The Relationship between Lifetime Health Trajectories and Socioeconomic Attainment in Middle Age

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ABSTRACT
A growing body of literature has demonstrated the importance of temporal patterns of health status to socioeconomic attainment. However, most previous studies focus on only one temporal dimension of health disadvantage—timing, duration, stability, or sequencing—and rarely provide a proper test of the health selection and social causation hypotheses. Using data from the British National Child Development Study, we examine the association between lifetime health trajectories and socioeconomic attainment in middle age. This study applies finite mixture modeling to identify distinct trajectories of health status, such that individuals in the same trajectory experience a similar health history. We further employ propensity score weighting models to account for the presence of time-varying socioeconomic factors in estimating the effects of health trajectories. This study will assess the extent to which socioeconomic attainment in middle age varies by differences in the timing, duration, stability, and sequence of health disadvantage over the life course.

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In this paper, we use data from the British National Child Development Study to examine the ways in which time-dependent exposure to poor health over the life course influences socioeconomic attainment in middle age. This study is motivated by two key, but largely overlooked, insights from the life course and human capital formation perspectives (Elder 1998; Heckman 2007; Mortimer and Shanahan 2003): (1) each temporal dimension of health disadvantage—timing, duration, stability, and sequencing—is intertwined with the other; and (2) time-dependent exposure to poor health not only affects, but is affected by, other time-varying factors that influence socioeconomic attainment.

The life course and human capital formation literatures provide competing hypotheses regarding how each temporal dimension of health disadvantage is associated with socioeconomic wellbeing in adulthood (e.g., Crosnoe 2006; Cunha and Heckman 2007; Jackson 2010; Schoon 2002). On the one hand, poor child health has lingering impacts on children's subsequent attainment because it hampers their cognitive and socioemotional development during sensitive-critical periods of childhood and adolescence (Hayward and Gorman 2004; Hobcraft 2004; Palloni 2006; Shonkoff and Phillips 2000). The cumulative disadvantage perspective further corroborates these "scar" effects of poor health during children's formative years, as it predicts that early health disparities persist and even become greater during adulthood (Goosby and Cheadle 2009; Haas, Glymour, and Berkman 2011; Jackson 2012). Indeed, a majority of studies have shown that poor childhood health is associated with lower socioeconomic status (SES) and higher mortality through lower educational attainment, poorer health in adulthood, lower labor force participation and earnings (Boardman et al. 2002; Case, Fertig, and Paxson 2005; Conley, Strully, and Bennett 2003; Jackson 2010; Smith 2009).

On the other hand, poor health in adulthood may have a more negative impact than poor health in childhood on socioeconomic attainment in middle age, to the extent that children's

impairments in cognitive and socioemotional development due to early health disadvantage recover over time, whereas health disadvantage in adulthood puts more direct constrains on upward socioeconomic mobility (Marmot, Brunner, and Hemingway 2001). In addition, the frequent occurrence of the onset of poor health may be more deleterious than the persistence of poor health, as it is likely to create the constant adaptation problems for individuals (Elder and Caspi 1988). Some research suggests that poor adulthood health and intermittent health problems also have negative impacts on SES over the adult life course (Marmot et al. 2001).

Taken together, these studies have greatly advanced our knowledge of the effects of differing time-dependent exposures to health disadvantage on socioeconomic attainment. However, we still know very little about (1) how estimates for the effects of each temporal dimension of health disadvantage vary when other temporal dimensions are taken into account and (2) how sensitive estimates for the effects of time-dependent exposure to health disadvantage are to the presence of time-varying covariates. Most studies focus on only one temporal dimension of health disadvantage, assuming that the timing, duration, stability, and sequencing of poor health operate independently. Does poor childhood health have independent effects regardless of the duration of health disadvantage, or does it merely indicate the persistence of poor health? Moreover, though studies based on the health selection hypothesis often adopt a life course framework, they rarely test the social causation hypothesis (Currie and Hyson 1999; Jackson 2010; Smith and Kington 1997). This issue is more pronounced when socioeconomic factors affecting health status are time-varying. For example, changes in parental employment during childhood and individuals' own employment during adulthood are likely to influence as well as be influenced by changes in individuals' own health status. Then, what role do such time-varying socioeconomic factors play in shaping a particular temporal pattern of health disadvantage—antecedents, mediators, or both?

To address the complexity of temporal patterns of health disadvantage and the reciprocity between time-dependent exposure to poor health and time-varying confounders, this study develops a novel analytic approach that combines finite mixture modeling with propensity score

weighting. First, instead of analyzing the timing, duration, stability, and sequencing of exposure to poor health separately, we apply longitudinal latent class analysis (LCA) to evaluate each of these temporal dimensions simultaneously (Muthén 2001, 2004). As a finite mixture modeling, LCA addresses how the probabilities of a set of observed indicators vary across groups of individuals where group membership is not observed. Referring to the data as a mixture of the unobserved groups of individuals, i.e., latent classes, LCA aims to identify the smallest number of latent classes that describe the associations among a set of observed indicators. We use this modeling strategy to find the best-fitting number of trajectories of individuals' exposure to poor health over the life course. Because individuals' health status at each age serves as observed time-ordered indicators, these trajectories are distinct from one another in terms of the timing, duration, stability, and sequencing of exposure to poor health.

Second, we employ a propensity score weighting method to directly address the question of how to estimate the effects of time-dependent exposure to poor health when time-varying confounders are present (Robins 1999; Robins, Hernán, and Brumback 2000). The key feature of this method is to use an inverse probability of treatment (IPT) weighting estimator by which individuals who experience poor health and those who do not at age k are balanced on prior health history and observed time-constant and time-varying covariates. We use pooled logistic regression to calculate the conditional probability of exposure to poor health at age k as propensity score, ps, and weight individuals by the inverse of their propensity score. On the one hand, individuals exposed to poor health at age k are given a weight of $1/ps$, thereby assigning those with the higher propensity scores less weights while those with the lower propensity scores more weights. On the other hand, individuals not exposed to poor health at age k are given a weight of $1/(1 - ps)$, thereby assigning those with the higher propensity scores more weights while those with the lower propensity scores less weights. The IPT weighting, therefore, can be understood as a sequential randomization of exposure to poor health, by generating a pseudo-

population in which exposure to poor health at any given age is independent of prior observed covariates.

We then analyze the propensity score weighted data to estimate the effects of distinct health trajectories over the life course on socioeconomic attainment in middle age. Because time-varying covariates are already accounted for in the weight construction, it is no longer necessary to condition on those covariates. Our approach thus avoids the potential problem of overcontrolling for time-varying covariates as mediators.

With this new analytic strategy, we seek to answer the following questions:

(1) How are childhood health trajectories linked to adulthood health trajectories?

(2) What impacts do different health trajectories over the life course have on socioeconomic wellbeing in middle age?

(3) What role do time-varying socioeconomic factors play in associating individuals' health trajectories with their socioeconomic attainment in middle age?

This study uses data from the British National Child Development Study (NCDS). The NCDS is an ongoing longitudinal survey that follows members of the cohort born in Great Britain (Scotland, England, and Wales) in the week of March 3, 1959 and gathers information on the same people at birth and ages 7, 11, 16, 23, 33, 42, 46, and 50. The aim of the NCDS is to improve understanding of the causes and consequences of human development over the life course. The data provide rich information on parental characteristics, health, cognitive and socioemotional development, educational progress, labor market outcomes, and family relationships. Given these features, the NCDS data are well suited for the objective of this study. Since the data allow us to trace childhood events far into mid-adulthood, it is possible to construct all study variables prospectively (Case et al. 2005).

As in most longitudinal data sets, sample attrition is inevitable in the NCDS data. Of the original sample of 17,415 children, 9,408 of them participated in the survey at age 50. To the extent that there is nonrandom attrition, our analysis will produce biased results. We address this

issue by comparing the original participants with the latest ones in detail with respect to key covariates. We further adjust for sample attrition in the propensity score weighting framework in which weights are constructed for time-dependent exposure to attrition. To address item-nonresponse, we employ a multiple imputation (MI) method to fill in missing values (Little and Rubin 2002; Royston 2005).

The dependent variables in this study are self-reported health status, employment status, and occupational attainment, all of which are measured at age 50. Each respondent was asked "How would you describe your health generally? Would you say it is excellent, good, fair, or poor?" Self-reported health status, albeit subjective, has been shown to be highly correlated with morbidity and mortality, even after accounting for physician assessed health status and health-related behavior (Idler and Kasl 1995). Employment status is measured by indicators of whether the respondent worked either part-time, full-time, or was unemployed. Occupational attainment is classified as professional, managerial, non-manual, manual skilled, semi-skilled, and unskilled. For employment status and occupational attainment, we restrict our analysis to men only because a large number of women in this cohort do not work (Case et al. 2005; Palloni 2006).

The main explanatory variable is individuals' trajectory of exposure to poor health over the life course. As mentioned above, we use finite mixture modeling to identify distinct temporal patterns of health status from birth to age 46. Health status at birth is determined using low birthweight status. Health status during childhood (ages 7, 11, and 16) is measured by indicators of whether a physician diagnosed the child as having any physical or mental/emotional health problem. Health status during adulthood (ages 23, 33, 42, and 46) is measured with the self-reported health measure described above.

The NCDS data include an extensive array of covariates that are potential confounders of the association between health trajectories and socioeconomic wellbeing in middle age. For time-constant covariates, we include sex, region, mother's and father's school-leaving age, maternal grandfather's occupational attainment, mother's marital status, and access to basic resources. We

also measure family income at age 16 and the number of O-level exams passed by age 16 to use as covariates predicting adulthood health status. We do not control for race/ethnicity because the NCDS respondents are overwhelmingly white (more than 98 percent).

Time-varying covariates measured during childhood include father's occupational attainment, mother's employment status, number of children in the household, number of residential moves, access to basic resources, math and reading test scores, and parents' and child's educational expectations. Some of these time-varying covariates measured at birth are treated as baseline covariates, alongside the time-constant covariates. Time-varying covariates measured during adulthood include employment status, occupational attainment, and family structure.

Collectively, this study provides a simultaneous assessment of the timing, duration, stability, and sequencing of exposure to poor health and a way to account for its reciprocal relationships with time-varying socioeconomic factors. By taking this holistic approach to time-dependent exposure to poor health, this study will contribute to updating the life course perspective and increasing our understanding of the role of health in social mobility.

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