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Economic Hardship in Childhood and Adult Health Trajectories: An Alternative Approach to Investigating Life-course Processes

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Abstract

In this study, we advance existing research on health as a life course process by conceptualizing and measuring both childhood disadvantage and health as dynamic processes in order to investigate the relationship between trajectories of early life socioeconomic conditions and trajectories of health in midlife. We utilize a trajectory-based analysis that takes a disaggregated, person-centered approach to understand dynamic trajectories of health as latent variables that reflect the timing, duration and change in health conditions experienced by respondents over a period of 10 years in midlife as a function of stability and change in exposure to economic hardship in early life. Results from repeated-measures latent class analysis of longitudinal data from the Panel Study of Income Dynamics indicate that economic hardship in childhood has long-term, negative consequences for health both among individuals beginning life and remaining in poverty as well as those moving into poverty. In contrast, adults with more advantaged early life experiences, or who moved out of poverty during the period of observation, were at a lower risk of experiencing health trajectories characterized by the early onset or increasing risk of disease. We argue that a person-centered, disaggregated approach to the study of the relationship between socioeconomic status and health across the life course holds potential for the study of health inequality and that a greater focus on trajectory-based analysis is needed.

Keywords

life course; health trajectories; disaggregated trajectories; childhood disadvantage; latent class analysis; PSID

1. Introduction

Various disciplines increasingly embrace the use of a life course perspective to gain a better understanding of health disparities and longitudinal analyses of health trajectories have become more commonplace. Across disciplines there is emerging agreement that

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approaching the study of health from a life course perspective allows for a better understanding of health as a function of the long-term accumulation of life experiences, such as exposure to disadvantage and its associated risks. One focus of recent life course research is on the childhood origins of health inequality, and various conceptual models have been put forward to describe the mechanisms linking childhood environment and later life health.

Our study advances existing research on health as a life course process by conceptualizing and measuring both childhood disadvantage and health as dynamic processes in order to investigate the relationship between trajectories of early life socioeconomic conditions and trajectories of health in adulthood. We utilize trajectory-based research that takes a disaggregated, person-centered approach to understanding pathways of health, modeling trajectories of childhood disadvantage as dynamic constructs that incorporate timing, duration, and change in exposure to economic hardship in early life. Using repeated-measures latent class analysis we identify unique groups of individuals with similar trajectories of hardship in childhood and examine how each pattern of experience is related to the timing and change in trajectories of adult health risk. Similar to childhood disadvantage, we also conceptualize health as a dynamic, multi-faceted process that unfolds over time. We measure health longitudinally as a risk profile that captures the probability of experiencing one of a number of different health conditions in mid-life. Repeated measures allow us to assess how this trajectory of risk changes over time, and its relationship with patterns of childhood disadvantage.

2. Literature review

Life course research on health within the social sciences strives to take into account time, context, and process and many recent studies focus on the individual and social patterning of health trajectories over time. A key framework informing studies of health within sociology are theories of cumulative dis/advantage and cumulative inequality, which suggest that inequality is generated by a process through which initial relative advantage associated with structural location and resources results in systematic divergence in life course processes across individuals or groups over time (Dannefer, 2003; Ferraro & Shippee, 2009; O'Rand, 1996). This framework, which is rooted in the theoretical literature on stratification and status attainment, emphasizes the dynamics of change over the life course (Blau & Duncan, 1967; DiPrete & Elrich, 2006; Merton, 1968). Cumulative dis/advantage suggests an intra-individual accumulative process that acts as a mechanism through which a favorable relative position early in life generates further gains across the life course, resulting in the growth of the advantage of one individual or group relative to another across time. The resulting inequality generated by the this process can be seen in the various forms of life course capital, such as health (O'Rand & Henretta, 1999), where advantage has been linked to better health, fewer chronic conditions, and a longer life expectancy (see, for example Dupre, 2007; Hoffmann, 2011; Lynch, 2003; Phelan, Link, & Tehranifar, 2010; Willson, Shuey, & Elder, 2007). Cumulative dis/advantage in health suggests a process whereby the relationship between socioeconomic resources and health is initiated early in life and becomes magnified over time, with advantaged individuals and groups also retaining a growing health advantage relative to others as they age. This accumulative process operates through the association between socioeconomic resources and exposure to an unfolding

series of risk factors resulting from disadvantaged conditions, as well as a greater difficulty in taking steps to ameliorate the consequences of such exposure among the disadvantaged (Link & Phelan, 2000). Future life chances are thought to be differentially affected based on the onset, magnitude, and duration of such exposures (Schafer, Shippee, & Ferraro, 2009). As an example, a child growing up under persistent economic disadvantage is likely to experience lower life chances in education, which in turn creates disadvantage in occupational status and the other contexts within which one lives life, such as neighborhood, and increases the chances of exposure to a variety of stressors that have an undermining effect on health (eg. see Pearlin, Schieman, Fazio, & Meersman, 2005). Research seeking to identify the mechanisms through which this accumulative process impacts health have focused on various aspects of socioeconomic status such as educational attainment and economic resources and the ways in which these resources are in turn associated with a myriad of more proximal factors associated with health, such as exposure to stress, health behaviors, physical overload at work, and exposure to toxins and other health hazards, all of which can have long term and possibly accumulative effects on health later in life (for discussion see Kjellson, 2013; Halleröd & Gustafsson, 2011). Moreover, research has investigated the relationship between disadvantage and the accumulation of allostatic load that is associated with stress exposure and related to a myriad of health problems such as high blood pressure and a greater risk for cardiovascular disease (McEwen & Wingfield, 2003).

Although life course research on health has proliferated over the past decade, there are many ongoing debates and unanswered questions regarding the effect of the accumulation of advantage and disadvantage on health, including the extent to which the process is limited by advancing age and senescence or impacted by other social factors such as welfare state policy and health care institutions (for a review see Corna, 2013; Quesnel-Vallée, 2004). Generally, studies of cumulative dis/advantage conceptualize health inequality within a population in later life as the end product of an accumulative process of exposure to risks and opportunities that operates across the individual life course, with recent research testing theories of cumulative dis/advantage by examining aggregate trajectories and rates of return to resources over time to address debates about whether inequalities grow, are maintained, or converge with age. Support for a theory of cumulative dis/advantage as an inequality generating mechanism is provided by research showing that the relatively low levels of health inequality seen early in life increase as people age because of the compounding of the advantages and disadvantages associated with resources such as education or wealth. Research examining the health returns to socioeconomic resources suggests that a process of cumulative dis/advantage operates across the life course, generating diverging trajectories of health and widening disparities between advantaged and disadvantaged socioeconomic (e.g., Dupre, 2007; Lynch, 2003; Willson et al., 2007) and race-ethnic groups over time (Brown, O'Rand, & Adkins, 2012; Shuey & Willson, 2008).

More recently, attention has shifted upstream to inequality in resources early in life and raises the important question of when and how this accumulative process begins. Although there is variation in study focus and health outcome, a common theme across research from various disciplines is the notion that early life socioeconomic environment initiates pathways or trajectories of health advantage or disadvantage that continue across the life

course (for review see Corna, 2013; Graham, 2002). One avenue of research focuses on the importance of critical or sensitive periods of development during which exposure to disadvantage is particularly harmful and has direct effects on future heath. For example, within the medical sciences Barker's fetal origins hypothesis focuses on the developmental origins of adult disease and the permanent changes that disadvantage during the critical period of *in utero* programming can have on physiology and metabolism and subsequent disease risk in adulthood (Barker, 1994; for review see De Boo & Harding, 2006). Other research suggests that childhood is a sensitive period during which infections and other disruptions to biological functioning can have a long term direct effect on adult health, although the consequences are not necessarily harmful and the process is thought to be potentially modifiable (Kuh & Wadsworth, 1993; Miller, Chen, & Parker, 2011). Within the social sciences, stress research recognizes the long term mental health implications of experiences during the multiple developmental phases of early, middle and late adolescence which involve periods of rapid change and life transitions (for example see Miech & Shanahan, 2000).

In contrast to critical period models, other life course research investigating early life origins focuses on the indirect, long-term effects of childhood socioeconomic advantage or disadvantage on health that operate by conditioning exposure to future opportunities and risks. Referred to in epidemiology as pathway models and in sociology as a path-dependent process (Diprete & Eirich, 2006), this body of research focuses on the extent to which childhood disadvantage sets individuals on disadvantaged trajectories or pathways whereby early exposures to risk increase the likelihood of further exposure in what has been referred to in epidemiology as a "chain of risk" (Ben-shlomo & Kuh, 2002). Similarly, sociologists examining early life social conditions and mortality suggest that early disadvantage sets in motion a series of "cascading socioeconomic and lifestyle events" that have negative consequences for mortality (e.g., Hayward & Gorman, 2004; O'Rand & Hamil-Luker, 2005).

Finally, a third related model focuses on the accumulation of exposure to disadvantage across the life course as an explanation for health disparities across the life course. A cumulative exposure model, as one form of a cumulative dis/advantage process, suggests that continued exposure to the same or new harmful circumstances resulting from a disadvantaged status has a continuing, direct effect on health across the life course (Diprete & Eirich, 2006). Support for this model comes from studies showing that the duration of disadvantage affects later life health and health disparities across groups (e.g., Ben-shlomo & Kuh, 2002; Lynch & Davey Smith, 2005; Mcleod & Shanahan, 1996; Willson et al., 2007).

Although scholars note that models identifying the link between childhood environment and health present complementary rather than competing perspectives on health disparities (see Graham, 2002), some confusion remains in distinguishing between the models conceptually and empirically. Although all incorporate life course principles such as timing and duration, the models differ in their relative emphasis on each. For example, the timing of adversity is a key determinant of later life health within critical period models such as the fetal origins hypothesis, and experiencing adversity during such a period is thought to have permanent

effects on health regardless of other life experiences. Pathway models implicate childhood disadvantage in initiating "social chains of risks and resources" and suggest a process that begins early and, with longer duration, may become increasingly difficult to modify over time and thus increasingly difficult for an individual or group that is behind to catch up to their more advantaged counterparts (Diprete & Eirich, 2006). The focus on timing is less explicit in models of cumulative exposure, which typically identify the duration of exposure to harmful experiences as the mechanism behind an accumulation process that generates health inequality. Such models do not explicitly focus on early life and the timing of the onset of this accumulative process, but view persistent exposure to disadvantage as harmful for health regardless of when it occurs within the life course.

Determining the most appropriate way to examine and test hypotheses regarding health across the life course is a critical issue facing life course researchers, and tension exists between understanding and describing the pathway that best fits the sample as a whole and an approach that problematizes deviation from normative pathways (George, 2007). Both empirical tests of cumulative dis/advantage theory within sociology, as well as the bulk of existing research on the childhood origins of health, examine aggregate trajectories of health across a segment of the life course. The type of aggregate approach taken by the majority of studies of health disparities focuses on average effects and normative patterns, ignoring that most individual trajectories do not fit this modal pattern (George, 2003). For example, Wickrama and colleagues used growth curve models to estimate depressive symptoms over three developmental periods (Wickrama, Noh, & Elder, 2009). They found the trajectory of depressive symptoms was curvilinear and that family resources influenced the level and rate of change in depressive symptoms trajectories. Although useful for describing normative patterns of inequality within the population as a whole or for disadvantaged subgroups, these models overlook the contribution of intra-individual variability over time to an understanding of health as the result of an accumulative process (Kelley-Moore & Lin, 2011).

Such an approach to studying health obscures the heterogeneity in pathways and patterns of stability and change that results from changes in individual circumstances, such as whether childhood conditions are improving or deteriorating, as well as issues of timing related to whether disadvantage occurs early or later in childhood (Wagmiller, Lennon, Kuang, Alberti, & Aber, 2006). We know from previous research that there is often instability in socioeconomic resources in childhood and across the life course, with life course research disputing traditional views of disadvantage and poverty as long-term, irreversible states (see McDonough & Berglund, 2003; McDonough, Sacker, & Wiggins, 2005). Previous research also suggests that the over time dynamics of health are not characterized by one common trajectory of decline and notes variation across individuals in terms of direction of change and pace of decline and distinct patterns of experience that include recovery from disability, improved health, and intermittent change in health over time (eg. Gill, Allore, Hardy, & Guo, 2006; Sacker, Wiggins, Bartley, & McDonough, 2007). By design, aggregate models cannot account for potential uniqueness and variation in the pathways experienced by individuals who may not follow a normative functional form with regard to time and thus risk falsely implying the existence of a normative process and aging effect (Kelley-Moore & Lin, 2011).

In contrast, examining disaggregated trajectories problematizes heterogeneity within a population and seeks to understand questions such as how differences in the timing or change of individual experiences are associated with a particular outcome. This is a person-centered approach that focuses on the conceptualization and description of individual patterns of stability and change in health over time through the use of longitudinal or life history data covering a substantial portion of the life course. One early example of this type of approach (Clipp, Pavalko, & Elder, Jr. 1992) used inductive logic regarding similarities and differences in health histories to construct typologies representing unique patterns of health that differ in the timing, sequence, and direction of change. More recently, Hamil-Luker & O'Rand (2007) used latent class analysis to identify three heart attack risk trajectories that differ in terms of the timing of onset; a low risk group who had a very low probability of experiencing a heart attack throughout the observation period, a high risk group with a very high probability of experiencing a heart attack very early in the observation period, and an increasing risk group consisting of respondents who had a low probability of experiencing a heart attack until late in the observation period. Examining disaggregated trajectories is preferred when one expects that there is variability in experience and patterns of stability and change within the sample, and when these patterns are hypothesized to be meaningful predictors of another life course outcome (George, 2009).

Although life course research typically recognizes that health is not static, studies of the effect of early environment on adult health tend to ignore that childhood disadvantage also represents a dynamic process. Relatively little attention has been given to change in disadvantaged environments over time (but see McDonough et al., 2005; Wagmiller et al., 2006) and the tendency in previous research has been to measure childhood experience at one point in time or through static retrospective accounts of perceptions of childhood circumstances (see, for example, Goosby, 2013; O'Rand & Hamil-Luker, 2005). Temporal complexities of childhood experience, such as the duration, timing, and sequencing of children's exposure to economic hardship during childhood, have been shown to be important for developmental processes and outcomes such as socioeconomic attainment in young adulthood and mid-life, and are likely important to health as well (see, for example, Guo, 1998; Schoon et al., 2002; Wagmiller et al., 2006). Indeed, research suggests a "windows problem" in studies that use single point in time snapshots of observed circumstances to draw conclusions about processes that are of longer duration, such as childhood experience (Wolfe, Haveman, Ginther, & An, 1996). Such snapshots serve as weak proxies for the entire childhood experience and often lead to conclusions that may be misleading. We arguably "need more than a single slice in time to adequately capture exposure to risks or resources" (Ferraro, 2011:472). In practice, the primary difficulty for life course researchers lies in finding adequate data sources that allow such observations.

The life course perspective directs us to consider how heterogeneity in patterns of stability and change in economic hardship experienced in childhood is related to other dynamic processes such as health. In this analysis we utilize a disaggregated approach to explore and identify distinct pathways of childhood economic hardship and link them to trajectories of adult health risk that also differ in terms of characteristics such as stability, change and timing. A unique contribution of our study is the utilization of longitudinal, prospective reports from parents about the economic and demographic context of their children's lives to

construct trajectories of childhood experience, rather than relying on retrospective reports from adults about their own childhood environment (also see Poulton et al., 2002 for another example of a study using prospective, repeated measures of parent's socioeconomic status). Using multiple waves of prospective data allows us to capture patterns of stability and change in the childhood environment and also to avoid concerns over the accuracy of recall and the effect of current state on memories of childhood circumstances that accompany the use of adults' retrospective reports (Dobson, Smith, & Panchana, 2005; Raphael, Cloitre, & Dohrenwend, 1991).

3. Research questions

In light of the considerations outlined above, the question guiding this study is whether patterns of stability and change in childhood economic hardship are associated with trajectories of health risk in adulthood. In other words, we ask whether adult health risk trajectories differ for individuals with different trajectories of childhood hardship. Identifying distinct groups of individuals with similar experiences of childhood economic hardship allows for greater heterogeneity in experience and outcome within individuals than that provided by research based on more frequently used techniques of longitudinal analysis such as growth curve analysis.

In this study, we are interested in the stratification of health risk trajectories, which are latent variables that can be thought of as risk profiles that capture the timing of experiencing a health condition, and how this risk changes over a 10 year period of mid-life. In addition, we distinguish individuals on the basis of the socioeconomic conditions of their childhood, specifically their exposure to economic hardship, and the timing (early childhood versus adolescence) and stability of this exposure. We first determine whether clear patterns of economic hardship in childhood and distinct trajectories of health risk in midlife are present in the data. Second, we estimate health risk trajectories in adulthood and examine whether they differ according to patterns of childhood economic hardship.

4. Methods

Analytic Approach

Consistent with a life course approach, we view health as a long-term process that takes the form of a trajectory operating across biographical and historical time. As a long-term process we can describe life course health by referring to a number of different dimensions including, but not limited to, pattern, sequence, stability, direction (reversibility), and pace (see Pavalko, 1997; Clipp, Pavalko, & Elder, 1992). The various commonly used statistical techniques available to understand health across the life course conceptualize dynamic processes in different ways. For example, event history (survival) analysis involves the analysis of time to an event(s) and limits us to addressing questions such as, what are the characteristics of individuals who have a higher than average risk of early onset of chronic conditions? The method's focus on a relatively sharp disjunction between pre- and post-event and the focus on the probability that an event will occur at a particular time does not allow us to conceptualize this event as part of a larger trajectory of experience that differs in shape and pattern. Alternatively, general growth mixture modeling (GGMM), and growth

curve models more generally, are methods that also use repeated observations to examine the relationship between individual characteristics and health across time or age. These models allow us to estimate between-person differences in within-person change (Curran, Obeidat, & Losardo, 2010), assessing how individual characteristics modify the starting point and rate of change in health over time. They generate estimates of the mean intercept and slope across individuals (or groups of individuals) and an assessment of the shape of the health trajectory (flat, linear or curvilinear decline). While these models do conceptualize health as a trajectory rather than as an discrete event, their utility is limited to investigations of the starting point and the general characteristics of growth for the group as a whole and for the individuals within the group (i.e. the size of the variance component implies the degree of difference in the size of the trajectory parameters around the mean values) (Curran et al. 2010).

Because of the limitations of these techniques, we apply repeated-measures latent class analysis (RMLCA) (Collins & Lanza, 2010) to the analysis of childhood economic hardship trajectories and health risk trajectories to model patterns of experience that include dimensions of timing, duration, stability and change.[1] Repeated-measures latent class analysis, an application of latent class analysis, has the ability to detect associations among variables due to an unmeasured, latent source of variation and sorts individuals into mutually exclusive and exhaustive latent classes (Collins & Lanza, 2010; McCutcheon, 1987). Using RMLCA enables us to identify groups (or classes) of individuals who differ in their timing and experience of health risks. Each group can be viewed as having a unique trajectory of health in terms of risk of onset and its timing.[2] The approach allows us to identify factors which predict diverse patterns of health and illness later in the life course. Similar to GGMM, the use of RMLCA to analyze repeated measures enables the identification of subgroups of individuals who are homogenous in their pattern of experience over time on some outcome. However, RMLCA differs from GGMM in that it does not assume that individual change follows a functional form with respect to time, e.g., growth is not characterized as linear, quadratic, etc.; instead, RMLCA models change over time in "whatever form it naturally occurs in each latent class" (Collins & Lanza, 2010:187). Therefore, RMLCA is an intuitively appealing, person-centered approach which allows us to identify unique patterns and trajectories of childhood economic hardship and of health for groups of individuals.

Data

Data for this study are drawn from the U.S. Panel Study of Income Dynamics (PSID), an ongoing, nationally representative sample of approximately 5,000 families (Panel Study of Income Dynamics, 2013). The PSID began in 1968 and interviewed families annually until 1997, when interviewing became biennial. The latest wave of data available for this analysis was collected in 2009. The original sample design of the PSID included an oversample of families from low-income neighborhoods, which allows us to discern varying experiences of childhood economic disadvantage. When children of PSID families leave their parents'

[1]See (Lanza, Stephanie T, Dziak, J. J., Huang, L., Xu, S., & Collins, 2011) for the LCA mathematical model.
[2]In addition, the intensity of health changes, for example, the number or severity of conditions, may be of conceptual interest to researchers, however, we do not address that here.

homes, they become PSID family units as well, and this "split off" sample has been found to be representative (Fitzgerald, Gottschalk, & Moffitt, 1998). The multi-generational design and long span of data collection allows us to link adult children to their parents and to look back in time to use data on childhood socioeconomic environment provided prospectively by parents at the time the child was in the parental home.

We focus our analysis on adult children who are part of the late Baby Boom cohorts (newborn to 8 years old in 1968). This age range was chosen for two reasons. First, it is substantively interesting, as much attention has been focused on the health of these cohorts that are so strongly contributing to an aging population. Second, from a practical standpoint, the ages of these respondents correspond well with the years in which the PSID has collected data on the measures of interest (discussed below). Our analytic sample ranges in age from 42 to 49 in 2009 and thus, during the observation period, enter a stage of the life course in which many health problems begin to emerge. To estimate patterns of childhood economic hardship, rather than limit the sample to only those PSID respondents remaining in the sample as adults, we utilized the entire sample of 4,167 children between the ages of birth and eight years of age as of 1968. Latent class analysis assigns cases to the class for which the posterior probability is the highest, and cases in the same latent class are similar to each other because their responses are generated by the same probability distribution (Magidson & Vermunt, 2004). Because the composition of the sample shapes the probability distribution, and the PSID children were most representative of U.S. children before attrition began to shrink the sample, it was important to use the full sample to generate latent classes of childhood economic hardship. In 1999, when the health indicators begin, 1,426 of these respondents remained in the PSID; therefore, this is the final sample used to estimate health risk trajectories.

Missing Data—Incomplete data is a challenge in longitudinal research, and can present particularly important problems for studies of health. There are two types of missing data in most longitudinal analyses, including this one. First, in any given survey year, some individuals may provide incomplete data; for example, a family's household income may be missing in a survey year. LCA uses a full-information likelihood (FIML) approach to deal with missing data assumed to be ignorable (MCAR or MAR) on indicators (but not covariates) of the latent variable given variables included in the analysis. Individuals with missing data on the health measures, including those who are not present in all survey years between 1999–2009, are included in the analysis and model estimates are adjusted on the basis of the information these individuals provide (Collins & Lanza, 2010). On the other hand, attrition from the PSID from childhood to adulthood (i.e., attrition between 1968–1999) potentially weakens the representativeness of the survey over time, and is not addressed in the models. If individuals remaining in the sample over time are increasingly the healthiest and most affluent respondents, results may suggest a weaker relationship between socioeconomic status and health over time than is the case (Willson et al., 2007). The decline in the PSID sample from its initial size is considerable; however, it is low given the 40-year period over which the children and their families have been followed. Comparisons of the PSID with a nationally representative repeated cross-sectional survey show that the weighted PSID sample maintains its representativeness over time on many

characteristics (Fitzgerald, 2011). Overall, extensive analyses of the impacts of attrition with this cohort of children from the PSID do not show strong evidence of attrition bias, with some exceptions; for example, female subsamples show fewer effects of attrition than males, and the effect of higher education on retention in the sample is stronger than that of health (Fitzgerald, 2011). Several studies of the relation between attrition and health in the PSID find some evidence that less healthy people are more likely to drop out over time, but primarily conclude that attrition is not selective by health (Fitzgerald, 2011; Halliday, Kimmitt, & Kimmitt, 2012; Johnson & Schoeni, 2011; Meer, Miller, & Rosen, 2003). In analyses not shown here, we found that our measures of childhood economic hardship (our independent variable) predict whether the child has an observed adult health measure, with children who experienced poverty less likely to be measured in adulthood. Because any selective attrition with respect to health (our dependent variable) is likely to lead to an understatement of the impact of childhood economic hardship, taken together, these investigations of the effects of attrition in the PSID suggest that, while not seriously biased, our findings are likely conservative estimates of the association of childhood economic hardship and adult health.

Measures

Decisions regarding the operationalization of the outcome measure used in this analysis were made partially in response to the limitations of other conceptualizations of health, such as self-rated health and analyses of separate health conditions that are commonly utilized in social science research. There is ample research that suggests caution in using a subjective measure of self-rated health to understand health inequality, with recent studies confirming differences in meaning across age and socioeconomic status and expressing concern over the longitudinal validity of the measure and its ability to capture change in health (eg. Dowd & Zajacova, 2010; Gunasekara, Carter, & Blakely, 2012; Layes, Asada, & Kepart, 2012). Moreover, although evidence suggests that different diseases may involve different causal variables and mechanisms (Galobardes, Lynch, & Davey Smith, 2004) with some, such as heart disease, potentially more strongly linked to early life circumstances than others, studies that focus on one disease give us information on mechanisms and proximal causes for only one specific manifestation of health inequality (Phelan et al., 2010). In contrast, the goal of this analysis is to conceptualize health as a form of life course capital that individuals preserve or deplete at different rates depending on a combination of factors including access to resources that are protective of health, such as socioeconomic status (O'Rand, 2006). Understanding the process of health depletion lies not in one specific disease or condition, but by looking at health more globally; for example, by capturing the presence of any of a number of common chronic health conditions. Thus, the current analysis examines health risk trajectories that are constructed using RMLCA (e.g., Collins & Lanza, 2010) in SAS Proc LCA and a series of repeated observations (collected in the PSID between 1999 and 2009) of five physician-diagnosed health conditions: heart disease, high blood pressure, diabetes, arthritis, and cancer. Respondents were coded 1 if they reported they were diagnosed with at least one condition in that survey wave. The assumption behind RMLCA is that there exist a certain number of distinct pathways of health risk, and respondents can be grouped into distinct latent classes based on their profile of health conditions over the period of 1999–2009, with each subject belonging to one class.

We also use RMLCA to identify subgroups of individuals with similarities in their experience of economic hardship in childhood. We used RMLCA to classify children into groups on the basis of their family's poverty status between 1968 and 1977 when the children were 0–8 years old. A child is considered to be living in poverty in a given year if the family's total annual income falls below 125% of the official U.S. poverty threshold.[3]

An important step in latent class analysis is the introduction of covariates into models to identify characteristics that predict membership in the various latent classes. Following the lead of Wagmiller and colleagues (2006), we predict latent classes of childhood economic hardship using several variables (all measured in 1968) that have been shown in previous research to have a strong association with bwioth short- and long-term poverty experiences. These include female head of household, African-American head of household, the number of children in the family, head of household had less than a high school education, and head of household was unemployed. Next, using the posterior probability of belonging to each latent class of childhood economic hardship, we created a series of dummy variables by assigning respondents to the class for which this probability is the largest. We include the childhood economic hardship dummy variables (described below), along with respondents' mean-centered age, as predictors of health risk trajectory latent classes.[4]

5. Findings

Model Fit

One of the primary decisions that must be made when using latent class analysis is the number of latent classes to specify. Model evaluation and selection are based on a combination of statistical criteria, parsimony, and interpretability (Collins and Lanza, 2010). The likelihood-ratio statistic G^2 is used to assess absolute model fit, with larger values indicating more evidence against the null hypothesis that this is the population model that produced the observed data (i.e., smaller is better) (Agresti, 1990). To asses relative model fit, or the optimal balance of fit and parsimony, information criteria associated with each model can be compared. The Akaike information criterion (AIC; Akaike, 1987) and the Bayesian information criterion (BIC; Schwarz, 1978) are the two most commonly used tools for model comparison. For both, a smaller value indicates a more optimal balance of model fit and parsimony; however, they do not always identify the same model as optimal, and are best used as guides for ruling out models, so theory remains an important guide in estimating these models.

Models with one through six classes were fit to the data for both childhood economic hardship and health risk. Tables A1 and A2 show fit statistics for each model of childhood economic hardship and health risk respectively. Because the degrees of freedom in both cases are large, the reference distribution for the G^2 statistic is not known and therefore *p*-

[3]We use 125% of the U.S. poverty threshold because the PSID consistently finds higher reported incomes than the Census Bureau (Bane & Ellwood, 1983; Wagmiller et al., 2006).

[4]We did not include covariates used in the childhood economic hardship LCAs as covariates in models estimating health risk trajectory LCAs for several reasons. The covariates are demographic characteristics of the family of origin, not the individual, and are measured at one point in time. Our conceptual model views these variables as affecting health trajectories indirectly through experiences of childhood economic hardship, and in this descriptive analysis we are not building a full explanatory model of adult health.

values for tests of absolute model fit were not calculated (Collins & Lanza, 2010). We relied primarily on the AIC, BIC, model interpretability and the previous literature to determine the appropriate number of latent classes. In the model of childhood economic hardship, the AIC and BIC both continued to become smaller as more latent classes were added. However, after the three-class solution, the decreases leveled off, and examination of the five and six-class solutions indicated that these latent classes were small and that their solutions had poor homogeneity and latent class separation compared to the solution with four latent classes. Based on these findings, and the previous literature (Wagmiller et al., 2006) we determined that the model with four latent classes provided the best fit to the data. These classes are consistent with those identified in earlier research using the PSID (McDonough, Sacker, & Wiggins, 2005; Wagmiller et al., 2006).

In the model of health risk, the AIC continued to decline, again at relatively small increments following the three-class solution, and although the BIC suggested a 4-class model was preferable, examination of the four, five, and six-class solutions again showed that these latent classes were small and had poor homogeneity and latent class separation compared to the solution with three latent classes. Three latent classes also provided the best conceptual fit to the data, and this solution was therefore chosen.

Childhood Economic Hardship

RMLCA provides information on the relative size of each of the latent classes, as well as a matrix of item-response probabilities. The item-response probabilities show the association between the indicators of childhood poverty and the latent classes of economic hardship. For each class of economic hardship, these probabilities indicate the proportion of children who lived in poverty in each year. Figure 1 displays the item-response probabilities for the measurement of the four classes of childhood economic hardship. The first row of Table 1 displays estimates of the proportion of the population in each group (weighted). Coefficients from a multinomial logistic regression carried out in Proc LCA relating class membership to the family demographic characteristics in 1968 (head's employment status, the race of the head, the sex of the head, the head's education, and the number of children in the family) are also presented in Table 1. The reference group in this model is the non-poor class.

Approximately 64% of children had a very low probability of experiencing economic hardship throughout the period of observation (labeled "Non-poor"). In contrast, children in the "Long-term Poor" class (18% of children) experienced a very high probability of exposure to economic hardship throughout the period -- .97 in 1968, which remained high, at .90 in 1977. The other two classes, those "Moving into Poverty" (8% of children) and those "Moving out of Poverty" (9.5% of children) experienced change in their poverty status over time and are differentiated by the direction of that change. Children whose families moved out of poverty experienced a high probability of poverty early in their lives (.81 in 1968), but their risk dropped over time to relatively low levels by the end of the observation period (.14 in 1977). In contrast, children moving into poverty began with a relatively lower risk of exposure to poverty (.43), which climbed steadily as they approached and transitioned into adolescence (.80).

The demographic characteristics we included as predictors of class membership provide insight into the factors that influence the dynamics of economic hardship experienced by families and provide profiles of the individuals in the classes. Although the demographic characteristics are all significant in differentiating the classes, the magnitude of their effects differs across the classes. In general, the results demonstrate that family background characteristics measured in 1968 are strong predictors of both economic hardship experienced early in the observation period and persistent economic hardship. For example, children in families in which the head is unemployed, female, or a high school dropout were much more likely to experience economic hardship, particularly persistent poverty and early poverty. In contrast, children living in families headed by an African American had a greater likelihood of experiencing long-term poverty than families with a white head of household, and were more likely to move into poverty over the period rather than move out.

Health Risk Trajectories

Recall that health risk trajectories are profiles that capture the initial probability of experiencing a health condition, and how this probability changes over time. Figure 2 plots the item-response probabilities from the baseline LCA model for three groups of respondents with different experiences of health risk and the first row of Table 2 includes the proportion of the sample in each latent class. For example, for a respondent in the latent class we named “Low Risk” (59% of the sample), the probability of reporting a chronic disease in 1999 was about .05, and this remained the case until the last wave, where it increased slightly to about .10, still greatly below the other two classes. In contrast, a respondent in what we named the “Increasing Risk” latent class (approximately 19% of respondents), had a probability of about .10 of reporting a health condition in 1999, which increased rather rapidly to about .84 in 2009. Finally, a respondent in the “High Risk” group (22% of the sample) began the period with a high probability of reporting a disease (.72 in 1999) and this increased to .88 in 2009.

We next examine whether adult health risk trajectories differ for individuals based on their experience of childhood economic hardship and, in particular, if the duration, timing, and change in economic hardship in childhood are factors that predict membership in a particular health risk latent class. Table 2 presents coefficients and odds ratios from a multinomial logistic regression predicting membership in latent classes of health risk trajectories (the reference category in this model was the “low risk” health trajectory), and Figure 3 presents predicted probabilities of experiencing each latent class of health risk based on childhood experience of economic hardship, with age set to the mean.

The long-term negative health effects of extended exposure to economic hardship in childhood are evident. Those in the long-term poor class have the highest predicted probability of experiencing a high risk health trajectory in mid-life. In addition, coefficients for long-term poverty and moving into poverty are positive, indicating that compared to the non-poor, individuals in these latent classes were more likely to be in the increasing risk and high risk latent classes than the low risk class. For example, individuals who experienced long-term poverty in childhood were almost twice as likely as the non-poor to be in the high

risk latent class than the low risk, and over 60% more likely to fall into the increasing health risk class.

While persistent economic hardship is clearly a long-term detriment to health, the effects of changing poverty statuses on adult health are more complex. Overall, moving into poverty in childhood appears to be more detrimental to midlife health than beginning life in poverty and moving out. Compared to the non-poor, those whose families moved into poverty over the period were almost 2.5 times more likely to be in the increasing risk latent class than the low risk and 70% more likely to be in the high risk latent class (Table 2). Their predicted probability of experiencing an increasing risk of disease is twice as high as those who moved out (29% vs. 14%) and their probability of being in the low health risk group is lower (48% vs. 63%) (Figure 3). In contrast, individuals who moved out of poverty in childhood were as likely as the non-poor to experience a low risk health trajectory compared to the other health trajectories.

Older respondents are more likely to be in the increasing or high risk health classes relative to the low risk class. In models not shown here, we included an interaction between age and the economic hardship variables to further examine whether the timing of the experience of hardship affected one's later experience of health risk. In other words, does moving into poverty during early childhood have the same long-term negative health effects as moving into poverty in later childhood? The interaction term was not significant, suggesting that the effect of economic hardship does not differ according to whether it begins earlier or later in childhood. However, it is important to keep in mind that the children in our sample fall into a relatively narrow age range (8 years).

In sum, as depicted by Figure 3, the duration of economic hardship and the transition to hardship are two possible pathways through which childhood economic adversity has long-term, negative implications for health in mid-life. Having a high risk health trajectory in adulthood is predicted by the duration of hardship in childhood, with the long-term poor at the highest risk, followed by those who transition in or out of hardship. However, the similarity in the effects of transitions into and out of economic hardship on mid-life health ends there. Deteriorating health in mid-life (the increasing risk trajectory) is predicted by the transition into sustained economic hardship during childhood, while those whose families moved out have no greater risk of this health trajectory than those who never faced economic hardship.

6. Discussion and conclusion

Although a growing body of social science and epidemiological research seeks to understand the long arm of childhood conditions on adult health, the majority of health research conceptualizes disadvantage in early life and beyond as static attributes that are incorporated into models as snapshots of particular moments in time that occur across the life course (Corna, 2013). The majority of research also fails to treat health as a dynamic process and instead often evaluates the effect of disadvantage on a point-in-time estimate of health. This study was designed to address some of the existing gaps in research on life course health. In particular, we were interested in an approach that problematizes

heterogeneity within a population and seeks to understand questions such as how differences in the duration, timing, and change in individual experiences are associated with health inequality. Using repeated-measures latent class analysis, we examined heterogeneity in trajectories of exposure to economic hardship during childhood and the relationship between distinctive patterns of childhood disadvantage and trajectories of health in mid-life. We found that economic hardship in childhood has long-term, negative consequences for health both among individuals who begin life in poverty or remain in poverty for at least a decade of childhood, as well as those who moved into poverty during their childhood years. In contrast, adults with consistently more advantaged early life experiences, or who moved out of poverty, were at a lower risk of experiencing health trajectories characterized by the early onset or increasing risk of disease.

We agree with George (2009) that a person-centered, disaggregated approach to the study of the relationship between socioeconomic status and health across the life course holds potential for the study of health inequality and that a greater focus on trajectory-based analysis is needed. Conceptualizing both socioeconomic status and health as dynamic trajectories allows us to ask questions about process rather than limiting us to analyses of current status characteristics or average effects. Our trajectories of childhood economic environment not only provide a picture of relative advantage and disadvantage, but they also capture other important life course concepts such as duration (long-term disadvantage is associated with a greater likelihood of being in the high risk health group), stability and change (those moving into poverty are more likely to be in the high or increasing risk groups than those moving out of poverty), and timing (disadvantage initiated earlier in childhood rather than later, not found significant in this analysis). Health risk trajectories provide a similar level of detail regarding relative health risk in terms of stability and change (stably high risk, stably low risk, increasing risk), and timing (earlier onset, later onset).[5]

The various patterns that emerge suggest that early life experiences initiate a process of accumulation of opportunities and insults across the life course that can, in turn, be linked to individual change in health over time. Intra-individual trajectories of resource acquisition and loss across the life course likely take various forms in terms of the rates of return to resources and the timing at which the process is initiated. Cumulative dis/advantage is an individual level process of resource acquisition and risk avoidance that has population-level implications for changing levels of inequality with age. A disaggregated approach to understanding intra-individual trajectories of socioeconomic status and health provides a needed compliment to aggregated models such as growth curve analysis that try to understand the dynamics of processes of cumulative inequality across groups within the population.

Thus far, attempts to understand intra-individual processes associated with health, such as mechanisms of cumulative dis/advantage, have been designed primarily to examine the relative influence of childhood versus adult socioeconomic factors on health rather than approaching the individual life course as a unified trajectory and looking at issues of social

[5]Our measure of health captured the age of onset of a chronic condition as a unidirectional event rather allowing for reversibility such as we might see with a measure of disability, for example.

mobility related to stability and change in resources over time. As a result, research tends to be framed in terms of competing models that attempt to identify the specific period of life most important for determining later life health. For example, studies looking at the relative contribution of childhood environment and socioeconomic resources (and sometimes lifestyle and health behaviors) to health in midlife find that resources in adulthood attenuate but do not completely explain the harmful effects of early disadvantage (Guralnik, Butterworth, Wadsworth, & Kuh, 2006; Hamil-Luker & O'Rand, 2007; Hayward & Gorman, 2004; Luo & Waite, 2005; McKenzie, Carter, Blakely, & Collings, 2010). In some studies these findings are interpreted as offering support for both a pathway/path-dependent model and a critical period model; in others they are viewed as primarily offering support for a pathway model because the effect of adult resources is stronger than the effect of childhood resources. Existing studies have fallen short of providing a definitive answer in part because the conceptualization of life course health has been primarily driven by statistical models that test the relative importance of distinct life course periods by determining whether early disadvantage is mediated by adult resources. If the effect of childhood disadvantage is not fully explained by adult resources it is unclear whether this should be interpreted as support for a critical period model or whether it is an artifact of a windows problem or an omitted variable problem resulting from inadequate attempts to capture a dynamic process such as childhood environment.

Our study advocates for conceptualizing the entire individual life course as a dynamic trajectory and identifying and understanding how variations in socioeconomic pathways are associated with patterns of changing health with age. Such an approach involves observing individuals across the entire life course in order to identify individual pathways characterized by stability or change in socioeconomic status (such as those associated with transitions such as educational attainment) and the timing and mechanisms of change. A shift in focus and method helps to move the discussion beyond the models of health that are currently the focus of the health research to broader questions that are of interest not only to health researchers, but also to social scientists more generally; questions such as what are the health consequences of a pathway of upward or downward mobility, and to what extent does the timing and degree of mobility matter? Influences on health likely extend beyond the level of socioeconomic resources available during particular segments of the life course to the stability of resources, the timing of changes in resources, and the degree and direction of change. Conceptualizing the individual life course as a trajectory comprised of periods of stability and change that generate heterogeneous pathways of advantage and disadvantage allows more explicit examinations of the effects of social mobility on health, captured through key life course concepts such as timing, duration, and change.

This study represents a first step in addressing a relatively new approach to examining questions about trajectories, and as such has a number of limitations. First, the current project only examines conditions in early life, which represents only a small segment of the life course. This could be viewed as potentially problematic, as a focus only on childhood environment in the absence of measures of adult resources can create a "Time 1 Encapsulation Problem" whereby "late-life outcomes are over-attributed to early-life social circumstances to the exclusion of interim social context" (Kelley-Moore & Lin, 2011:60; also see Dannefer & Kelley-Moore, 2009). In such a situation, the concern is that the

overemphasis on starting position and lack of attention to the "ongoing and interactive nature of social structure and individual characteristics that occur throughout the life course" could lead us to draw incorrect conclusions about health (Kelley-Moore & Lin, 2011:60). Our conceptualization of the relationship between socioeconomic resources and health, however, focuses on intra-individual dynamics. Rather than testing competing models of the relative contribution of resources across various periods of the life course, we allow for heterogeneity in individual pathways of health and focus here on describing the anchoring of adult health in early life trajectories of relative advantage and disadvantage. Within this context, the extent to which the persistence or modification of early life trajectories across the remainder of the life course generates greater heterogeneity in individual pathways to health is an empirical question of interest rather than a source of model bias or mis-specification. Given the relative lack of theoretical and empirical direction regarding the effect of both the duration of exposure to disadvantage and changing resources across the life course on health trajectories, an analytic approach that allows for the modeling of change over time in whatever form it occurs is a valuable tool for advancing our ability to describe and understand these dynamic life course processes.

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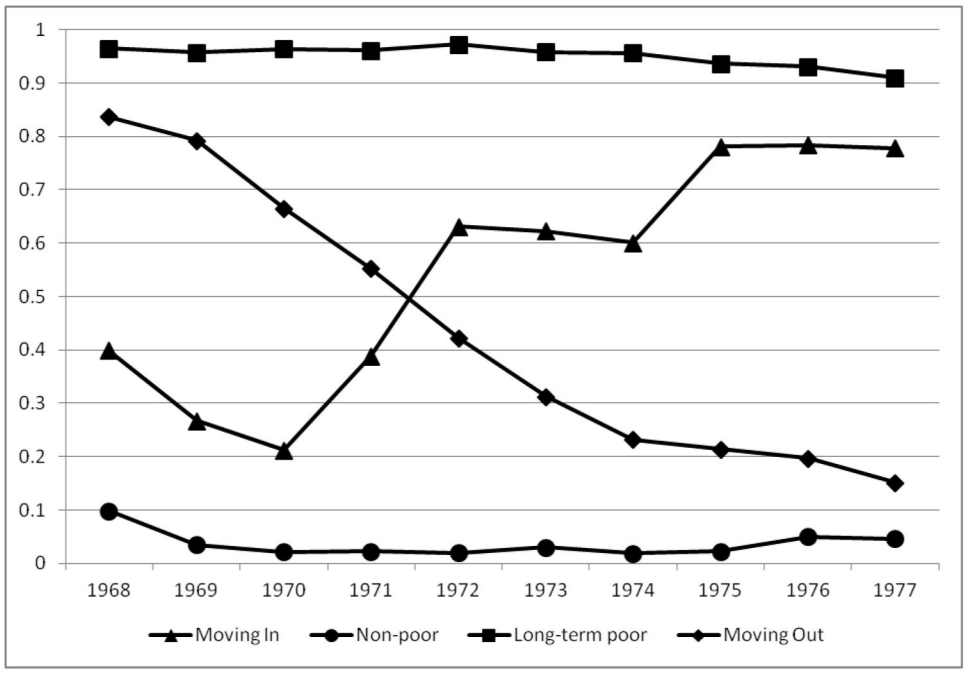

Figure 1.

Item-response Probabilities for a Four-Class Longitudinal Latent Class Model of Childhood Poverty Exposure, by Class and Year (PSID, 1968–1977).

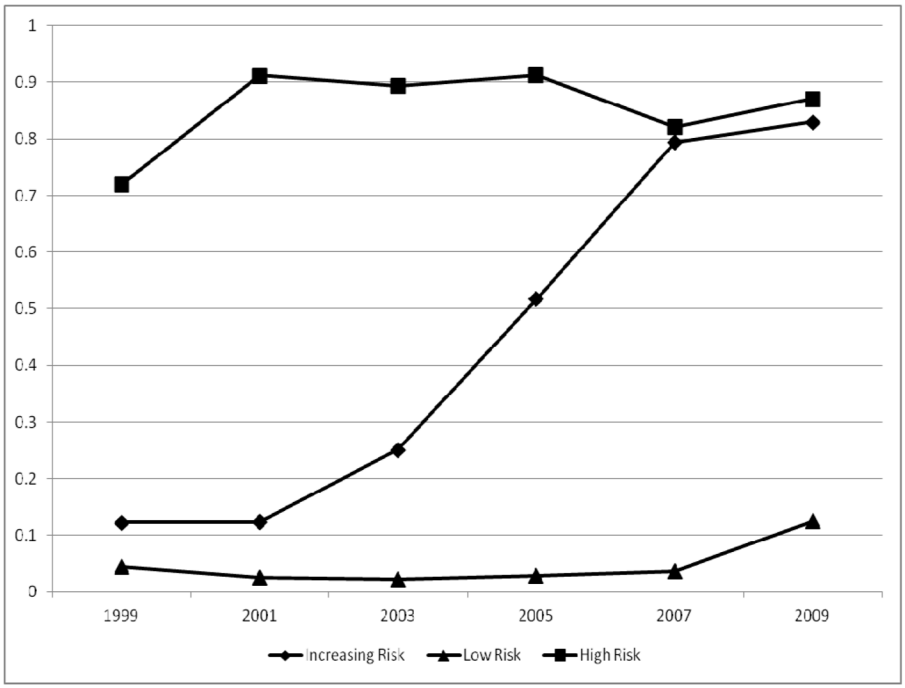

Figure 2.

Item-response Probabilities for a Three -Class Longitudinal Latent Class Model of Health Risk Trajectories, by Class and Year (PSID, 1999–2009).

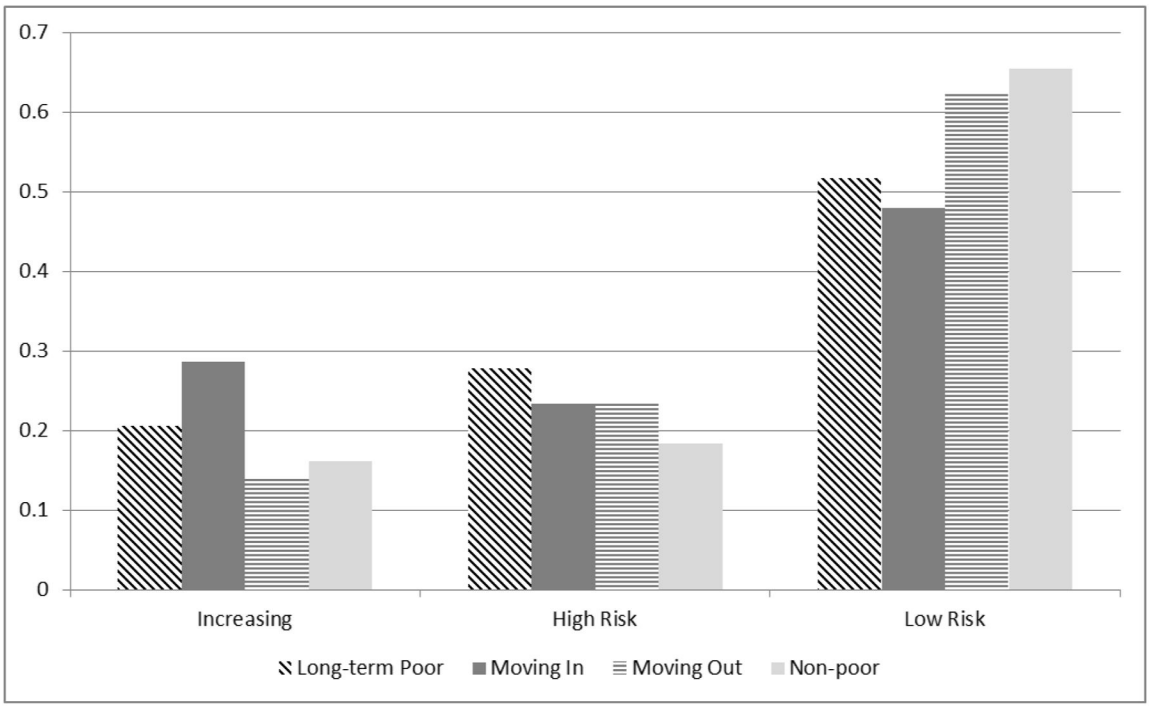

Figure 3.
Predicted Probabilities of Health Risk Trajectory by Latent Childhood Poverty Exposure Class.

Table 1

Predictors of Membership in Latent Classes of Childhood Economic Hardship (PSID, 1968–1977, N=4,167).

N (%)	Non-poor 2682 (64.3)		Moving Out 394 (9.5)		Long-term Poor 765 (18.4)		
	Log Odds (s.e.)	**Odds Ratios**	**Log Odds**	**Odds Ratios**	**Log Odds**	**Odds Ratios**	***p*-value**
Intercept	2.937 (.179)	18.860	−1.558 (.244)	.211	−3.569	.028	<.001
Head unemployed	−2.103 (.636)	.122	1.246 (.469)	3.475	1.685	5.394	<.001
African American head	−1.512 (.145)	.220	−.048 (.168)	.953	.572	1.771	<.001
Female head	−1.35 (.221)	.259	.981 (.110)	2.666	1.790	5.991	<.001
Head high school dropout	−1.251 (.141)	.286	.473 (.170)	1.606	1.008	2.739	<.001
Number of children	−.147 (.043)	.863	.363 (.045)	1.438	.677	1.968	<.001

Note: Moving-in latent class is the reference category (N=326, 7.8%).

Table 2

Childhood Economic Hardship Classes as Predictors of Membership in Latent Classes of Health Risk Trajectories (PSID 1967–2009, *N*=1,426).

***N* (%)**	**Increasing Risk Trajectory 274 (19.2)**		**High Risk Trajectory 311 (21.8)**		
	Log Odds (s.e.)	**Odds Ratios**	**Log Odds**	**Odds Ratios**	***p*-value**
Intercept	−1.399 (.218)	.247 (odds)	−1.270 (.118)	.281 (odds)	
Age	.049 (.038)	1.050	.105 (.031)	1.111	<.01
Non-poor (ref)	--	--	--	--	--
Long-term Poor	.477 (.208)	1.612	.650 (.164)	1.916	<.001
Moving Into Poverty	.886 (.309)	2.425	.548 (.290)	1.730	<.01
Moving Out of Poverty	−.105 (.334)	.900	.294 (.223)	1.342	>.05

Note: Low Risk Health Risk trajectory is the reference category (*N*=841, 59%).

Appendix A1

Summary of Information for Selecting Number of Latent Classes of Child Poverty Trajectories (PSID, 1968–1977, N=4,167).

Number of latent classes	G^2	*df*	AIC	BIC
1	23186.27	1013	23206.27	23269.62
2	5144.88	1002	5186.88	5319.92
3	2890.99	991	2954.99	3157.71
4	2140.76	980	2226.76	2499.16
5	1856.77	969	1964.77	2306.85
6	1680.72	958	1810.72	2222.49

Appendix A2

Summary of Information for Selecting Number of Latent Classes of Health Risk Trajectories (PSID, 1999–2009; *N*=1426).

Number of latent classes	G^2	*df*	AIC	BIC
1	2826.19	57	2838.19	2869.76
2	389.08	50	415.08	483.50
3	167.56	43	207.56	312.81
4	85.06	36	139.06	281.15
5	65.34	29	133.34	312.27
6	32.22	22	114.22	329.99