Poverty and Sleep in Later Life

Jen-Hao Chen
University of Missouri-Columbia
Email: chenje@health.missouri.edu

Abstract

Older adults are more likely to have insufficient sleep and difficulty falling asleep. Extant research attributes older adults sleep problems to biological aging and pays little attention to how challenges of social and economic life in old age affect sleep. Drawing on theories and research from the literature on medical sociology and population health, this study hypothesized that living in impoverished household contexts is a cause of sleep problems among older adults. Using the 2013 Disability and Use of Time (DUST) from the Panel Study of Income Dynamics (PSID), the analysis applied marginal structural model and the classification and regression tree technique to estimate the causal effects that current and long-term exposure to poverty have on the probability of inadequate sleep and difficulty falling asleep. Results showed that poverty, irrespective of duration, had no effect on insufficient sleep among older adults. Current and long-term exposure to poverty, however, increased the probability of having difficulty falling asleep on both weekdays and weekends. These findings suggest that poverty reduces older adults' abilities to initiate sleep.

INTRODUCTION

Not having a good night's sleep is increasingly being recognized as a critical behavioral risk factor for chronic diseases and mortality among older adults: poor sleep has been linked to declines in cognitive function (Cricco, Simonsick, & Foley, 2002) and increases in diabetes (Gangwisch et al., 2007), heart disease (Phillips & Mannino, 2007), and mortality (Cappuccio et al., 2010b). One large survey found that nearly half of the older adults reported having at least one insomnia symptom (Foley et al., 1995). However, in spite of the importance of sleep problems, our understanding of their causes in older adults is very limited. The vast majority of sleep research is clinic-based, includes non-representative patient populations, and focuses on the roles that the biological aging process plays in older adults' sleep outcomes. However, although the increasing frailty of sleep architecture as people age may be a reason why older adults have high prevalence of sleep problems, the biological aging process per se cannot explain why some older adults develop sleep problems but others are able to maintain relatively healthy sleep. More specifically, if the biological aging process works more or less the same way on every individual, then disparities in sleep would be minimal. Yet, public health scientists observe that there are considerable disparities in older adults' sleep according to their social groups at the population level (Kurina et al., 2015; Liu et al., 2016). Socially and economically disadvantaged older adults have higher prevalence of sleep problems (Chen, Lauderdale, & Waite, 2016; Kurina et al., 2015). Because older adults' positions in the social and economic stratification systems shape their experiences, interactions, and everyday life, the unequal distribution of problem sleep among older adults suggests that, to fully understand the origin of sleep problems in old age, researchers also need to consider the social and economic challenges faced by individuals in later life.

Motived by this concern, I have adopted a sociological approach for investigating the sleep problems of the elderly. I propose that economic hardship is a major cause of sleep problems in old age. As people age, the risk that they will be living in poverty increases (Sandoval, Rank, & Hirschl, 2009). However, poverty does not affect merely the material well-being of older adults. Poverty can also change individuals' life styles and everyday routines, create stress, and generate conflicts and disorders in the household. The very experience of living in poverty coupled with the decline in social resources and resilience put older adults who are poor at high risk for having sleep problems. Hence, from the sociological perspective, sleep problems are rooted in the social and structural disadvantages that these older adults live with.

The empirical analysis of this project takes advantage of time-use data from the Disability and Use of Time (DUST), Supplement to the Panel Study of Income Dynamics (PSID) to identify the causal effects of current poverty and long-term poverty on sleep among the elderly. This project aims to contribute to the sociological literature in two significant ways. First, the project draws on theories from medical sociology and social inequality to theorize the relationship between poverty and sleep. Perspectives from sociology provide explanations for how sleep is regulated and affected by social contexts and processes. Second, the present study has adopted the innovative marginal structural model (MSM) and the classification and regression tree (CART) technique to estimate the causal effects of poverty on two sleep problems in older adults: insufficient sleep and difficulty falling asleep. By employing innovative statistical methods, this project is able to provide better estimates of the causal effects and to address the methodological problems caused by time-varying confounders. Taken together, the findings provide new sociological insight into one emerging public health problem by linking economic hardship of older adults and their sleep, which helps to illuminate the role of social

structures and processes in causing sleep problems in old age, and shed lights on public health interventions that aim to promote sleep health in old age.

BACKGROUND

Problem Sleep in Old Age: Biological Frailty and Social Causes

Sleep is one of the most important restorative behaviors for an individual's health and well-being; it provides new energy for the brain and for daily activities. As individuals age, sleep becomes more and more important for their health. Poor sleep in old age has been linked to increased chances of developing chronic diseases and of excessive mortality (Cappuccio et al., 2010b; Gangwisch et al., 2007; Phillips & Mannino, 2007). Furthermore, older adults have a higher prevalence of problem sleep. Recent national data showed that approximately one-fourth of older adults reported having insufficient sleep (Liu et al., 2014) and approximately 40% of older adults reported having trouble falling asleep (Lauderdale et al., 2014). This makes sleep health at old age a critical concern not only for health scholars but also for the government. The U.S. Department of Health and Human Services' Healthy People 2020 initiative is, for the very first time, considering improvements to sleep health and the elimination of disparities in sleep as one of the central goals for the agency (U.S. Department of Health and Human Services, 2010).

However, our understanding of the causes of older adults' sleep problems remains limited. Scientists agree that sleep architecture becomes more fragile in later stage of the life. As individuals age, their abilities to initiate sleep and maintain a continuous and consolidated sleep declines (Espiritu, 2008; Vitiello, 2006). Thus, the decline of sleep in old age is an indicator and a key aspect of frailty that deserves social scientists' attention. Yet, unlike other indicators of frailty such as cognitive decline and functional limitation, few studies have considered how

social processes affect problem sleep in old age. The decline of biological ability does not necessarily translate into a decline in sleep quality in every older adult. Why some older adults sleep poorly but others keep having a good night's sleep? Apparently, the continuing search for new biological factors adds little to our understanding of the sleep problems in older adults at the aggregate level.

Older adults live in social worlds, so they also sleep in social worlds. Decades of sociological research has demonstrated the powerful role of social stratification systems in affecting the physical and mental health of individuals (McLeod, 2015). It is, therefore, unrealistic to assume that the increasing frailty of sleep in old age is caused mainly by biological processes. From this view, what the biological theory suggests is that this biological process makes older adults' sleep more vulnerable to the influences of external social conditions and interactions. Identifying social factors that trigger sleep problems in old age are essential for prevention of sleep problems and promotion of sleep health. Nevertheless, the dominant approach of sleep research that isolate the analysis of sleep on autonomous individuals adds little knowledge about how social processes contribute to problem sleep in old age.

There is an emerging literature in sociology that has begun to link sleep problems to the structural contexts of people's lives. For example, Burgard (2011) and Burgard and Ailshire (2013) focus on how gender stratification systems in families affect sleep in men and women. More recently, several studies have attempted to uncover how social challenges in later life influence sleep among the elderly. These studies pay attention to how changes in family and social life in old age facilitate or hamper the development of problem sleep among older adults (Chen, Lauderdale, & Waite, 2015; Chen, Waite, & Lauderdale, 2016). However, although the

studies do provide remarkable insights into how dynamics of social and family relationships in later life come to affect the sleep, there has been no other study that considers how economic well-being affect the elderly' sleep. Securing adequate income and maintaining economic well-being is a challenge for many older adults. Life course transitions often make older adults have higher chances of being in poverty. No study, however, has considered economic hardship as a potential cause of sleep problems of older adults.

Poverty and Health in Later Life

Decades of sociological research and work in the social sciences have found strong and consistent socioeconomic disparities in nearly every health outcome and in every stage of life. Individuals at the bottom of the income distribution have the worst health outcomes (Bowling, 2004; Minkler, Fuller-Thomson, & Guralnik, 2006; Robbins et al., 2001; Ward et al., 2004). Also, inequalities in health outcomes across the income spectrum persist in old age (Bowling, 2004; Schoeni, Martin, Andreski, & Freedman, 2005), suggesting that economic well-being remains an influential factor for healthy aging.

Older adults, however, have a higher risk of becoming poor. Transitions in later life are often associated with changes in economic status for older adults. For example, transition into retirement can lead to a decline in income. The loss of a spouse may also reduce the financial well-being of an older adult. Research using longitudinal data that investigates the dynamics of poverty over the life course has found that the risk of poverty begins to increase at around age 60 (Besharov, 2008; Rank, & Hirschl, 2001). The increasing risk of poverty in old age, therefore, threatens the health and well-being of older adults. Given the high prevalence of problem sleep in the elderly, examining the relationship between poverty and sleep can provide new insights

into this emerging public health issue.

This study builds on these sociological works to link older adults' sleep problems to poverty, drawing on theories and prior research in medical sociology, social inequality, and population health. The study asks two key questions concerning sleep problems in old age: first, whether and how economic hardship affects sleep and, second, whether enduring economic hardship has greater consequences for sleep in older adults. The project addresses this gap in the literature by 1) developing a theoretical framework regarding the processes through which poverty affects sleep, and 2) estimating the causal effects of poverty on two common sleep problems among the elderly: insufficient sleep and difficulty falling asleep.

Theorizing about Poverty and Sleep in Old Age

Social Negotiation of Sleep. Two broad theoretical perspectives provide valuable insights into the process through which poverty affects sleep. The first perspective considers sleep as determined by a serious of complex processes of social negotiation. An individuals' economic resources and structural positions affect how sleep is negotiated with himself/herself and with others. First, individuals make decisions about the amount of time they should spend in activities based on each activity's relative cost (Becker, 1965). Here, cost is referring not only to the economic cost but also the opportunity cost. When it comes to determining sleep time, individuals weigh the activity in terms of cost and then allocate appropriate amounts of time to sleep (Antillon, Lauderdale, & Mullahy, 2014; Biddle & Hamermesh, 1990). A decrease in income reduces the cost of sleep. Older adults who are poor may have few resources for other activities and may, therefore, spend more time on sleep (which is less costly).

However, the economic cost is only one of the factors that older adults consider when

negotiating their sleep time. Sociological theory suggests that individuals also consider the demands of their social roles and the demands from social relationships when determining sleep time (Meadows, 2005). Living in poverty may bring about challenges in social relationships and social roles that make older adults less likely to negotiate a good night's sleep. Demographic research has shown that older adults who are poor are more likely to live with adults and young children who are not their spouses or grandchildren (Kim & Waite, 2016). Such complex living arrangements suggest that these older adults may have additional challenges in terms of negotiating sleep time with non-family members living in the same households. It is clearly more difficult for older adults to reconcile sleep habits and schedules with other people who live in the same house. This could result in older adults not being able to sleep at their desired times, which in turn could increase their chances of having insufficient sleep and difficultly falling asleep. Furthermore, older adults who are poor also have to negotiate sleep within the larger social and neighborhood context. Prior research has shown that individuals who live in disadvantaged neighborhoods develop different strategies and behaviors to adapt to the life and social interactions in these poor communities (Anderson, 2000; Klinenberg, 2003). Older adults who are poor and live in disadvantaged neighborhoods may, then, develop different sleep habits from older adults who live in more affluent communities.

Combining all of these factors, older adults negotiate sleep based on the available economic resources, the demands and conditions of their social relationships, and the characteristics of their neighborhoods. While the decline in economic resources may prompt poor older adults to spend more time sleeping, the demands and challenges of living in complex households and disadvantaged neighborhoods may cause older adults to have shorter sleep durations and increased difficulty falling asleep. Thus, the social negotiation perspective helps to

establish a negative relationship between poverty and difficulty falling asleep. The relationship between poverty and insufficient sleep, however, remains ambiguous.

Stress Process Model. The second perspective, the stress process model, provides a powerful theoretical framework for understanding how economic hardship affects sleep. From this perspective, poverty or economic hardship is a *social stressor*, which is defined as an event that is undesirable and threatens people's capacities to achieve their objectives (Aneshensel, 1992; Aneshensel, 2015). Living in poverty is a stressful experience for older adults. Poverty first affects older adults' material well-being. Older adults who do not have adequate financial resources may find it difficult to afford nutritious food, obtain medications and healthcare services, and pay their monthly rent or utility bills. However, finding money to pay bills may not be the only stressful task that poor older adults need to deal with on a daily basis. Other kinds of stress may stem from living in poverty. For example, economic hardship may change family dynamics. Prior research suggests that poverty often leads to a decline in marital quality and greater family conflict and violence (Conger et al., 1990; Fox et al., 2002; Hardie & Lucas, 2010). Therefore, older adults who live in poverty may need to handle the stresses and strains of decline in family relationships. Also, poor older adults may feel stress and frustration when applying for social welfare benefits such as Medicaid and SNAP (the supplemental nutrition assistance program, formerly referred to as the food stamp program). Not only is the paperwork for applying for these benefits complicated but service providers may offer only lower qualities of service to those who are on social welfare. For example, studies have revealed that many physicians do not want to accept Medicaid patients (Decker, 2012). As such, Medicaid recipients often get poorer qualities of healthcare than individuals who have private health insurance (Goldman, Vittinghoff, & Dudley, 2007). Finally, older adults who are poor may be forced to

live in disadvantaged neighborhoods with high crime rates. Concerns about safety may mean that older adults have to be vigilant and attentive to the outside environment. This generates additional stress for them at night. It is not difficult for scholars to find other stressors that originate from poverty and so the list continues to grow. The crucial point here is that this stress proliferation process exposes older adults not only to stress that is generated directly through poverty but also to stress that is produced by living in a poor household and neighborhood. There is ample evidence in biomedical and psychological literature that high levels of stress impair sleep (Akerstedt, 2006; Lorant, Deliège, Eaton, Robert, Philippot, & Ansseau, 2003). The process in which poverty (as a primary stressor) leads to the proliferation of stressors (Pearlin, Schieman, Fazio, & Meersman, 2005) makes poverty a major social cause of sleep problems in old age. In short, the stress model predicts that the stressful experience caused by poverty increases the chances of insufficient sleep and difficulty falling asleep.

Furthermore, the stress model suggests that chronic stressors are more detrimental to individuals' health than short-term stressors (Aneshensel, 2015; Pearlin, 1983; Pearlin, Schieman, Fazio, & Meersman, 2005). The challenges of living in poverty can compound and accumulate over time. As economic hardship persists, older adults who are poor may be continually exposed to stress. In addition, the longer the duration of the poverty spell, the more stressors that may proliferate. This suggests that older adults who are exposed to long-term poverty can face even higher levels of stress than older adults who experience poverty only over the short term. There is ample evidence that lasting poverty has a greater negative effect on health than intermittent poverty. For example, McLeod and Shanahan (1996) demonstrate that long-term poverty affects children's problem behaviors more than short-term poverty. Lynch and colleagues (1997) analyzed a sample of 1,000 middle-aged adults and older adults and found that

long-term economic hardship leads to poor physical and mental health. Consequently, the stress model predicts that long-term poverty leads to greater negative effects on older adults' sleep. Specifically, the longer a poverty spell lasts, the stronger is its effect.

Methodological Challenges in Estimating the Effects of Poverty on Sleep

Theories and prior research suggest a causal link between poverty and sleep in older adults. However, in practice, there are two main methodological problems when estimating the effects of poverty on sleep. First, individuals are not randomly assigned to different poverty statuses. Therefore, research into the effects of poverty on sleep must address potential bias due to confounders. Bias arises when regression does not control for the factors that affect both people's chances of being poor and their chances of having poor sleep outcomes. For the purpose of this study, it is essential to control for confounders that can lead to changes in poverty status as well as sleep problems.

Also, even when all confounders are fully controlled in the regression, time-varying confounders may present another challenge for researchers when estimating the effects of long-term poverty on sleep. These covariates change over time and are related to both poverty status and sleep outcomes. The life-course perspective suggests that the sequences of and responses to events are reciprocally intertwined with each other (Elder, 1985; Elder, Johnson, & Crosnoe, 2003). These time-varying covariates, therefore, cannot be viewed as isolated factors. Instead, researchers must take a dynamic approach to considering one time-varying factor in the context of other time-varying factors and treatment histories. Consequently, in the context of longitudinal analysis, time-varying covariates may be confounders in one context while simultaneously serving as mediators in another context. The two roles of the time-varying factors, therefore,

present a problem for traditional regression. On the one hand, these time-varying covariates need to be controlled because they are confounders. On the other hand, these time-varying covariates should not be controlled when estimating the causal effects because they are mediators on the causal pathways. In short, to be able to estimate the effects of long-term exposure to poverty, researchers need to address the unique characteristic of time-varying covariates effectively.

This study adopted a rigorous methodological approach to addressing these two problems. First, the study adopted the counterfactual framework and used inverse probability treatment weighting (IPTW) to provide a better estimate of the effect of current poverty on older adults' chances of having insufficient sleep and difficulty falling asleep. IPTW is an extension of the propensity method by estimating the probability of older adults in poverty (i.e., the treatment) or non-poverty (i.e., the non-treatment) group. The effect of poverty on sleep is then weighted by the IPT weights. The effect of poverty on sleep is then influenced by the IPT weights. Under the assumption of conditional ignorability, results from IPTW provide better estimates of traditional regression.

The study used the marginal structural model (MSM) to address this second issue. The MSM takes into account the dynamic of time-varying covariates and provides better estimates then traditional longitudinal methods. Furthermore, to minimize the risk of model misspecification, this study adopted the classification and regression tree (CART) technique to estimate the IPT weights. CARTs are machine-learning methods for constructing prediction models from data. The models are obtained by recursively partitioning the data space and fitting a simple prediction model within each partition (Lee, Lessler, & Stuart, 2010). Traditionally, the propensity score is generally estimated using a logistic regression model. However, parametric models require assumptions regarding variable selection, the functional form and distributions of

variables, and the specifications of interactions. If any of these assumptions is incorrect, covariate balance may not be achieved through conditioning on the propensity score, which may result in a biased effect estimate (Drake, 1993). The CART technique uses a machine-learning approach so that it does not rely on making strong parametric assumptions in estimating the propensity score. As such, CARTs provide a better alternative for calculating propensity scores by balancing covariates and minimizing the risk of model specification.

By applying these methods, this study was able to provide a better understanding of the effects of poverty on older adults' sleep by offering a more complete picture of the range of estimates than can be obtained from a single regression model.

METHODS

The PSID and DUST Data

This study used the 2013 wave of data from the PSID's DUST Supplement. The PSID is a longitudinal study that began in 1968 with a nationally representative sample of approximately 5,000 families. The PSID interviewed members of core families annually from 1968 to 1997 and biennially thereafter. In 2013, the PSID conducted a supplementary study that included innovative time-use modules to understand the daily activities of older adults and their allocation of time.[1] All the PSID households were eligible for the DUST 2013 if either the household head or the spouse had been 60 years of age or older as of December 31, 2012. If the household head was married or cohabitating, his or her partner was also eligible. In total, 1,776 individuals were included the 2013 DUST data. I eliminated older adults who were not household heads, such as those who were identified as spouses, but I was not able to find information regarding household

heads in the 2013 DUST dataset. Therefore, I eliminated older adults in households for which there was no information about whether they were or were not the household heads. This led to a sample size of 1,693.

Measures of Sleep Problems

This study measured sleep problems in two ways: 1) insufficient sleep and 2) difficulty falling asleep. First, I calculated the durations of nighttime sleep in the older adults, which were defined, according to the approach of a previous time-use study, as the total lengths of time for the longest sleep episode (Antillon, Lauderdale, & Mullahy, 2014). This excluded naps and short-term sleep. Next, I created an indicator of insufficient sleep. Older adults who slept less than six hours were considered to have insufficient sleep (Krueger and Friedman 2009). Because each older adult completed two time diaries, I had two indicators for insufficient sleep: one for weekdays; another for weekends.

In addition, the DUST questionnaires included a question about difficulty falling asleep if a respondent reported sleep as either the first activity or last activity of the day. The question was "Did it take you more than half an hour to fall asleep?" The answers were "yes" or "no." This simple question captures one key aspect of insomnia: the ability to initiate sleep. Although it is simple, this question was able to provide important information about the older adults' sleep problems.

Exposure to Poverty

The main PSID survey included a full history of each family's income.[2] Using information about total family income,[3] I created binary indicators of each family's poverty

status for all of the survey years based on the federal poverty line that uses total pretax family income and adjusting for family size. Because families whose total incomes were above the 100% federal poverty line but below the 133% federal poverty line were considered to be economically disadvantaged and were eligible for social welfare benefits, I used the 133% federal poverty line as the cut-off point for poverty in this study. I defined current poverty as being classified in the poverty category for the 2013 survey year. For long-term poverty, I traced a family's poverty history over the previous five-year period. In other words, I traced each family's poverty status back-to-back to the 2009 survey year for all the respondents in the 2013 DUST. Ideally, I would have been able to trace the poverty trajectories of nearly all older adults back to 1968, the year when the PSID survey began. The decision to trace the families' poverty histories for up to five years was guided by two factors. First, given the moderate sample size of the 2013 DUST, I was able to identify only a very small number of older adults who were consistently living in poverty for more than five years. This did not allow me to make empirical estimates of the effects of exposure to poverty for more than five years. Second, prior demographic research suggests that the majority of poor older adults experience spells of poverty that last for less than five years (Sandoval, Rank, & Hirschl, 2009). The five-year cut-off point still allowed me to capture the experiences of older adults whose poverty spells were *longer* than the average. Therefore, while this approach may underestimate the impact that very long-term exposure to poverty has on sleep problems, examining the effect of five years of exposure can still provide valuable insights into the long-term effects of poverty on the sleep of older adults.

Covariates and Inverse Probability Treatment Weights

This study included a rich set of covariates from the core PSID and 2013 DUST that could confound the associations between poverty and sleep. The time-invariant covariates included gender, race, years of education, and the season of the interviews. The time-varying covariates included age, marital status, years of education, employment status, hours of work, homeownership, self-rated health, residential location, and state of residence. In addition, I included several family-level characteristics: age, gender, and race of the household head, type of household (single, married couple only, others), number of adults in the family unit, number of children under 18 in the family unit, number of older adults employed in the family unit, number of older adults with high level of psychological distress in the family unit, number of older adults with functional limitations, residential area of the family unit (i.e., an eight-category indicator of rural-urban residential location). The 2013 DUST included a set of six functional limitation questions that was developed for the U.S. Census (Weathers, 2005). The respondents were asked if they had serious difficulty with the following actions: seeing, even when wearing glasses; concentrating; remembering or making decisions; walking or climbing stairs; dressing or bathing; and doing errands alone. I created a dichotomous indicator for the presence of any disability and added up the number of older adults with functional limitations living in the same family unit. This module was available only in the 2013 DUST, making it equivalent to a time-invariant covariate. Beginning in 2005, the PSID added the K6 psychological distress scale to the main survey. I used the cut-off point of 19 to distinguish between high-level and low-level psychological distress (Kessler et al., 2003) and added up the number of older adults with high level of psychological distress in the same family unit. Appendix A summarizes these covariates.

STATISTICAL APPROACH

Traditional Regression Model

I started with a cross-sectional analysis that estimated the relationship between current poverty status and problem sleep. Because most of the respondents' spouses were also in the DUST surveys, I used a multilevel model that links poverty status to sleep to account for the nested nature of the data. The first level was individual; the second level was family. Specifically, I modelled problem sleep, Y, as a function of household poverty status, T, with family-level covariates, X, and individual-level characteristics, Z:

$$Y_{ij} = \alpha + \beta T_{ij} + \gamma X_j + \delta Z_{ij} + \varepsilon \cdots\cdots (1)$$

To estimate the relationship between long-term exposure to poverty and sleep, I expanded the above model. I formulated problem sleep, Y, as a function of the duration of the exposure to poverty, TD, the history of family-level covariates, XH, and the history of individual-level characteristics, ZH. The following equation specifies the model:

$$Y_{ij} = \alpha + \beta TD_{ijt} + \gamma XH_{jt} + \delta ZH_{ijt} + \varepsilon \cdots\cdots (2)$$

Counterfactual Models for Poverty Exposure and Sleep

As previously described, estimating the causal effects that exposure to poverty has on sleep was challenging. The traditional regression models outlined above are vulnerable to several problems and may produce biased estimates. First, the estimates from both models are vulnerable to the threat of confounders. Second, when estimating the long-term effects, there is an additional problem of *over control* of the indirect pathways through which long-term exposure to poverty affects sleep. In statistics literature, this is described as the collider problem (Cole et al.,

2010). This study used the counterfactual model approach to address these issues and to define causal effects. In the following section, I describe the counterfactual model used to estimate the effects of current poverty exposure and long-term poverty exposure on older adults' sleep.

Counterfactual Model for Current Poverty Exposure. The counterfactual approach that was developed in statistics in the past several decades helps research work in the social sciences to make causal inferences with observational data. One method that is commonly used in practice is the propensity score method. Propensity scores represent the conditional probability of receiving a treatment given observable characteristics. In experiments, the probability of receiving a treatment is known to the researchers. However, in observational data, propensity scores are unknown and need to be calculated. For this study, I calculated the conditional probability of being in the poverty category, given the observed individual- and family-level characteristics. To reduce the chance of model misspecification, I used the machine learning, CART, approach to calculate the propensity score. I then calculated the inverse probability treatment weight, which is the inverse of the estimated conditional probability. I combined regression-adjustment with propensity score weighting to estimate the effects of current poverty on the sleep of older adults. This approach, the "doubly robust estimator," reduced the chance of biased estimates and model misspecification compared to a situation in which only regression or propensity score weighting is used (Funk et al., 2011).

Counterfactual Model for Current Poverty Exposure. I then turned to the effects of long-term exposure. The collider problem refers to the fact that a traditional regression model may over-control time-varying covariates. Figure 1 illustrates this issue. In the diagram, Y is the outcome, X is a time-varying control variable, and T is the treatment. Subscript 1 represents

variables at time 1, and subscript 2 represents the subsequent time period. U is an unobserved variable that affects T2 and Y. It is important to note that X2 is a confounder because it predicts not only treatment T2 but also outcome Y (directly and through U). X2 is also affected by prior treatment T1. The presence of X2 poses a challenge. On the one hand, since X2 is a confounder, it should be controlled in the regression. On the other hand, since earlier treatment T1 affects X2, controlling it may eliminate the effect of earlier treatment on the outcome. Either way, we have biased estimates of longitudinal exposure to household poverty.

The MSM used the IPTW technique to adjust for time-varying confounding. The intent of the MSM method was to generate a pseudo-population in which exposures to household poverty were sequentially independent of, although not confounded by, prior observed covariates. Thus, the approach simultaneously solved the issue of confounding by and over-controlling for the observable time-varying covariates. The IPTW was obtained by calculating the probability that a family was exposed to its actual poverty category at wave t, conditional on past treatment and confounders. In calculating the weight for each time period, the approach balanced treatment assignment across prior confounders. The weights obtained by this procedure, however, may yield imprecise estimates. To improve the statistical properties, I followed the standard practice of the MSM literature and used stabilized weights.

$$IPTW_{ijt} = \prod_{t=1}^{T} \frac{P(T_t = t_{it} | T_{it-1}, X_{i1})}{P(T_t = t_{it} | T_{it-1}, X_{it-1})} \cdots\cdots (3)$$

Here, t indexes time, i indexes the individual, and j indexes the family. $T_{ijt} = t_{ijg}$ is the actual treatment received for individual i in family j during time period t. X_{ijt} is a vector of time-invariant and time-varying covariates at both the individual and family levels. The numerator can

be interpreted as an individual's conditional probability of receiving his or her own observed treatment up to time t, given past treatment and baseline covariates. The denominator can be viewed as the conditional probability of receiving an individual's observed treatment up to time t, given past treatment, and the history of all covariates. Under the assumption of sequential ignorability, meaning no unmeasured confounders, and no misspecification of the model, the IPTW regression produces unbiased and consistent estimates of the treatment effect. I addressed these assumptions in two ways. First, while the assumption of no unmeasured confounders can to be tested, the PSID and 2013 DUST data contain a wide range of information about the respondents and their families. I included an extensive set of demographic, family, health, and social factors in the calculations of the weights. This may ease some of the concerns. Second, I used the machine-learning approach, the CART technique, to detect the optimal model specification for estimating propensity scores (Lee, Lessler, & Stuart, 2010). In this way, I minimized the risk of model misspecification.

Appendix B shows statistics for the stabilized weights for estimating the effects of current poverty and long-term poverty on sleep. All of the weights were estimated using the CART technique. The table shows that stabilized weights were well behaved. They centered around one and were not very variable. Following the convention in the MSM literature, I bottom-coded the 1st percentile and top-coded the 99th percentile of the stabilized weights to improve efficiency in the estimation and minimize the influence of outliers (Lauen & Gaddis, 2013; Wodtke, Harding, & Elwert, 2011).

RESULTS

Summary Statistics

Table 1 shows the summary statistics for selected social, demographic, and health characteristics of older adults in 2013 by duration of exposure to poverty. The table shows substantial differences in the characteristics of older adults who experienced different exposures to poverty. Also, as expected, the longer the exposure to poverty, the more disadvantaged the older adults were. Older adults with no exposure to poverty were more likely to be male, white, married, and have excellent or very good health ratings. They also had a higher level of education and a lower rate of depressive symptoms. In contrast, older adults who had been in poverty over the five-year period were more likely to be female, African-American, and single. Of the four groups, this one also had the lowest level of education and the lowest ratings in terms of self-rated health and mental health. These patterns suggest that older adults who were not exposed to poverty were different in almost every aspect of social, demographic, and health characteristics from older adults who were exposed to poverty. Many of these characteristics are also associated with sleep among older adults. Therefore, an analysis that does not consider these confounders may overestimate the effects of exposure to poverty on older adults' sleep outcomes.

Table 2 provides summary statistics for sleep among older adults in 2013 by duration of exposure to poverty. Panel A shows statistics for the weekday diaries, and Panel B shows statistics for the weekend diaries. Of the older adults who were not exposed to poverty, more than 10% reported insufficient sleep and difficulty falling asleep. Reported sleep problems, however, increased with the duration of the poverty spell. Of the older adults who were exposed to poverty for five years, 25% reported insufficient sleep on weekdays, and 20% reported insufficient sleep on weekends. Approximately 32% of older adults living in long-term poverty

reported difficulty falling asleep on weekdays. Table 2 suggests that sleep problems were quite prevalent in old age, in particular for older adults who experienced poverty. In addition, there were no significant differences between the prevalence of sleep problems on weekdays and on weekends, suggesting that problem sleep may not have been due to schedule differences between weekends and weekdays.

Regression Results of Exposure to Poverty on Sleep

Table 3 shows the effects of current poverty on insufficient sleep and difficulty falling asleep using three methods: an unadjusted model, a regression-adjusted model, and a stabilized IPTW model. Each number in Table 3 represents a result from a regression or analysis. Coefficients for the covariates were omitted to facilitate comparison of the estimated effects of different methods. Panel A shows results for the weekday diaries, and Panel B displays results for the weekend diaries. The results from the unadjusted model show that current poverty strongly predicted insufficient sleep and difficulty falling asleep in older adults both on weekdays and on weekends. The inclusion of the full set of covariates reduced these effects. After controlling for social, demographic, and health characteristics, current poverty no longer predicted insufficient sleep. However, current poverty remained a significant predictor of difficulty falling asleep even after controlling for a wide range of covariates. With respect to the results from the stabilized IPTW model, the effects were slightly reduced, but the results remained statistically significant (more precisely, marginally significant for difficulty falling asleep on weekdays). Specifically, the estimates showed that current poverty increased the odds of having difficulty falling asleep on weekdays by approximately 48% (exp(0.392)=1.480) and on weekends by 51% (exp(0.412)=1.510). Therefore, the results from Table 3 suggest that

current poverty led to an increased chance of having difficulty falling asleep but not to insufficient sleep.

Table 4 shows the effects that long-term exposure to poverty has on insufficient sleep and difficulty falling asleep. Similar to Table 3, for ease of comparison, I only presented results for the effects of long-term exposure. In addition, because the key interest here is to estimate the effects of long-term exposure on older adults' sleep, I did not present the results for a one-time exposure to poverty and a two-time exposure to poverty (available upon request). The results from the unadjusted model show that long-term exposure to poverty, once again, led to a higher likelihood of insufficient sleep and of difficulty falling asleep among older adults. However, most of the effects disappeared when I adjusted the full set of covariates in the regression. The only exception was difficulty falling asleep on weekdays. The regression-adjusted model suggested that exposure to poverty for five years led to an increase in difficulty falling asleep. When I applied the MSM to adjust the dynamic nature of the time-varying covariates, the results changed slightly. The results for having difficulty falling asleep on weekdays and on weekends were both marginally significant. Specifically, Table 4 shows that exposure to long-term poverty led to an increase of approximately 75% (exp(0.558)=1.750) in difficulty falling asleep on weekdays and of approximately 73% (exp(0.546)=1.730) on weekends. The results showed that long-term exposure to poverty increased the probability of having difficulty falling asleep and, therefore, had a negative effect on older adults' sleep initiation.

In addition to the main analysis, I performed further analysis to test whether the effects of current poverty and long-term poverty on insufficient sleep and difficulty falling asleep differed for men and women. The results (available upon request) show no gender differences in terms of

the effects of poverty on sleep. Therefore, there was little evidence to support the idea that sleep among men was more affected by exposure to poverty than sleep among women. Furthermore, I performed another sensitivity analysis by examining the effects of poverty on sleep duration (instead of using the binary indicator of insufficient sleep). The results (available upon request) show that current poverty and long-term exposure to poverty appear to increase sleep duration slightly, a finding that may be consistent with the prediction from the time allocation perspective. However, none of these effects were statistically significant at the 0.05 level.

Taking the results from Table 3 and Table 4 together, my analysis has shown that exposure to poverty, either over the short or long term, did not affect sleep duration by increasing or decreasing the likelihood of insufficient sleep among older adults. Nevertheless, exposure to poverty had a negative effect on older adults' sleep initiation by increasing the likelihood of experiencing difficulty falling asleep. Furthermore, the effect size for exposure to long-term poverty was greater than the effect size for current poverty. Therefore, poverty in old age appears to be more significant for the quality of sleep among older adults than for their sleep durations. Long-term poverty had a greater impact than current poverty on difficulty falling asleep.

DISCUSSION AND CONCLUSION

The prevalence of sleep problems increases with age. Various estimates show that 30–50% of older adults reported some type of sleep problem. However, whether and how social and family conditions lead to sleep problems in old age remains a relatively unexplored topic. Given the decline of financial well-being after retirement, it is essential to understand the impact of poverty on sleep in older adults. Using unique time-use data from the 2013 DUST and rich

information from the core PSID, this study examined the relationship between poverty and sleep in the general population of older adults. The study asked two key questions. First, does current poverty affect the sleep duration and sleep quality of older adults as measured by insufficient sleep and also the difficulty they have falling asleep? Second, does long-term exposure to poverty affect sleep in older adults? The results, after using the MSM coupled with the CARD technique, show that poverty, both current poverty and long-term exposure to poverty, increased the likelihood among the elderly of having difficulty falling asleep. Long-term poverty had a greater negative effect than current poverty. I found no evidence that poverty caused insufficient sleep or reduced sleep duration in older adults. In summary, living in poverty does not cause older adults to sleep less but it makes older adults less likely to fall asleep.

It is important to note that patterns were consistent for weekdays and weekend days. Effect sizes were also similar. These results suggest that the negative impact that poverty has on the difficulty in falling asleep is not limited to the specific time or day. The challenges of living in poverty do not only appear in a specific day of the week. As discussed at the beginning of this article, poverty influences the ways in which older adults negotiate their sleep and generate stress from day to day. Nevertheless, it is unlikely that older adults sleep in the exact same conditions every day. This implies that minor changes in sleep-related practices, such as sleep-preparation behaviors and activities before sleep, and living conditions in homes, such as room temperatures, noise and light levels, and fresh air, have little effect in easing the consequences that poverty has on difficulty falling asleep. This study's results, therefore, point out that economic hardship is a fundamental factor for sleep in older adults. An over emphasis on the practice of sleep hygiene and the role of the physical sleeping environment in current sleep research (Patlak, 2005) overlooks the underlying social process that contributes to inequality in human sleep. Prior

studies in the sociological literature on sleep have demonstrated gender inequality as a fundamental cause of gender gaps in sleep (Burgard, 2011; Burgard & Ailshire, 2013; Maume, Sebastian, & Bardo, 2010). With the two-day design of DUST, results from this study add some nuance to the central concern of sociologists for socioeconomic status as a fundamental factor for individuals' health and well-being (Link & Phelan, 1995).

The non-effect of sleep duration may indicate that older adults strive to maintain normal sleep routines in the face of economic hardship. The coping strategies of older adults may, therefore, explain why poverty did not lead to inadequate sleep. The exercise of human agency in adapting to adverse events has been widely observed in sociological studies (Mendenhall et al., 2008). However, the negative effect that poverty has on the difficulty that older adults experience falling asleep indicates that they are not as totally autonomous as the sleep researchers assumed (Patlak, 2005). In fact, if older adults are able to adopt sleep-promoting behaviors as they wish, we would not expect to observe that poverty has a negative effect on sleep. The relationship between poverty and difficulty falling asleep, however, implies that the abilities of older adults to exercise human agency are socially and culturally constrained (Elder, 1994; Thoits, 2006). Not all coping strategies will be successful (Thoits, 2006). Older adults who live in poverty may find it relatively easy to keep their bedtimes and wake-up times. However, the sleep behaviors that facilitate getting to sleep are more difficult for older adults to do in the face of economic hardship. Also, although physicians recommend that individuals slow down and relax prior to going to bed (Patlak, 2005), this may not be easy when older adults are consistently exposed to the stresses brought upon them by poverty. How can older adults relax before going to sleep if they have no money to buy food or pay the bills that are due in the next few days? Furthermore, these issues may be exacerbated by the decline in social networks and supports as people age

(Cornwell, Laumann, & Schumm, 2008). Older adults have fewer social resources to enhance their abilities to cope successfully with stress from poverty and to invoke strategies to facilitate getting to sleep. Findings from this study reveal the complex processes through which economic hardship and the aging processes constrain sleep-enhancing behaviors in different ways. The differential relationships between poverty and two sleep measures can be considered as the consequences of older adults exercising human agency in responding to economic hardship under their social constraints. From this perspective, it is also suggested that the biological and medical community need to reconsider their presumption regarding the autonomous human agent in their recommendations for sleep hygiene.

Finally, this study provides a new insight into an understudied behavioral risk factor that is connected to chronic diseases and mortality. Biological evidence has linked shorter sleep duration to higher risks for diabetes and heart disease (Gangwisch et al., 2007; Phillips & Mannino, 2007). Many epidemiological studies have observed associations between shorter sleep durations and higher rates of diabetes, coronary heart disease, and mortality (Cappuccio et al., 2010a; King et al., 2008). In this respect, it is possible that the influence of poverty on the physical health of older adults operates through the way poverty influences sleep outcomes. The results from this study provide the very first evidence for this hypothesis. Since I found evidence that both current and long-term poverty increased the probability of experiencing difficulty falling asleep, these findings imply that the relationships between poverty and physical health in old age may operate through the decline of good sleep. Nevertheless, since I did not test this mechanism directly, future studies with longitudinal data on economic well-being, sleep, and morbidity/mortality may provide additional empirical evidence on this issue.

In spite of the fact that the study used innovative data and advanced statistical techniques for causal inference, it has several limitations. First, the 2013 DUST sample is not a nationally representative sample of older adults. Therefore, the study's findings may not be generalizable to the elderly in the United States. However, the 2013 DUST collected sleep information for a sample of the general population of older adults, which is a significant improvement on many studies that relied on clinical or convenience samples to examine sleep in older adults. Consequently, the findings from this paper still provide valuable insights into the effects of poverty on sleep outcomes in old age.

Second, since 1997, the PSID interviews have been conducted biennially. Income and poverty information for the year between the two interview years was not available. As a result, I may have overestimated the number of older adults who were exposed to long-term poverty because I was unable to capture potential changes in poverty status between two waves. The impact that long-term poverty has on difficulty falling asleep might be smaller if some of the older adults in the group did not experience poverty during the non-interview years. However, Table 1 presents significant differences in terms of almost all aspects of social, demographic, and health characteristics between older adults who were exposed to long-term poverty and older adults who were exposed to poverty once or twice. I believe the majority of older adults in the long-term poverty category were actually exposed to poverty over the five-year period. Therefore, the lack of poverty status for the non-interview years may not seriously bias the results.

Third, measurement error may affect my estimations. I may have overestimated older adults' sleep durations because it is very difficult to obtain accurate information of older adults'

wake times after sleep onset. The effects of poverty on sleep may be stronger if the measurements of sleep captured older adults' actual sleep durations more accurately. In addition, the 2013 DUST did not capture all the important aspects of sleep that may be affected by poverty. For example, the DUST did not include measures of sleep consolidation, which is an aspect of older adults' sleep that previous studies have demonstrated as being the most likely to be affected by social conditions (Chen, Lauderdale, Waite, 2015; Chen, Waite, Lauderdale, 2016). The DUST also did not have information about restfulness, which is an important indicator of insomnia. Better sleep measures in future waves of data collection may not only reveal that poverty has stronger effects on sleep but also help to provide an in-depth understanding of the relationship between poverty and different aspects of sleep in old age.

Finally, the changes in the sampling rules between the 2009 pilot wave of DUST and the 2013 DUST make it difficult to perform a longitudinal study of older adults' sleep and to employ alternative longitudinal methods, such as the fixed-effects model, for causal inference. Again, future data collections that carefully follow respondents in the 2013 DUST may provide essential data to explore the critical question of how older adults' sleep changes over time as a result of their changes in economic well-being.

Limitations notwithstanding, this is one of the very first systematic studies to examine the relationship between poverty and sleep. In particular, this paper has improved upon prior studies of sleep among older adults by 1) adopting advanced statistical techniques and 2) carefully considering the impact of the dynamic nature of economic well-being on insufficient sleep and difficulty falling asleep. This study documented an important but often neglected consequence of poverty in old age: sleep. The findings reveal that sleep is regulated by the household

socioeconomic context, which is similar to other health behaviors. Furthermore, since older adults' sleep health is increasingly recognized as a critical public health issue, the findings from this study offer a different perspective on and sociological solution for improving sleep health in older adults (Thoits, 2010). In addition to medications and psychotherapies, programs and initiatives that help to alleviate poverty in old age may also benefit older adults' sleep outcomes. Finally, the findings from this project may also energize the sociological approach to studying sleep, a topic that is currently receiving little attention in the field of sociology. The role of sleep as both a health behavior and an intimate behavior makes it a potential topic for medical sociology and sociology of the family. This study demonstrates to researchers that sleep is an important health behavior that is also regulated by social processes, and it encourages other nationally representative population surveys to collect data on sleep so that deeper future study is possible. In summary, the study provides the very first evidence that poverty affects the sleep quality of older adults by increasing their probability of experiencing difficulty falling asleep; this finding has the potential to inform policy for the estimated over 4.2 million older adults in the U.S. who are poor (Census Bureau 2014).

Table 1: Summary Statistics of Selected Time-Invariant and Time-Dependent Characteristics in 2013 by Duration of Exposure to Poverty

	No Poverty Exposure (Mean or Proportion)	**One-Time Exposure** (Mean or Proportion)	**Two-Time Exposure** (Mean or Proportion)	**Long-Term Exposure** (Mean or Proportion)
Time-Invariant Characteristics				
Current poverty	0	0.43	0.71	1
Male	0.46	0.37	0.33	0.23
Race and ethnicity				
White	0.81	0.57	0.47	0.31
African-American	0.13	0.37	0.39	0.65
Hispanic	0.05	0.02	0.06	0.04
Other	0.01	0.04	0.08	0.01
Years of education	14.06	13.22	12.13	10.92
DUST interview season				
Fall	0.38	0.35	0.46	0.41
Winter	0.14	0.14	0.08	0.10
Spring	0	0	0	0
Summer	0.48	0.50	0.46	0.49
Number of disabled older adults in 2013	0.43	0.50	0.71	0.73
Time-Dependent Characteristics				
Age in 2013	66.06	66.38	66.72	68.89
Married in 2013	0.77	0.48	0.40	0.20
Hours of work per week	18.18	11.61	6.64	3.31
Self-rated health				
Excellent	0.12	0.15	0.06	0.02
Very good	0.37	0.26	0.19	0.15
Good	0.33	0.32	0.31	0.27
Fair	0.15	0.19	0.33	0.36

Poor	0.03	0.09	0.11	0.20
K6 scale	8.14	8.82	9.37	9.84
Number of adults	1.96	1.81	1.88	1.47
Number of children	0.16	0.27	0.28	0.43
Sample size	1311	160	89	133

Table 2: Summary Statistics of Problem Sleep by Duration of Exposure to Poverty (N=1693)

	No Poverty Exposure (Proportion)	**One-Time Exposure** (Proportion)	**Two-Time Exposure** (Proportion)	**Long-Term Exposure** (Proportion)
A: Weekday Diary				
Insufficient sleep	0.18	0.18	0.21	0.25
Difficulty falling asleep	0.15	0.17	0.20	0.32
B: Weekend Diary				
Insufficient sleep	0.14	0.19	0.16	0.20
Difficulty falling asleep	0.12	0.18	0.25	0.24
Sample size	1311	160	89	133

Table 3: Effects of Current Poverty on Insufficient Sleep and Difficulty Falling Asleep (N=1693)

	Insufficient Sleep Log odds ratio (S.E.)	**Difficulty Falling Asleep** Log odds ratio (S.E.)
A: Weekday Diary		
Unadjusted model	0.360 (0.161)*	0.755 (0.164)***
Regression-adjusted model	0.131 (0.202)	0.528 (0.208)*
Stabilized IPT weighted	0.206 (0.222)	0.392 (0.224)†
B: Weekend Diary		
Unadjusted model	0.297 (0.175)†	0.847 (0.172)***
Regression-adjusted model	-0.001 (0.219)	0.447 (0.221)*
Stabilized IPT weighted	-.117 (0.241)	0.412 (0.235)*

Note. † P<.1, * P<.05, ** P<.01, *** P<.001. The regression-adjusted model controlled for the full set of covariates. The stabilized IPT weighted results employed the doubly robust estimator by weighting the regression using the stabilized weights and including the full set of covariates. Coefficients for the covariates were omitted to facilitate comparison of the estimated effects of different methods.

Table 4: Effects of Long-Term Exposure to Poverty on Insufficient Sleep and Difficulty Falling Asleep (N=1693)

	Insufficient Sleep Log odds ratio (S.E.)	**Difficulty Falling Asleep** Log odds ratio (S.E.)
A: Weekday Diary		
Unadjusted model	0.418(0.213)*	0.991 (0.212) ***
Regression-adjusted model	-0.016 (0.269)	0.695 (0.276)*
Stabilized IPT weighted	0.140 (0.313)	0.558 (0.310)†
B: Weekend Diary		
Unadjusted model	0.445 (0.230)†	0.829 (0.231)***
Regression-adjusted model	0.033 (0.289)	0.445 (0.294)
Stabilized IPT weighted	0.129 (0.324)	0.546 (0.324)†

Note. † P<.1, * P<.05, ** P<.01, *** P<.001. The regression-adjusted model controlled for the full set of covariates. The stabilized IPT weighted results employed the doubly robust estimator by weighting the regression using the stabilized weights and including the full set of covariates. Coefficients for the covariates were omitted to facilitate comparison of the estimated effects of different methods. Because the key interest was to estimate the effect of long-term exposure to poverty on older adults' sleep, the results (available upon request) for one-time exposure to poverty and two-time exposure to poverty are not presented in Table 4.

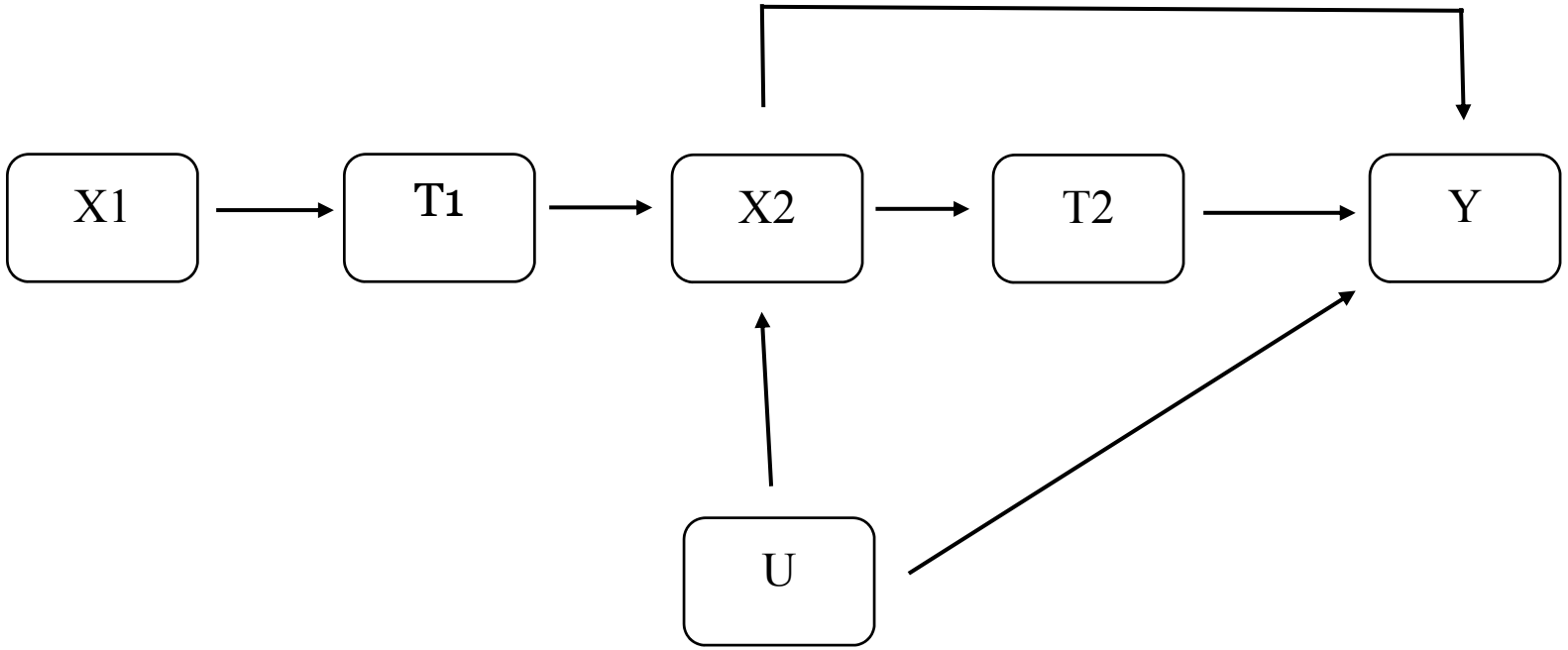
Appendix A: Predictors of Treatment (Poverty) in Each Wave

2013 Poverty	2011 Poverty	2009 Poverty
Time-Invariant Covariates		
Household head race	Household head race	Household head race
Household head education	Household head education	Household head education
Female-headed household	Female-headed household	Female-headed household
Time-Varying Covariates		
2013 Household head age	2011 Household head age	2009 Household head age
2013 Family type (marital status)	2011 Family type (marital status)	2009 Family type (marital status)
2013 Number of adults in household	2011 Number of adults in household	2009 Number of adults in household
2013 Number of children in household	2011 Number of children in household	2009 Number of children in household
2013 Number of adults rated in poor health	2011 Number of adults rated in poor health	2009 Number of adults rated in poor health
2013 Number of adults with depression	2011 Number of adults with depression	2009 Number of adults with depression
2013 Number of adults with disability	2011 Number of adults with disability	2009 Number of adults with disability
2013 Number of adults working	2011 Number of adults working	2009 Number of adults working
2013 Home ownership	2011 Home ownership	2009 Home ownership
2013 Residential area	2011 Residential area	2009 Residential area
2011 Poverty indicator	2009 Poverty indicator	
2009 Poverty indicator	2009 Time-varying covariates	
2011 Time-varying covariates		

Appendix B: Statistics of Stabilized Weights

			Percentiles			
Weight	**Mean**	**SD**	**1st**	**25th**	**75th**	**99th**
Current poverty stabilized weight	1.22	0.68	0.39	0.78	1.48	3.04
Long-term poverty stabilized weight	1.32	1.12	0.21	0.57	1.66	4.52

Figure 1. Causal Graph for Long-Term Exposure to Household Poverty



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Endnotes

[1] In 2009, the DUST sampled older couples in the PSID who met the following criteria: (1) both spouses were 50 or older as of December 31, 2008, and (2) at least one spouse was 60 or older. Non-married, cohabitating couples were excluded. The process identified 832 eligible couples, sampled 543 couples, and had 394 couples (788 individuals) with at least one complete time diary. This study did not use the 2009 data for two reasons. First, the 2009 DUST was considered the "pilot wave". As such, it had a much smaller sample (N=755) and more restricted sample selection rules. It sampled only married older adults, which meant that the 2009 DUST sample included fewer economically disadvantaged households. Given these reasons, the present study focused on the 2013 DUST.

[2] The definition of family unit and household unit in the PSID requires some clarification. According to the PSID website (2016), a family unit is "a group of people living together as a family. They are almost always related by blood, marriage, or adoption. And they must all be living in the same household unit". Occasionally, unrelated persons can be part of a FU. They must be permanently living with the family and share both income and expenses. Any person in a study family is a family unit member. The term "other family unit member" (OFUM) refers to members who are not the head or wife/"wife". The household unit (HU) is the physical dwelling where the members of the FU reside. It can be a house, townhouse, apartment, a room in a rooming house, or even a tent or a car. Not everyone living in an HU is automatically part of the FU. There may be other people living in the HU temporarily who do not meet the criteria of relatedness and economic integration. The PSID data is about FU members only.

[3] This variable is generated by the PSID survey team by summing all sources of income for family members. Total family income includes a family's (1) head and wife taxable income (2) head and wife transfer income (3) taxable income from other family members, (4) transfer income from other family members, (5) head social security income, (6) wife social security income, and (7) social security income from other family members. The survey team imputed missing data such that there are no missing values for total family income. When performing the imputation, each income source was imputed separately by the PSID team (Duffy, 2011). This imputation did not include benefits from means-tested programs including SNAP. It also did not consider the assets of a family. It is worth noting that the PSID collected income information for the prior tax year, not the survey year.