistent with this interpretation, Supplementary Table S9 shows that the health-related characteristics of the upwardly mobile is comparable to those in the stable managerial/professional groups, while the health profile of the downwardly mobile is more akin to those stable at less advantaged social class positions. These mobile individuals appear to adopt characteristics of their destination group, yet carry some of the legacy of origin, which serves to dilute the destination effect.

Relation to Other Studies

Our results are consistent with the extant literature documenting that individuals of less advantaged SEP experience higher AL burden (Johnson et al., 2017). Findings from the UK Household Longitudinal Study, *Understanding Society* (Präg & Richards, 2019) found approximately equal influence from both origin and destination on later-life AL burden. This equal influence is echoed by recent results from the National Longitudinal Study of Adolescent Health (Add Health) of the United States (Gugushvili et al., 2021), although a significant and positive mobility effect was reported in this study for those who experienced upward movement from origin. Our study however, found that a higher weight was afforded to destination SEP. These disparate findings between studies regarding whether origin or destination holds more influence in determining later-life AL provoke the obvious question as to why these differences arise, as methodological disparities cannot be held responsible for inconsistencies in results across studies in this case, as all studies utilized DRM. Alternate explanations will therefore be addressed in turn, including (a) differences in biomarker composition between studies, (b) differences in cohort characteristics, (c) differences in class schema, and (d) varying patterns of social mobility.

Differences in biomarker composition

One of the longstanding criticisms of allostatic load as a concept is that there is no standard definition of the measure (Johnson et al., 2017; Juster et al., 2010) and investigators have tended to use the battery of biomarkers that are

Table 4. Independent and Mutually Adjusted Associations of Origin and Destination Social Class With Allostatic Load Burden

	Panel A		Panel B		Panel C	
	b	95% CI	*B*	95% CI	*b*	95% CI
Origin class						
Professional/managerial	Ref		—		Ref	
Non-manual/skilled manual	0.04	(−0.03, 0.11)	—		−0.01	(−0.08, 0.07)
Semiskilled/unskilled/never worked	0.15***	(0.08, 0.23)	—		0.08*	(0.01, 0.16)
Destination class						
Professional/managerial	—		Ref		Ref	
Non-manual/skilled manual	—		0.16***	(0.10, 0.23)	0.16***	(0.10, 0.22)
Semiskilled/unskilled/never worked	—		0.30***	(0.22, 0.38)	0.28***	(0.20, 0.36)

Notes: All models adjust for age, sex and childhood self-reported health. (A) The association of origin class with allostatic load. (B) The association of destination class with allostatic load. (C) Mutually adjusted associations of origin and destination class with allostatic load.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

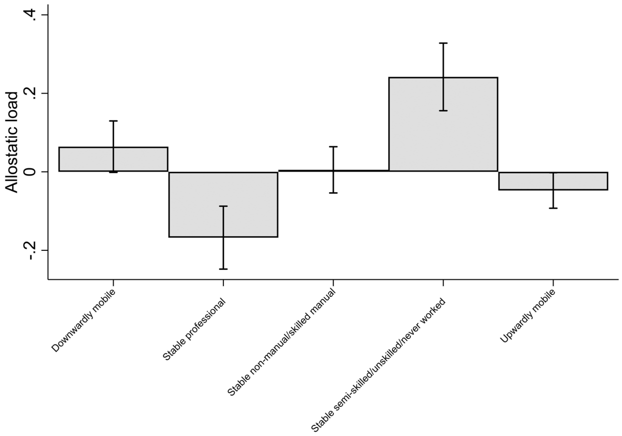

Figure 1. Conditional means for allostatic load according to intergenerational social class trajectory, adjusting for age, sex, and childhood health.

available to them in any given study to construct the index. Could the differences that we have observed regarding the relative weight to be afforded to origin as opposed to destination be due to the differing composition of the AL index between studies? This seems unlikely given the substantial overlap in the biomarkers used to define AL, with TILDA sharing 9/12 biomarkers in common with *Understanding Society*. Nevertheless, to address this possibility, we compared results for allostatic load subsystems—cardiovascular, metabolic, glucose—for which we substantially or entirely overlapped, and found that destination continued to predominate in terms of influence on later-life AL in the present study (Supplementary Table S8). Nonetheless, the lack of consensus remains a challenge with AL research, and this must be addressed to facilitate direct comparisons of results across studies and to advance the field.

Differences in sample composition

Another possibility is that the disparity in the relative weights afforded to origin and destination across studies arise due to differences in cohort characteristics. The mean age of the TILDA sample is 61.8 years, whereas *Understanding Society* and *Add Health* participants have a considerably younger age profile with a mean of 52.6 and 29 years, respectively. Allostatic load is posited to represent a measure of cumulative physiological dysregulation, so it may well be the case that the relative weights to be attached to origin and destination shift in balance over the life course as participants age (Steiber, 2019).

Differences in class schema

Of course, it is entirely tenable that differences in results may arise due to the use of different occupational coding schemas. The present study uses the Irish Central Statistic's Office (CSO) occupational social class schema which is comparable to the British Registrar General's Social Class (RGSC). This schema assumes a linear ranking of occupations according to skill, whereas Prag and Richard (2019) use the National Statistics-Socioeconomic Classification (NS-SEC), which focuses more on the relational aspects of class, operationalizing a nonlinear social class on the basis of employment relations and conditions (Szreter, 1984). Despite these differences, it should be acknowledged that both studies documented a pronounced social gradient in AL among the socially immobile, so contrasts in the occupational coding are an unlikely explanation for the differences in the relative weight to be afforded origin as opposed to destination observed between studies. Moreover, rates of mobility have been compared using both classification schemes using English census data and observed strong correspondence between the two measures (Bartley & Plewis, 2007).

Different levels of social mobility

The final consideration is different levels of social mobility across countries. We acknowledged previously that Ireland experienced tremendous structural mobility over the last 50 years with over half of the cohort experiencing mobility across generations. Given that the direction of mobility was predominantly in the upward direction, it is entirely plausible that the extent of structural mobility dwarves relative mobility, making it more difficult to isolate pure mobility effects on physiological dysregulation. Indeed, it has been alleged that the upgrading of Ireland's class structure in the latter half of the 20th century masked a persistent and deepening problem of blocked relative mobility (Kirtby, 2002). The same accusation could be leveled against using intergenerational educational transitions as our measure of mobility as Ireland introduced two educational reform acts during this period, with the 1967 Act introducing free-secondary level schooling for all children, and the 1972 act introducing an additional year of schooling (Callan & Harmon, 1999). This means that later-born cohorts have more education than earlier born cohorts due to a structural policy change, not necessarily mobility effects per se. An alternative possibility is that the stronger origin effects observed in *Understanding Society* reflect an older and more ingrained class system. It may also represent a cohort or period effect, as Bartley and Plewis (2007) acknowledge that the relative importance of father's social class on a person's destination has become more pronounced in the UK over recent decades. Future research should endeavor to compare results with more diverse populations, to provide insight into the potential impact of varying social mobility patterns.

Strengths and Limitations

The study has several strengths, including the use of objective biological data from an Irish sample of midlife and older adults, who grew up in an era of great social and economic change that enabled a large proportion of the population to climb the social ladder. We have already touted the advantage of DRMs over alternative approaches such as mutual adjustment or comparing different mobility groups as they allow one to isolate pure mobility effects and allow one to parameterize the relative importance of origin and destination class regarding their impact on health.

The primary limitation of the current study is that the analyses are cross-sectional, and causal relationships cannot be assessed. Indeed, any causal effect of intergenerational social mobility would be difficult to establish, as there is no counterfactual understanding of mobility effects (Wei & Xie, 2022). When comparing individuals with the same origin and destination SEP, mobility can only go in one direction, a world in which it would go into a different direction is not conceivable. While we can assess the impact of origin and destination SEP on AL, it is outside the remit of DRMs to assess more than two generations (Zang et al., 2022), and as such may not be sensitive to detecting subtle changes in the influence of origin and destination on physiological dysregulation at varying stages of the life course. It is of course possible that this study has underestimated levels of mobility, wherein individuals have been classed as socially immobile by virtue of ending up in the same class as their origin yet were mobile between these two very broad life stages. Misclassification of class categories could also be an issue as origin class was based on a retrospective report of father's occupation. On a similar note, there has been considerable debate about the extent to which a woman's own occupation is captured as a result of traditional parental responsibilities (Bartley & Plewis, 2007).

Conclusion

Tracing the imprint of disadvantage offers a powerful tool to comprehend histories of vulnerability, and thus to inform policy on health inequalities (Prior et al., 2018). These results imply that moving up or down the social ladder does not directly influence AL burden, although individuals tend to adopt similar AL burden to those in the socioeconomic position of their destination. This does not refute the possible lasting impact of origin SEP on later-life health but offers promise that interventions channeling individuals out of early-life disadvantage to more advantageous socioeconomic circumstances may lead to a lessening of AL burden within a population.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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Author Contributions

S. McLoughin: conceptualization; methodology; data curation; formal analysis; writing—original draft; writing—reviewing and editing. P. Präg: writing—reviewing and editing. M. Bartley (PhD): writing—reviewing and editing. Rose Anne Kenny (MD): supervision; funding acquisition. C. McCrory: conceptualization; methodology; writing—reviewing and editing; supervision; funding acquisition. All authors had responsibility for accuracy of the final content and read and approved the final manuscript.

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Conflict of Interest

None declared.

References

Allen, A. M., Thomas, M. D., Michaels, E. K., Reeves, A. N., Okoye, U., Price, M. M., Hasson, R. E., Syme, S. L., & Chae, D. H. (2019). Racial discrimination, educational attainment, and biological dysregulation among midlife African American women. *Psychoneuroendocrinology*, **99**, 225–235. doi:10.1016/j.psyneuen.2018.09.001

Bartley, M., & Plewis, I. (2007). Increasing social mobility: An effective policy to reduce health inequalities. *Journal of the Royal Statistical Society. Series A: Statistics in Society*, **170**(2), 469–481. doi:10.1111/j.1467-985X.2006.00464.x

Ben-Shlomo, Y., & Kuh, D. (2002). A life course approach to chronic disease epidemiology: Conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, **31**(2), 285–293. doi:10.1093/ije/31.2.285

Berkman, L. F., & Syme, S. L. (1979). Social networks, host resistance, and mortality: A nine year follow up study of Alameda county residents. *American Journal of Epidemiology*, **109**(2), 186–204. doi:10.1093/oxfordjournals.aje.a112674

Billingsley, S., Drefahl, S., & Ghilagaber, G. (2018). An application of diagonal reference models and time-varying covariates in social mobility research on mortality and fertility. *Social Science Research*, **75**, 73–82. doi:10.1016/j.ssresearch.2018.06.008

Blane, D., Harding, S., & Rosato, M. (1999). Does social mobility affect the size of the socioeconomic mortality differential? Evidence from the Office for National Statistics Longitudinal Study. *Journal of the Royal Statistical Society. Series A: Statistics in Society*, **162**(1), 59–70. doi:10.1111/1467-985X.00121

Blau, P. M. (1956). Social mobility and interpersonal relations. *American Sociological Review*, **21**(3), 290–295. doi:10.2307/2089282

Bulczak, G., Gugushvili, A., & Zelinska, O. (2021). How are social origin, destination and mobility linked to physical, mental, and self-rated health? Evidence from the United States. *Quality and Quantity*, **56**, 3555–4585. doi:10.1007/s11135-021-01286-5

Callan, T., & Harmon, C. (1999). The economic return to schooling in Ireland. *Labour Economics*, **6**(4), 543–550. doi:10.1016/s0927-5371(99)00035-4

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, **35**(8), 1381–1395. doi:10.1249/01.Mss.0000078924.61453.Fb

Galobardes, B., Lynch, J. W., & Davey Smith, G. (2004). Childhood socioeconomic circumstances and cause-specific mortality in adulthood: Systematic review and interpretation. *Epidemiologic Reviews*, **26**, 7–21. doi:10.1093/epirev/mxh008

Green, M. J., & Popham, F. (2019). Interpreting mutual adjustment for multiple indicators of socioeconomic position without committing mutual adjustment fallacies. *BMC Public Health*, **19**(1), 1–7. doi:10.1186/s12889-018-6364-y

Gruenewald, T. L., Karlamangla, A. S., Hu, P., Stein-Merkin, S., Crandall, C., Koretz, B., & Seeman, T. E. (2012). History of socioeconomic disadvantage and allostatic load in later life. *Social Science & Medicine*, **74**(1), 75–83. doi:10.1016/j.socscimed.2011.09.037

Gugushvili, A., Bulczak, G., Zelinska, O., & Koltai, J. (2021). Socioeconomic position, social mobility, and health selection effects on allostatic load in the United States socioeconomic position, social mobility, and health selection effects on allostatic load in the United States. *PLoS One*, **16**(8), 1–30. doi:10.1371/journal.pone.0254414

Gugushvili, A., Zhao, Y., & Bukodi, E. (2019). "Falling from grace" and "rising from rags": Intergenerational educational mobility and depressive symptoms. *Social Science & Medicine*, **222**, 294–304. doi:10.1016/j.socscimed.2018.12.027

Gustafsson, P. E., Janlert, U., Theorell, T., Westerlund, H., & Hammarstrom, A. (2011). Socioeconomic status over the life course and allostatic load in adulthood: Results from the Northern Swedish Cohort. *Journal of Epidemiology & Community Health*, **65**(11), 986–992. doi:10.1136/jech.2010.108332

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**(8), 1555–1562. doi:10.1016/S0277-9536(03)00344-7

Hickson, D. A., Diez Roux, A. V., Gebreab, S. Y., Wyatt, S. B., Dubbert, P. M., Sarpong, D. F., Sims, M., & Taylor, H. A. (2012). Social patterning of cumulative biological risk by education and income among African Americans. *American Journal of Public Health*, **102**(7), 1362–1369. doi:10.2105/AJPH.2011.300444

Iveson, M. H., & Deary, I. J. (2017). Intergenerational social mobility and subjective wellbeing in later life. *Social Science & Medicine*, **188**(11), 20. doi:10.1016/j.socscimed.2017.06.038

Johnson, S. C., Cavallaro, F. L., & Leon, D. A. (2017). A systematic review of allostatic load in relation to socioeconomic position: Poor fidelity and major inconsistencies in biomarkers employed. *Social Science & Medicine*, **192**, 66–73. doi:10.1016/j.socscimed.2017.09.025

Juster, R. P., McEwen, B. S., & Lupien, S. J. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. *Neuroscience & Biobehavioral Reviews*, **35**(1), 2–16. doi:10.1016/j.neubiorev.2009.10.002

Kaiser, C. (2018). *DRM diagonal reference model stata*. Open Science Framework. doi:10.17605/OSF.IO/KFDP6

Kirtby, P. (2002). *Celtic tiger in distress: Growth and inequality in Ireland*. Palgrave International Political Economy.

Kubzansky, L. D., Kawachi, I., & Sparrow, D. (1999). Socioeconomic status, hostility, and risk factor clustering in the Normative Aging Study: Any help from the concept of allostatic load?. *Annals of Behavioural Medicine*, **21**(4), 330–338. doi:10.1007/bf02895966

Luo, Y., & Waite, L. J. (2005). The impact of childhood and adult SES on physical, mental, and cognitive well-being in later life. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **60**(2). doi:10.1093/geronb/60.2.S93

Matthews, K. A., & Gallo, L. C. (2011). Psychological perspectives on pathways linking socioeconomic status and physical health. *Annual Review of Psychology*, **62**, 501–530. doi:10.1146/annurev.psych.031809.130711

McEwen, B. (1998). Protective and damaging effects of stress mediators. *The New England Journal of Medicine*, **338**(3), 171–179. doi:10.1056/NEJM199801153380307

McLoughlin, S., Kenny, R. A., & McCrory, C. (2020). Does the choice of allostatic load scoring algorithm matter for predicting age-related health outcomes?. *Psychoneuroendocrinology*, **120**, 104789. doi:10.1016/j.psyneuen.2020.104789

Merkin, S. S., Karlamangla, A., Roux, A. V., Shrager, S., & Seeman, T. E. (2014). Life course socioeconomic status and longitudinal accumulation of allostatic load in adulthood: Multi-ethnic study of atherosclerosis. *American Journal of Public Health*, **104**(4), e48–e55. doi:10.2105/ajph.2013.301841

Miller, G. E., Chen, E., & Parker, K. J. (2011). Psychological stress in childhood and susceptibility to the chronic diseases of aging: Moving toward a model of behavioral and biological mechanisms. *Psychological Bulletin*, **137**(6), 959–997. doi:10.1037/a0024768

Newman, K. S. (1999). *Falling from grace: Downward mobility in the age of affluence* (Vol. **319**). University of California Press.

Ó Gráda, C., & O'Rourke, K. H. (2022). The Irish economy during the century after partition. *Economic History Review*, **75**(2), 336–370. doi:10.1111/ehr.13106

Präg, P., Fritsch, N. -S., & Richards, L. (2022). Intragenerational social mobility and well-being in Great Britain: A biomarker approach. *Social Forces*. doi:10.1093/sf/soab153

Präg, P., & Richards, L. (2019). Intergenerational social mobility and allostatic load in Great Britain. *Journal of Epidemiology & Community Health*, **73**, 100–105. doi:10.1136/jech-2017-210171

Prior, L., Manley, D., & Jones, K. (2018). Stressed out? An investigation of whether allostatic load mediates associations between neighbourhood deprivation and health. *Health & Place*, **52**, 25–33. doi:10.1016/j.healthplace.2018.05.003

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**(3), 451–460. doi:10.1093/geronb/gbt122

Robertson, T., Popham, F., & Benzeval, M. (2014). Socioeconomic position across the lifecourse & allostatic load: Data from the West of Scotland Twenty-07 cohort study. *BMC Public Health*, **14**(1), 184. doi:10.1186/1471-2458-14-184

Seeman, T. E., Merkin, S. S., Crimmins, E., Koretz, B., Charette, S., & Karlamangla, A. (2008). Education, income and ethnic differences in cumulative biological risk profiles in a national sample of US adults: NHANES III (1988–1994). *Social Science & Medicine*, **66**(1), 72–87. doi:10.1016/j.socscimed.2007.08.027

Shuey, K. M., & Willson, A. E. (2014). Economic hardship in childhood and adult health trajectories: An alternative approach to investigating life-course processes. *Advances in Life Course Research*, **22**, 49–61. doi:10.1016/j.alcr.2014.05.001

Snyder-mackler, N., Burger, J. R., Gaydosh, L., Daniel, W., Noppert, G. A., Campos, F. A., Yang, Y. C., Aiello, A. E., Harris, K. M., Shively, C. A., Alberts, S. C., Biology, E., Columbia, N. B., Hill, C., Antonio, S., & Hill, C. (2020). Social determinants of health and survival in humans and other animals. *Science*, **368**(6493), 37–39. doi:10.1126/science.aax9553.Social

Sobel, M. E. (1981). Diagonal mobility models: A substantively motivated class of designs for the analysis of mobility effects. *American Sociological Review*, **46**(6), 893–906. doi:10.2307/2095086

Sorokin, P. A. (1927). *Social mobility*. Free Press.

Sorokin, P. A. (1959). *Social and cultural mobility*. Free Press.

StataCorp. (2017). *Stata Statistical Software: Release 15*. StataCorp LLC.

Steiber, N. (2019). Intergenerational educational mobility and health satisfaction across the life course: Does the long arm of childhood conditions only become visible later in life? *Social Science & Medicine*, **242**, 112603. doi:10.1016/j.socscimed.2019.112603

Szreter, S. R. S. (1984). The genesis of the registrar-general's social classification of occupations, *The British Journal of Sociology*, **35**(4), 522–546. doi:10.2307/590433

van der Waal, J., Daenekindt, S., & de Koster, W. (2017). Statistical challenges in modelling the health consequences of social mobility: The need for diagonal reference models. *International Journal of Public Health Volume*, **62**(9), 1029–1037. doi:10.1007/s00038-017-1018-x

Wei, L., & Xie, Y. (2022). Social mobility as causal intervention. *SocArXiv*, 1–72. doi:10.31235/osf.io/zcg4x

Whelan, B. J., & Savva, G. M. (2013). Design and methodology of the Irish Longitudinal Study on Ageing. *Journal of the American Geriatrics Society*, **61**(Suppl. 2), S265–S268. doi:10.1111/jgs.12199

Whelan, C. T., & Layte, R. (2002). Late industrialization and the increased merit selection hypothesis: Ireland as a test case. *European Sociological Review*, **18**(1), 35–50+i. doi:10.1093/esr/18.1.35

Whelan, C. T., & Layte, R. (2004). Economic change, social mobility and meritocracy: Reflections on the Irish experience. In *Quarterly Economic Commentary* (**Vol. 3**, pp. 89–108). ESRI.

Whelan, C. T., & Layte, R. (2006). Economic boom and social mobility: The Irish experience. *Research in Social Stratification and Mobility*, **24**(2), 193–208. doi:10.1016/j.rssm.2005.05.001

Zang, E., Sobel, M. E., & Lying, L. (2022). The mobility effects hypothesis: Past, present, and future. *SocArXiv*, **06520**. doi:10.31235/osf.io/d782b