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ESTIMATING DISPARITIES USING STRUCTURAL EQUATION MODELS

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Abstract

This paper advances an analytic approach to analyzing the full impact, both direct and indirect, of disparities by race, ethnicity and gender using structural equation modeling (SEM) and demonstrates its empirical application for adults ages 55-64 across a range of outcomes related to disability, Social Security Disability Insurance (SSDI) applications, and SSDI participation.

The paper found that:

- Based on survival analysis, non-Hispanic Blacks and Hispanics are at higher risk of becoming disabled than non-Hispanic whites, but conditional on being disabled, there is no substantial difference in the risk of applying for and receiving SSDI benefits by race and ethnicity. Women and men seem to follow similar patterns with respect to their risk of becoming disabled and applying for and receiving SSDI benefits.
- Focusing on the direct link only and controlling for demographic and socioeconomic factors, we find that the risk of becoming disabled or applying for SSDI benefits does not differ by race, ethnicity or gender. Accounting for both direct and indirect pathways, however, we find that all people of color are substantially more likely than non-Hispanic whites to become disabled and non-Hispanic Blacks are more likely to apply for SSDI benefits.
- Overall, the likelihoods of experiencing a new disability, being disabled, and receiving SSDI benefits are substantially and statistically significantly higher for people of color than for their non-Hispanic white peers. Additionally, non-Hispanic Black older adults have an elevated risk of applying for and taking up SSDI benefits.
- In contrast, even accounting for indirect links, differences between women and men remain limited, with women being somewhat more likely to be disabled but less likely to receive SSDI benefits.

The policy implications of the findings are:

- The application of SEM methodology can advance SSA's understanding of the full impact of disparities by race, ethnicity and sex on a range of outcomes and demonstrate the extent to which traditional modeling approaches may misrepresent these disparities.

Introduction

While traditional regression analysis provides us with important insights about the relationship between outcomes and predictors of interest, it also faces various limitations that can, depending on context, substantially impact the validity of its insights. Arguably key among such limitations is its focus on the direct impact of predictors on outcomes and its inability to account for various possible indirect pathways through which some predictors may affect the outcomes. This could be particularly relevant for demographic characteristics such as race and ethnicity or gender, which are known to be correlated with health and socioeconomic factors. For example, various health measures are among the key predictors of older adults' wellbeing (e.g., Lee and Kim 2008; Meer, Miller, and Rosen 2003) as well as applications for and participation in federal programs such as Social Security Disability Insurance (SSDI), but health often varies systematically by race and ethnicity and by gender, among other characteristics (Angel, Mudrazija, and Benson 2016; Read and Gorman 2010). Failing to account properly for the complex relationship between model predictors can produce inaccurate inferences, thereby limiting the usefulness of such research for effective policy design and interventions. Because of their traditionally disadvantaged position in the labor market and, relatedly, socioeconomic vulnerability, this can have particularly important implications for women and people of color.

One possible solution to this problem is to use structural equation modeling (SEM). SEM represents a flexible class of models that consists of multiple equations in which the outcome variable in one equation can appear as a predictor in another equation, thereby allowing researchers to account for both direct and indirect impacts of key predictors, such as race/ethnicity and gender, on the outcomes of interest rather than just capturing the direct impacts as is the case with the traditional (single-equation) regression approach. SEM even allows for variables to affect each other reciprocally, either directly or indirectly, through a feedback loop. Not only does SEM account appropriately for the full impact of a predictor, but it also helps explain the exact path of its association with the outcome, including the impact on "intermediate" outcomes, that is, variables that mediate its impact, which can provide policymakers with a much better understanding of the nature of various relationships and how targeting any of them may have secondary consequences on other outcomes.

This paper advances an analytic approach to analyzing the full impact, both direct and indirect, of disparities by race/ethnicity and gender through the application of SEM

methodology. Following an overview of the foundations of SEM, the paper reviews its prior use, and compares its insights with those gained using traditional regression analysis. The core of the paper focuses on demonstrating the empirical applications of SEM across a range of outcomes related to disability, SSDI applications, and SSDI participation.

Background

SEM is not new: its use in natural sciences started in the first half of the 20th century, and the social sciences have been using it increasingly over the past half century (Tarka 2018). In the simplest sense, SEM is a system of multivariate regression models that represents an extension of the standard (single-equation) regression by introducing multiple outcomes (Pakpahan, Hoffmann, and Kröger 2015). Because independent/predictor variables in one model can be dependent/outcome variables in another model, the variables are usually labeled as either endogenous or exogenous (Bollen and Noble 2011). Endogenous variables are predicted by other variables in the model and therefore appear as an outcome in at least one equation, while exogenous variables are not determined by any other variable included in any of the equations. In this sense, the origins of SEM can be traced to path analysis, an analytic approach developed to understand the relationship between multiple variables with both direct and indirect causal links (Fan et al. 2016). SEMs can be further augmented by including latent variables alongside observed variables, allowing users to account for theoretical concepts of interest even in the absence of their direct measures in the data and to avoid confounding the effects with the measurement error (Bollen and Noble 2011). In other words, with latent variables users can account for information that is critical for correctly specifying the model without having an actual variable that includes such information.

This combination of the measurement model, which relies on confirmatory factor analysis to assess how well the available variables describe the unmeasured underlying construct and to refine the model if necessary, and the structural model, which focuses on describing the links between various endogenous and exogenous variables, is arguably among the key advantages of SEMs (Weston and Gore 2006). Jointly, they provide an unparalleled opportunity to model simultaneously multiple linked outcomes, estimate direct, indirect, and total effects for variables of interest while accounting for measurement error in latent concepts (Pakpahan, Hoffmann, and Kröger 2015). In practice, SEM fitting is generally an iterative process that

proceeds with the initial model specification, estimation, and evaluation, followed by possible modifications and repeating the initially pursued steps. An essential part of this process is a conceptual diagram that lays out the relationship between all variables included in the SEM framework, and should be directly translatable into estimated model specifications (Ullman and Bentler 2013). The decision to include or exclude relationships between variables of interest is consequential, with the error of omitting a relationship that exists (and falsely assuming that one controlled successfully for confounding) much more detrimental than including a nonexistent relationship (VanderWeele 2012).

Overall, then, SEM is a flexible and powerful modeling approach that can lead to important new insights. Although it produces more results than a traditional single-equation model, its interpretation is not substantially more complicated other than the fact that the total impact of a predictor of interest is additive because it incorporates both direct and indirect impacts on the outcome of interest. However, the flip side of this flexibility and power is its strong underlying assumptions. Because of its multi-equation structure, assumptions about model functional form, data distribution, or possible confounding are carried over across all models rather than being limited to a single equation (VanderWeele 2012). For this reason, it is important to carefully weigh the costs and benefits of its use.

Studies on Race/Ethnicity, Gender, and Disability

Racial disparities in health and disability have been well documented, showing that Black adults have the highest rates of functional limitations, followed by whites, Hispanics, and Asians (Goodman, Morris, and Boston 2017; Mahajan et al. 2021). Accounting for nativity, one study found that most U.S.-born people of color, including Hispanics, have significantly higher levels of functional limitations and disability than U.S.-born white people (Melvin et al. 2014). These differences are relatively small at younger ages, but increase dramatically at older adults (Goodman, Morris, and Boston 2017). Nativity may, in part, explain the age pattern. One study found that foreign-born individuals, including both white people and people of color, have lower rates of functional limitations than U.S.-born white individuals in mid-life, but higher rates of functional limitations than U.S.-born white individuals in late-life. In contrast, most U.S.-born people of color have significantly higher rates of functional limitations than U.S.-born white people in both mid- and late-life (Melvin et al. 2014).

Most studies find that differences in socioeconomic status help to explain racial disparities in health and disability (Bowen 2009; Goyat, Vyas, and Sambamoorthi 2016; Shipeolu et al. 2023). Some studies find that controlling for socioeconomic status accounts for all racial disparities in disability (Goyat, Vyas, and Sambamoorthi 2016), while other studies find that it accounts for about half of the racial disparities in disability (Shipeolu et al. 2023).

Importantly, studies find racial/ethnic differences in not only disability as an outcome but also in the disablement process (i.e., the pathway from chronic conditions to functional limitations). Quiñones et al. (2019) found that non-Hispanic Black older adults had higher initial chronic disease counts but lower rates of chronic disease accumulation than their non-Hispanic white counterparts. In contrast, Hispanics had lower initial chronic disease counts but higher rates of chronic disease accumulation than non-Hispanic whites. Based on these findings, the authors suggest the need to delay the onset of chronic diseases for non-Hispanic Black older adults and to slow the rate of accumulation of chronic diseases for Hispanic older adults.

SEM Studies on Race/Ethnicity, Gender, and Disability

SEM has been used previously to examine the relationship between race/ethnicity and/or gender and disability-related health outcomes, highlighting the important role that these demographic characteristics play as determinants of differences in disability. For example, Kail, Taylor, and Roger (2020) assessed whether the link between functional limitations and chronic health conditions varied by race and ethnicity, finding that Black and Hispanic adults experience a stronger association between the two, even after accounting for socioeconomic disparities between these racial/ethnic groups. On the other hand, pain has been more strongly associated with disability among white older adults than Black older adults (Horgas 2008). Focusing on Mexican American older adults, Peek and colleagues (2003) found the disablement process to proceed from the pathology to functional limitations and, finally, activity of daily living (ADL) disability, with gender (and age) having additional indirect effects on ADL disability. Among older women, muscle strength appears to mediate the relationship of physical activity and disability (Rantanen et al. 1999). Kelly-Moore and Ferraro (2004) considered the question of whether racial disparities in disability increase over the life course. They found that the racial gap persisted but did not increase after accounting for socioeconomic characteristics, social

integration, and other health indicators, and that the racial gap was no longer statistically significant after controlling for incident morbidity.

While not focusing directly on disability, many other studies use the SEM methodology to examine how health outcomes may vary by race/ethnicity and gender. For example, self-rated health is found to be a significant predictor of objective health decline, and self-rated health has been declining at a faster rate for Black than white adults (Ferraro, Farmer, and Wybraniec 1997). Focusing on sex-ethnicity differences in the role of depressive symptoms as a factor linking socioeconomic status with dietary quality and obesity among U.S. adults, Beydoun et al. (2009) found that SES is positively related to central adiposity (i.e., trunk body fat) for Black adults but inversely related to central adiposity for white women. Importantly, the authors found that the mediating effect of depression on the link between SES and dietary quality and obesity was significant for white adults—particularly white women. Depression among dementia caregivers, many of whom are middle-aged or older themselves, appears lower and overall well-being higher among Black caregivers compared to their white peers (Roth et al. 2008). Mahmoodi et al. (2022) found significant gender differences in the association of age and mental health outcomes, with the negative impact of age on happiness among older women only.

An overarching theme of these studies is that race/ethnicity and gender play an important role as distal causes of disability and other health outcomes for older adults. Moreover, using SEM methodology appears to be an important element in uncovering the true nature and the full extent of this relationship.

Data and Methods

Data and Sample

Data for the empirical analysis comes from the Health and Retirement Study (HRS), a nationally representative longitudinal survey of Americans over the age of 50. This dataset is appropriate for the analysis because it includes detailed information on the health status of respondents and SSDI disability episodes, as well as rich information on their demographic and socioeconomic characteristics. We focus on adults aged 55-64 since they are both continuously represented in the HRS and below the age when they would typically start collecting retirement Social Security benefits. We also keep in the sample only those with non-missing information on all covariates of interest and focus on the period between 1998 and 2020, resulting in a pooled

sample of 23,141 respondents and 72,475 person-years. In models where the sample is further conditioned on not having a disability and, alternatively, not having applied for or received SSDI benefits among those who are disabled, the analytic sample decreases accordingly.

Variables

We examine three outcomes of interest: disability, SSDI application, and SSDI receipt. Disability is an indicator variable equal to one if a respondent reported having a work-limiting health condition, any functional limitation (including both limitations with ADLs and with instrumental activities of daily living [IADLs]), or memory/cognitive disease. SSDI application is an indicator variable that captures whether a respondent applied for Social Security disability benefits, and SSDI receipt is an indicator variable that records whether a respondent receives disability benefits.

Poverty and food insecurity are endogenous variables in the models of disability, SSDI application, and SSDI receipt. Poverty is determined based on the official poverty level, which varies with household size, and food insecurity is a self-reported indicator for not having enough money for necessary food.

All models include a comprehensive set of exogenous variables. The two variables of key interest are race and ethnicity, which includes non-Hispanic white (reference category), non-Hispanic Black, Hispanic, and other non-Hispanic, and gender (coded as one if the respondent is a woman). Other variables include age (in years), nativity (coded as one if foreign born), relationship status (married/partnered, divorced/separated, widowed, and never married), educational attainment (less than high school, high school/GED, some college, and college or above), self-rated health (excellent/very good, good, and fair/poor), an indicator of having any health insurance coverage, and a period indicator (i.e., survey wave).

Analytic Approach

We demonstrate the empirical application of SEM in the study of several outcomes of interest: the prevalence of disability, the likelihood of applying for SSDI, and the likelihood of participating in SSDI. Before estimating these models, however, we provide a descriptive analysis of their links with race and ethnicity and gender. This includes examining changes in their association over time, as well as differences in survival patterns by race/ethnicity and

gender for the onset of the three outcomes of interest, and how these patterns differ from the expected ones.

Next, we turn to estimating the models. To explain the model specification, that is, the system of equations that we estimate for each of the outcomes of interest, we provide a visual depiction in Figure 1. We assume that race and ethnicity and gender have a direct effect as well as indirect effects, through their impact on poverty and food insecurity, on all three outcomes: the risk of becoming disabled,[1] the risk of applying for SSDI, and the risk of receiving SSDI.[2] Therefore, poverty and food insecurity, as endogenous predictors of disability, partly mediate the impact of race/ethnicity and gender. Even more so, because we expect that people in poverty are more likely to experience food insecurity, the indirect effect of race/ethnicity and gender on the three outcomes goes along the poverty-food insecurity-disability/SSDI application/SSDI receipt pathway as well as through the separate poverty-disability/SSDI application/SSDI receipt and food insecurity-disability/SSDI application/SSDI receipt pathways. Therefore, in addition to their direct relationship with the outcomes, we identify three additional indirect pathways that define the presumed total impact of race/ethnicity and gender on the three outcomes of interest.

We fit survival models for the onset of the three outcomes of interest, with logistic regressions for other (intermediate) outcomes, and calculate all indirect and total effects of interest. Additionally, we model the prevalence of disability and SSDI receipt, which includes not only newly disabled persons or new SSDI recipients, but also those who are disabled or are receiving SSDI benefits irrespective of when they became disabled or began receiving benefits.

[1] We consider anyone who reports a work-related disability, any functional limitation, or who has been diagnosed with memory/cognitive disease to be disabled and treat disability (in particular as it relates to respondents' ability to perform paid work) as an observed variable. It is possible, however, to conceptualize disability as an unobserved (latent) concept, which is a construct of these same and/or some other observed variables, in which case our depiction of SEM would include a measurement component alongside the structural component.

[2] Key relationships of interest are depicted with solid lines, while other relationships are depicted with dashed lines.

Results

Descriptive Results

Over a period of two decades (1998-2020), the prevalence of SSDI receipt has been noticeably higher in the second half (2010-2020) than the first half (1998-2008), with the difference reaching almost three percentage points overall (Figure 2). Simultaneously, the prevalence of disability also increased, yet the magnitude of this increase was only about a third as much, tentatively suggesting that factors other than disability, such as the Great Recession, may partly account for the growth in SSDI receipt. Interestingly, poverty and food insecurity increased over the same period at a rate comparable (albeit slightly higher) than that observed for SSDI receipt.

This same trend can be generally observed across various subgroups defined by gender and race/ethnicity,[3] demographic characteristics of our particular interest. However, other than poverty among Hispanics, non-Hispanic Black older adults have experienced the largest increase in the prevalence of all four outcomes, with the magnitude of the increase in SSDI receipt (7.1 percentage points) just over twice as high as the increase in disability (3.4 percentage points). Trends for Hispanics are somewhat more distinct, with below-average increases in SSDI receipt and food insecurity, no increase in disability, but the highest absolute increase in poverty (8.5 percentage points), revealing both the possible greater economic vulnerability of Hispanics coupled with substantial resilience.

While these trends over time highlight possible important (and sometimes complex) relationships between these various variables, our main analytic interest is more closely related to trends over the biological passage of time, that is, aging, than the calendar passage of time. With this in mind, in Figures 3, 4 and 5 we examine the Kaplan-Meier survival curves for the onset of disability, as well as SSDI application and SSDI receipt conditional on being disabled, all stratified by race/ethnicity and gender. Overall, about a third of our sample develops some disability between ages 55 and 64, which is mostly attributable to newly self-reported work-limiting health conditions, and less so to the onset of ADLs, IADLs, or memory disease. Excluding other non-Hispanics, the risk of becoming disabled is higher for people of color than

[3] Here, as well as in Figure 6, we show results for the three main groups of older adults by race/ethnicity (non-Hispanic white, non-Hispanic Black, and Hispanic), and we omit the results for the other non-Hispanic category, which is smaller, has less reliable results, and has unclear substantive relevance given that it comprises people with varied origins and experiences.

for non-Hispanic whites, and the racial/ethnic gap increases with age (Figure 3, left graph). In addition, men have a slightly lower risk of becoming disabled than women, and the gender gap decreases slightly with age (Figure 3, right graph). The overall risk of applying for SSDI is about half of the risk of becoming disabled, and it appears somewhat higher for non-Hispanic Blacks than for other racial/ethnic groups at older ages (Figure 4, left graph). Simultaneously, the risk of applying for SSDI at the end the observation period is slightly elevated for men than women (Figure 4, right graph). Finally, the risk of receiving SSDI, which is overall about three quarters of the risk of applying for SSDI, is somewhat higher for non-Hispanic Blacks and lower for Hispanics than non-Hispanic whites (Figure 5, left graph). Men have a slightly higher risk than women of receiving SSDI, with the difference increasing by age (Figure 5, right graph). Overall, this analysis suggests that, in the absence of accounting for their personal characteristics, non-Hispanic Black and Hispanic adults aged 55-64 are at a higher risk than non-Hispanic white adults of becoming disabled, but there is no similar clear racial/ethnic difference in their risk of applying for or receiving disability benefits, conditional on disability. In addition, gender differences appear marginal in the absence of accounting for compositional differences between women and men.

These insights are further summarized in Figure 6, which shows the percentage difference in the expected and actual events of new disability, SSDI application, and SSDI receipt, by race/ethnicity and gender, where the expected events are from a log rank test for equality of the survival curves across racial/ethnic and gender groups for these outcomes. The results show that disability as well as SSDI applications and receipts are substantially higher than expected among non-Hispanic Black older adults. Among Hispanics, however, a higher-than-expected prevalence of disability is accompanied with a sharply lower-than-expected prevalence of SSDI applications and receipt, suggesting a disconnect between their disability status and disability-related support. Non-Hispanic whites have a lower-than-expected prevalence of disability and only marginal levels of discrepancy for SSDI application and receipt. Differences between expected and actual disability onset are negligible for both women and men. However, the prevalence of SSDI applications and receipt are lower than expected for women and higher than expected for men, albeit the magnitude of these discrepancies remains somewhat lower than that observed for non-Hispanic Black and Hispanic persons.

Inferential Results

We next turn to the SEM results for the onset of disability (Table 1). The model of direct effects suggests that there is no difference in the risk of disability onset by race and ethnicity once sociodemographic, economic, and health profiles of respondents are accounted for. This finding differs from the Kaplan-Meier survival curves that show a higher risk of becoming disabled for Hispanic and non-Hispanic Black respondents in our sample. Supplemental analysis (results not shown) suggests that the relationship status (for non-Hispanic Blacks), nativity status (for Hispanics), and educational attainment (for both groups) account for most of the observed difference.

Continuing with the direct effects, we also find no difference in disability risk by gender. In contrast, food insecurity and poverty are each independently strong predictors of disability, increasing the risk of its onset by 77 percent and 74 percent, respectively. Looking at other variables, being foreign born and better educated are associated with a lower disability risk, while being unmarried is associated with a higher risk of disability onset.

Relative to non-Hispanic whites, all other racial/ethnic groups have a substantially higher risk of disability onset indirectly through the food insecurity-disability pathway, poverty-disability pathway, and food insecurity-poverty-disability pathway. Consequently, once both direct and indirect effects are accounted for, non-Hispanic Blacks are more than three times, Hispanics nearly three times, and other non-Hispanics more than twice as likely to experience disability onset than non-Hispanic whites. In contrast to race/ethnicity, gender has no direct or indirect effect on disability onset.

In Table 2, we focus on the likelihood of having a disability, irrespective of when it started. Similar to the results for disability onset, there is no significant difference in the prevalence of disability between non-Hispanic white and non-Hispanic Black or Hispanic respondents when we control for other demographic characteristics. In contrast, other non-Hispanic respondents have a higher likelihood of being disabled, but since this group is smaller in size and consists of various subpopulations it is unclear whether this difference is substantively important. Indirect pathways (through poverty, food insecurity, and their combination), however, suggest a higher likelihood of disability for all people of color. Accounting for both direct and indirect effects results in large differences in disability prevalence by race and ethnicity, with the likelihood of being disabled about seven times higher for non-

Hispanic Black respondents and almost five times higher for Hispanic and other non-Hispanic respondents compared with non-Hispanic white respondents. Unlike the results for disability onset, we also observe differences in disability prevalence by gender, with women having a 40 percent higher likelier of being disabled than men after accounting for their higher likelihood of poverty and food insecurity.

Next, we turn to examining new SSDI applications, conditional on being disabled (Table 3). In this model, we do not observe any statistically significant direct relationship between new SSDI applications and race/ethnicity or gender. However, food insecurity and poverty are positively correlated with SSDI applications, and through them, race/ethnicity and gender are also positively correlated with SSDI applications. Because of this indirect link, the combined (direct plus indirect) risk of applying for SSDI is 66 percent higher for non-Hispanic Black respondents than for non-Hispanic white respondents. Although the risk is also higher for Hispanics and other non-Hispanic respondents than for non-Hispanic white respondents, and higher for women than for men, the estimated difference does not reach statistical significance at the conventional level.

Finally, in Tables 4 and 5, we show model results for new and any SSDI receipt, conditional on being disabled. Similar to the results for new SSDI applications, accounting for both direct and indirect effects, non-Hispanic Black respondents have a statistically significant higher risk (46 percent) of new SSDI receipt than non-Hispanic whites. In contrast, the estimated coefficients for Hispanics and other non-Hispanics do not reach statistical significance (Table 4). Although women have a lower direct risk of new SSDI benefit receipt, this relationship becomes statistically insignificant after accounting for indirect pathways linking gender with the outcome. Focusing on any SSDI receipt, we observe differences between direct and total effects by race/ethnicity and gender (Table 5). In the model tracking direct effects, we find that non-Hispanic Blacks are 37 percent and other non-Hispanics 28 percent more likely to receive SSDI benefits than non-Hispanic whites, and women are 31 percent less likely to receive SSDI benefits than men. However, food insecurity and poverty are both positively correlated with SSDI benefit receipt and being non-white and being a woman are both positively associated with food insecurity and poverty. Therefore, once these indirect effects are accounted for, the total estimated effects of race/ethnicity and gender increase substantially. The likelihood of receiving SSDI benefits is more than twice as high for non-Hispanic Blacks and 71 percent

higher for other non-Hispanics than for non-Hispanic whites. Hispanics also have a 24 percent higher likelihood of SSDI receipt than non-Hispanic whites—this total effect being positive and statistically significant whereas the direct effect was negative and not statistically significantly different from zero. Finally, the estimated coefficient for women remains negative and statistically significantly correlated with SSDI receipt, although its coefficient is somewhat attenuated compared with the coefficient in the model of direct effects.

Discussion

In this paper, our goal was to advance the use of the SEM methodology in the context of examining racial, ethnic and gender differences across three outcomes of interest: disability, SSDI applications, and SSDI receipt. We find that, accounting for both direct and indirect pathways and controlling for demographic and socioeconomic factors, the likelihoods of experiencing a new disability, being disabled, and receiving SSDI benefits are substantially and statistically significantly higher for people of color ages 55-64 than for their non-Hispanic white peers. Additionally, non-Hispanic Blacks older adults have an elevated risk of applying for and starting SSDI benefits. These findings differ somewhat from the descriptive results, which disregard compositional differences for different populations. They also differ from the direct results alone, which reflect regression estimates from the main models for each of the three outcomes of interest, but disregard the fact that race and ethnicity (and gender) are significantly correlated with poverty and food insecurity, two important determinants of disability and SSDI applications and benefit receipt. Using the SEM methodology, we are able not only to capture more appropriately the total effects but also can observe a rich spectrum of indirect results through multiple hypothesized pathways linking the outcomes of interest with predictors under study.

Applying methods such as SEM that allow for a flexible and rich representation of hypothesized relationships across many pathways is arguably growing in importance as we increasingly recognize the role of systemic and structural racism (and sexism) in perpetuating inequities in numerous areas of society, including health (Braveman et al 2022). Because of their presumed deep entrenchment in structures, policies, beliefs, and behaviors, as well as the interconnectedness of these different domains, we believe that traditional modeling approaches, predicated on the idea of "holding other things constant" may preclude researchers from

accounting appropriately for the full impact of personal characteristics such as race and ethnicity or gender on various outcomes. Moreover, the theory of intersectionality recognizes that people are often disadvantaged by several sources of discrimination, including their race and gender, and these different dimensions of identity compound and interact in different ways (Crenshaw 1989). Research has documented racial inequality in health outcomes, which Phelan and Link (2015) argue is tied to racism—directly because racism is a fundamental cause of health inequities and indirectly because racism is a fundamental cause of racial differences in socioeconomic status and socioeconomic status is a fundamental cause of health inequalities. Thus, the intersectionality of race/ethnicity (and gender), socioeconomic status, and health makes it difficult to disentangle their individual effects and increases the importance and need for capturing the impact of race/ethnicity (and gender) on outcomes in a rigorous way. For these reasons, SEM methodology offers one option for approaching modeling within a more flexible framework that can capture explicitly the interdependence of various (endogenous) variables and processes and account for both direct and indirect impacts of key predictors, such as race/ethnicity and gender, on the outcomes of interest.

While powerful, SEM methodology has limitations. In the measurement model, there is no guarantee that the latent variable is indeed an exact representation of the underlying construct (though it is likely a closer approximation than the corresponding observed variables), and SEM continues to be subject to some of the same weaknesses inherent to any analysis such as the lack of reliable data or poor research planning and design (Beran and Violato 2010). Indeed, it could be argued that the same limitations characteristic of traditional regression models may be even more consequential in the context of SEM because assumptions about linearity, distribution, and non-confounding are being made across the full set of models and variables included in it rather than just for a single equation with a single outcome (VanderWeele 2012). However, even in the presence of bias in structural equation estimates, reduced-form estimates of the impact of race/ethnicity and/or sex on the outcomes of interest represent a contribution by removing the bias inherent in corresponding past analyses that controlled for endogenous variables. Despite these acknowledged limitations, the SEM framework can provide important insights because of its flexibility and ability to capture explicitly any set of complex relationships. The present study demonstrates how valuable SEM can be in the quest to improve our understanding of the true nature and magnitude of the relationship between the key demographic characteristics such as

race, ethnicity and gender and a wide range of outcomes of interest including, for example, disability and disability benefits.

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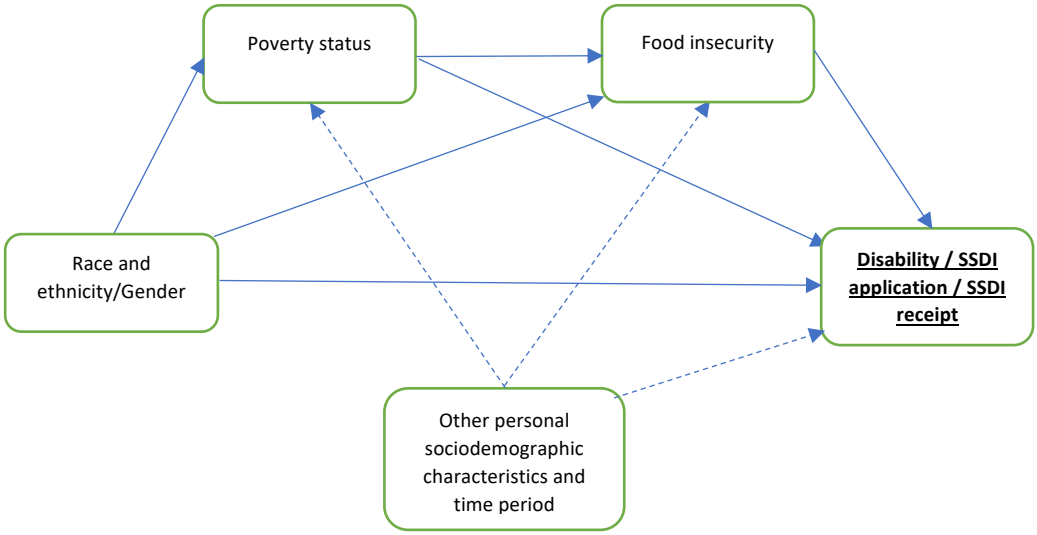
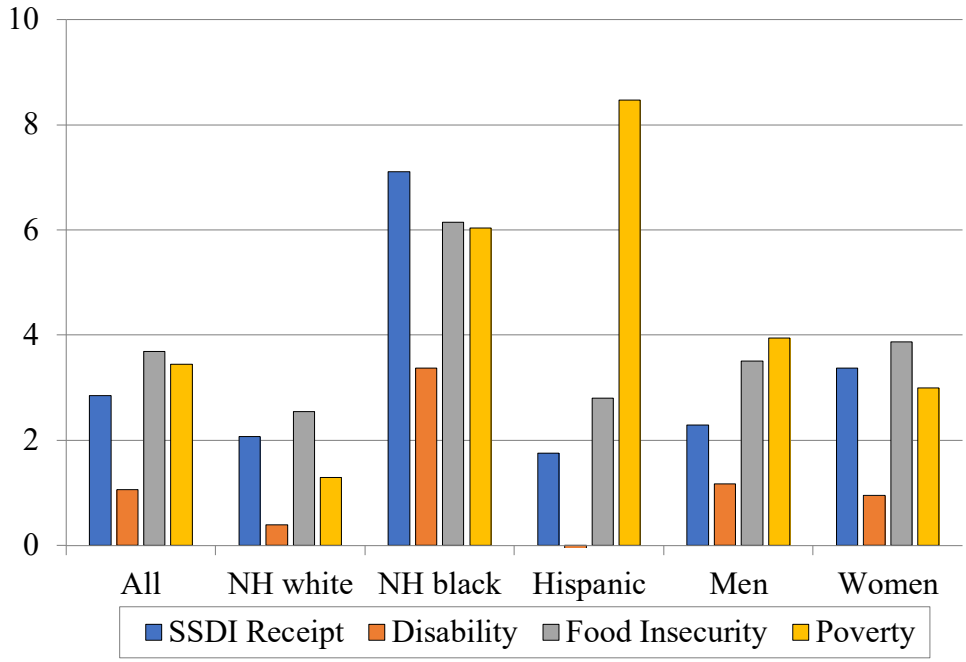
Figures

Figure 1. *SEM for the Outcomes of Interest*



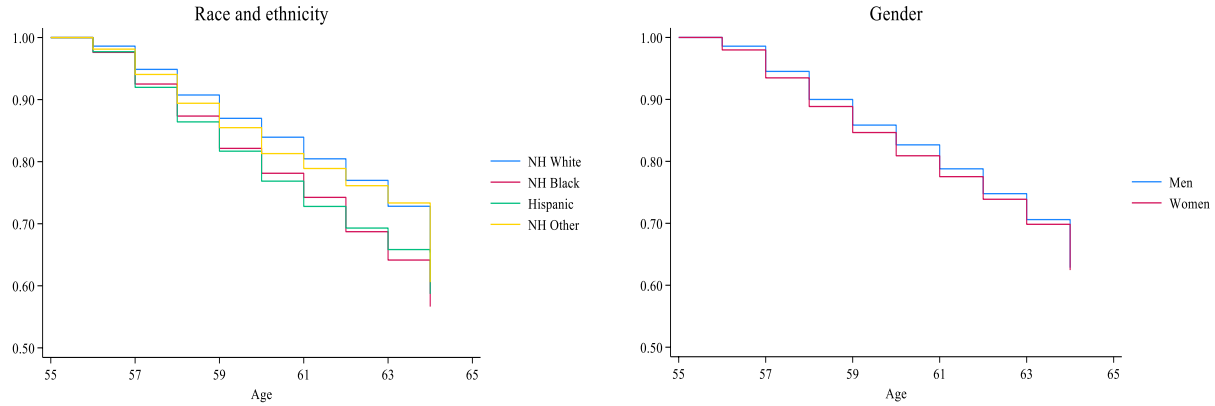
Source: Authors' conceptualization.

Figure 2. *Percentage Point Increase in the Prevalence of SSDI Receipt, Disability, Food Insecurity, and Poverty in 2010-2020 Relative to 1998-2008 among Adults Aged 55-64, by Race/Ethnicity and Gender*



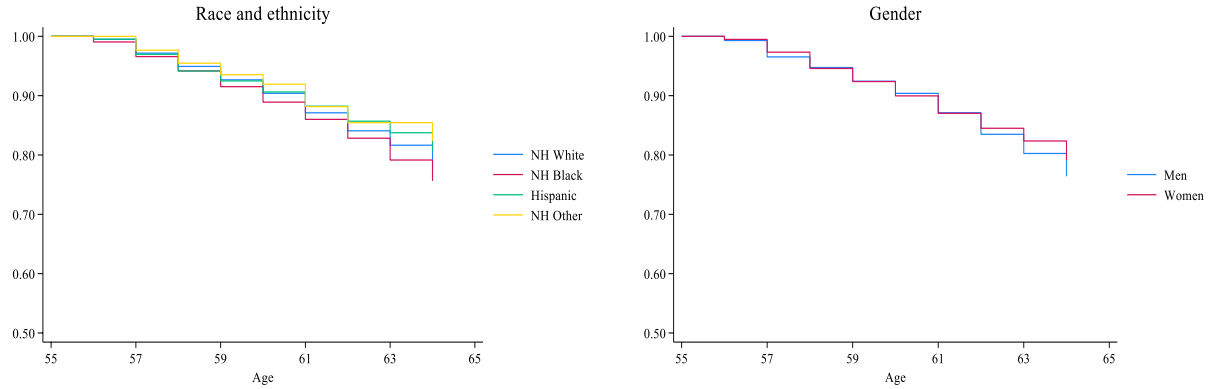
Note: Sample includes 72,475 person-years from 23,141 respondents.
Sources: HRS 1998-2020; authors' calculations.

Figure 3. *Kaplan-Meier Survival Curves for Disability among Adults Aged 55-64, by Race/Ethnicity (Left) and Gender (Right)*



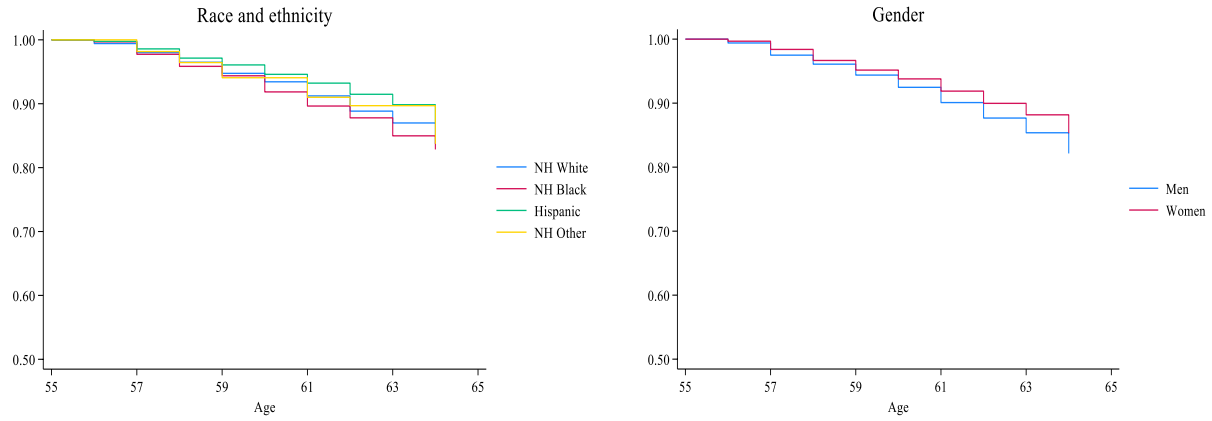
Note: Sample includes 33,726 person-years from 13,884 respondents.
Sources: HRS 2000-2020; authors' calculations.

Figure 4. *Kaplan-Meier Survival Curves for SSDI Application Conditional on Disability among Adults Aged 55-64, by Race/Ethnicity (Left) and Gender (Right)*



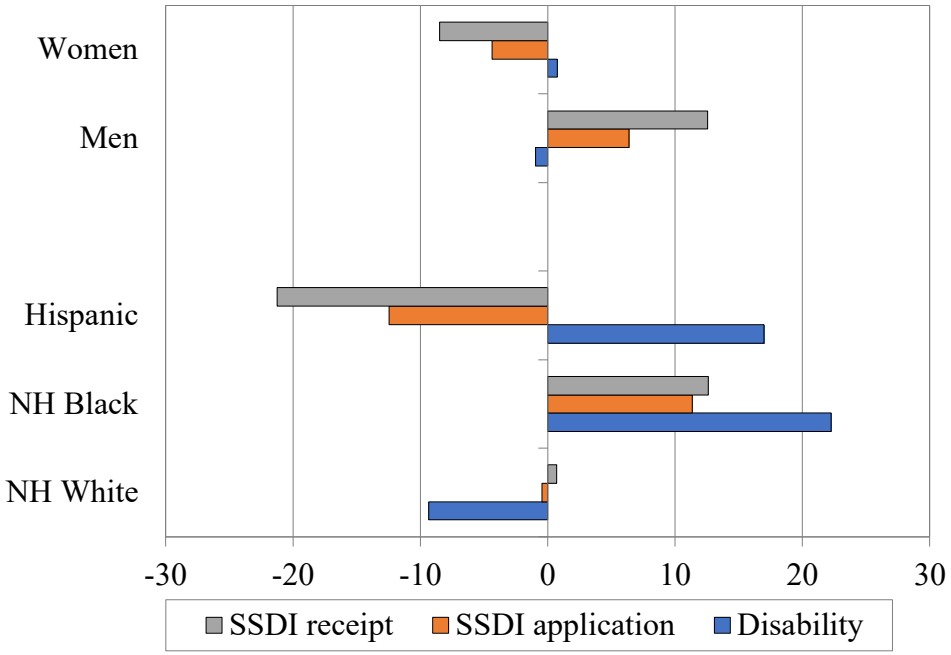
Note: Sample includes 14,001 person-years from 7,443 respondents.
Sources: HRS 2000-2020; authors' calculations.

Figure 5. *Kaplan-Meier Survival Curves for SSDI Receipt Conditional on Disability among Adults Aged 55-64, by Race/Ethnicity (Left) and Gender (Right)*



Note: Sample includes 14,465 person-years from 7,508 respondents.
Sources: HRS 2000-2020; authors' calculations.

Figure 6. *Percentage Difference in Expected and Actual Events of New Disability, SSDI Application, and SSDI Receipt among Adults Aged 55-64, by Race/Ethnicity and Gender*



Note: Sample includes 33,726 person-years from 13,884 respondents for disability, 14,001 person-years from 7,443 respondents for SSDI application, and 14,465 person-years from 7,508 respondents for SSDI receipt.
Sources: HRS 2000-2020; authors' calculations.

Tables

Table 1. *Model Results for SEM of Disability Onset and Race/Ethnicity and Gender among Adults Aged 55-64*

	Disability onset		Food insecurity		Poverty	
Direct effects						
Food insecurity	1.77	***				
Poverty	1.74	***	2.16	***		
Race/ethnicity (ref. NH white)						
NH Black	1.07		1.88	***	2.04	***
Hispanic	1.07		1.30	*	2.32	***
NH Other	1.12		1.68	***	1.63	***
Woman	0.94		1.10		1.03	
Age			0.96	***	0.97	***
Foreign born	0.76	***	1.02		1.17	*
Relationship status (ref. married/partnered)						
Divorced/separated	1.27	***	1.78	***	2.31	***
Widowed	1.15	*	1.62	***	2.38	***
Never married	1.21	*	1.45	***	3.21	***
Education (ref. less than high school)						
High school/GED	0.82	***	0.94		0.50	***
Some college	0.78	***	0.71	***	0.33	***
College or above	0.51	***	0.56	***	0.23	***
Any health insurance	0.95		0.55	***	0.39	***
Self-rated health (ref. excellent/very good)						
Good			1.45	***	1.18	**
Fair/poor			2.41	***	1.86	***
Indirect effects						
			Food Insecurity		Poverty	
Race/ethnicity (ref. NH white)						
NH Black			1.43	***	1.48	***
Hispanic			1.16	*	1.59	***
NH Other			1.34	***	1.31	***
Woman			1.05		1.01	
					Food insecurity – Poverty	
Race/ethnicity (ref. NH white)						
NH Black					1.37	***
Hispanic					1.45	***
NH Other					1.24	**
Woman					1.01	
Total effects						
Race/ethnicity (ref. NH white)						
NH Black	3.11	***				
Hispanic	2.86	***				
NH Other	2.45	***				
Woman	1.02					

*** p<0.001; ** p<0.01; *p<0.05.

Notes: Sample includes 33,726 person-years from 13,884 respondents. Models also control for survey wave.

Sources: HRS 2000-2020; authors' calculations.

Table 2. *Model Results for SEM of Disability and Race/Ethnicity and Gender among Adults Aged 55-64*

	Disability		Food insecurity		Poverty	
Direct effects						
Food insecurity	2.98	***				
Poverty	2.59	***	2.21	***		
Race/ethnicity (ref. NH white)						
NH Black	1.07	+	1.70	***	2.06	***
Hispanic	1.00		1.29	***	2.02	***
NH Other	1.32	***	1.54	***	1.59	***
Woman	1.04		1.10	**	1.11	**
Age	1.05	***	0.95	***	0.98	***
Foreign born	0.60	***	1.05		0.99	
Relationship status (ref. married/partnered)						
Divorced/separated	1.52	***	2.04	***	2.87	***
Widowed	1.38	***	1.82	***	2.63	***
Never married	1.41	***	1.66	***	3.95	***
Education (ref. less than high school)						
High school/GED	0.64	***	0.82	***	0.46	***
Some college	0.56	***	0.77	***	0.32	***
College or above	0.29	***	0.53	***	0.18	***
Any health insurance	1.71	***	0.71	***	0.53	***
Self-rated health (ref. excellent/very good)						
Good			1.56	***	1.44	***
Fair/poor			3.37	***	2.90	***
Indirect effects						
			Food insecurity		Poverty	
Race/ethnicity (ref. NH white)						
NH Black			1.78	***	1.99	***
Hispanic			1.32	***	1.95	***
NH Other			1.60	***	1.55	***
Woman			1.11	**	1.11	**
					Food insecurity - Poverty	
Race/ethnicity (ref. NH white)						
NH Black					1.87	***
Hispanic					1.84	***
NH Other					1.49	***
Woman					1.10	**
Total effects						
Race/ethnicity (ref. NH white)						
NH Black	7.08	***				
Hispanic	4.74	***				
NH Other	4.90	***				
Woman	1.40	***				

*** p<0.001; ** p<0.01; +p<0.1.
Notes: Sample includes 72,475 person-years from 23,141 respondents. Models also control for survey wave.
Sources: HRS 1998-2020; authors' calculations.

Table 3. *Model Results for SEM of New SSDI Application and Race/Ethnicity and Gender among Adults Aged 55-64, Conditional on Disability*

	New SSDI application		Food insecurity		Poverty	
Direct effects						
Food insecurity	1.26	**				
Poverty	1.25	**	1.94	***		
Race/ethnicity (ref. NH White)						
NH Black	1.13		1.59	***	2.13	***
Hispanic	0.94		1.08		2.12	***
NH Other	0.94		1.26		1.45	**
Woman	0.97		1.16	*	1.18	**
Age			0.94	***	0.95	***
Foreign born	0.71	*	1.12		1.06	
Relationship status (ref. Married/partnered)						
Divorced/separated	0.92		2.17	***	3.32	***
Widowed	0.45	***	1.78	***	2.46	***
Never married	0.74	*	1.83	***	4.48	***
Education (ref. less than high school)						
High school/GED	1.27	**	0.77	***	0.47	***
Some college	1.38	***	0.75	***	0.36	***
College or above	1.04		0.51	***	0.21	***
Any health insurance	0.40	***	0.87	+	0.72	***
Self-rated health (ref. Excellent/very good)						
Good			1.10		1.13	
Fair/poor			2.08	***	1.75	***
Indirect effects						
			Food insecurity		Poverty	
Race/ethnicity (ref. NH White)						
NH Black			1.11	**	1.18	**
Hispanic			1.02		1.18	**
NH Other			1.05		1.09	+
Woman			1.03	+	1.04	*
					Food insecurity - Poverty	
Race/ethnicity (ref. NH White)						
NH Black					1.12	**
Hispanic					1.12	**
NH Other					1.06	+
Woman					1.02	*
Total effects						
Race/ethnicity (ref. NH White)						
NH Black	1.66	***				
Hispanic	1.27					
NH Other	1.14					
Woman	1.06					

*** p<0.001; ** p<0.01; *p<0.05; +p<0.1.
Notes: Sample includes 14,001 person-years from 7,443 respondents. Models also control for survey wave.
Sources: HRS 2000-2020; authors' calculations.

Table 4. *Model Results for SEM of New SSDI Receipt and Race/Ethnicity and Gender among Adults Aged 55-64, Conditional on Disability*

	New SSDI receipt		Food insecurity		Poverty	
Direct effects						
Food insecurity	1.11					
Poverty	1.26	*	1.94	***		
Race/ethnicity (ref. NH White)						
NH Black	1.10		1.60	***	2.18	***
Hispanic	0.94		1.06		2.15	***
NH Other	1.05		1.29	+	1.48	**
Woman	0.85	*	1.14	*	1.19	**
Age			0.94	***	0.94	***
Foreign born	0.68	*	1.15		1.05	
Relationship status (ref. Married/partnered)						
Divorced/separated	1.02		2.16	***	3.26	***
Widowed	0.63	**	1.78	***	2.52	***
Never married	0.89		1.78	***	4.46	***
Education (ref. less than high school)						
High school/GED	1.35	**	0.77	***	0.48	***
Some college	1.38	**	0.76	***	0.38	***
College or above	0.96		0.51	***	0.22	***
Any health insurance	0.81	+	0.87	*	0.71	***
Self-rated health (ref. Excellent/very good)						
Good			1.12		1.12	
Fair/poor			2.10	***	1.74	***
Indirect effects						
			Food insecurity		Poverty	
Race/ethnicity (ref. NH White)						
NH Black			1.05		1.20	*
Hispanic			1.01		1.20	*
NH Other			1.03		1.10	+
Woman			1.01		1.04	+
					Food insecurity - Poverty	
Race/ethnicity (ref. NH White)						
NH Black					1.06	
Hispanic					1.05	
NH Other					1.03	
Woman					1.01	
Total effects						
Race/ethnicity (ref. NH White)						
NH Black	1.46	**				
Hispanic	1.19					
NH Other	1.22					
Woman	0.91					

*** p<0.001; ** p<0.01; *p<0.05; +p<0.1.

Notes: Sample includes 14,465 person-years from 7,508 respondents. Models also control for survey wave.

Sources: HRS 2000-2020; authors' calculations.

Table 5. *Model Results for SEM of SSDI Receipt and Race/Ethnicity and Gender among Adults Aged 55-64, Conditional on Disability*

	SSDI receipt		Food insecurity		Poverty	
Direct effects						
Food insecurity	1.42	***				
Poverty	1.16	***	1.90	***		
Race/ethnicity (ref. NH White)						
NH Black	1.37	***	1.63	***	2.07	***
Hispanic	0.88		1.21	*	2.09	***
NH Other	1.28	*	1.39	**	1.56	***
Woman	0.69	***	1.09	+	1.21	***
Age	1.00		0.94	***	0.96	***
Foreign born	0.57	***	1.16	+	0.96	
Relationship status (ref. Married/partnered)						
Divorced/separated	1.26	***	2.14	***	3.13	***
Widowed	1.35	***	1.83	***	2.54	***
Never married	1.20	+	1.66	***	4.18	***
Education (ref. less than high school)						
High school/GED	0.93		0.79	***	0.49	***
Some college	0.81	**	0.79	***	0.36	***
College or above	0.54	***	0.57	***	0.20	***
Any health insurance	6.06	***	0.80	***	0.70	***
Self-rated health (ref. Excellent/very good)						
Good			1.17	*	1.14	+
Fair/poor			2.14	***	1.74	***
Indirect effects						
			Food insecurity		Poverty	
Race/ethnicity (ref. NH White)						
NH Black			1.18	***	1.12	**
Hispanic			1.07	*	1.12	**
NH Other			1.12	**	1.07	*
Woman			1.03	+	1.03	*
					Food insecurity - Poverty	
Race/ethnicity (ref. NH White)						
NH Black					1.18	***
Hispanic					1.18	***
NH Other					1.11	***
Woman					1.04	***
Total effects						
Race/ethnicity (ref. NH White)						
NH Black	2.14	***				
Hispanic	1.24	*				
NH Other	1.71	***				
Woman	0.76	***				

*** p<0.001; ** p<0.01; *p<0.05; +p<0.1.
Notes: Sample includes 21,802 person-years from 9,627 respondents. Models also control for survey wave.
Sources: HRS 1998-2020; authors' calculations.

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