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8-1-2018

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Abdulkarim M. Meraya (iD)*, Nilanjana Dwibedi, Kim Innes, Sophie Mitra, Xi Tan, and Usha Sambamoorthi*

Objective. To examine the race-stratified relationships between labor income and health among working-age adults in the United States.

Data Sources. Data from eight waves of the Panel Study of Income Dynamics from 1999 through 2013 were used for this study.

Study Design. The study utilized a retrospective observational longitudinal design with repeated measures of labor income and health measures. System-generalized method of moment and heteroscedasticity-based instrument regressions were used to examine the relationships between labor income and physical and mental health measures, respectively. Dynamic panel models were used to examine the effect of loss in income on health measures.

Data Collection/Extraction Methods. We performed secondary data analysis.

Principal Findings. Adults in higher labor income quartiles had better self-rated health than those in the lowest quartile regardless of racial group. The relationship between labor income and psychological distress varied by race groups. Reductions in labor income were associated with increases in psychological distress among whites only.

Conclusion. These findings suggest heterogeneous relationships between labor income and overall health across racial groups. Our results highlight the need to provide safety nets for adults who experience a decline in income to prevent deterioration in health.

Key Words. Racial/ethnic differences in health, labor income and health economics

The relationship between economic status and health has been documented in the literature (Kawachi and Kennedy 1999; Meer, Miller, and Rosen 2003; Michaud and Van Soest 2008; Hajat et al. 2010a,b; Sareen et al. 2011; Williams et al. 2012; Golberstein 2015; Halliday 2016). Economic, sociological, and epidemiological studies have indicated that higher economic status

is associated with better physical (Fiscella and Franks 2000; McDonough and Berglund 2003; Meer, Miller, and Rosen 2003; Berry 2007; Michaud and Van Soest 2008; Halliday 2016) and mental health (McMillan et al. 2010; Sareen et al. 2011; Yilmazer, Babiarz, and Liu 2015). Specifically, family and labor income and net wealth were found to be positively associated with physical health (self-rated health and functioning) (Fiscella and Franks 2000; Berry 2007; Halliday 2016; Meraya et al. 2017a,b) and negatively associated with psychological distress and disorders (McMillan et al. 2010; Sareen et al. 2011; Yilmazer, Babiarz, and Liu 2015; Meraya et al. 2017a,b). Findings from some studies suggest the relationship between economic status and health may vary by age, sex, and race (Michaud and Van Soest 2008; Pollack et al. 2013; Halliday 2016). However, investigations regarding the potential relationships between economic status and health within racial groups in the United States are scarce. Understanding how the relation between health and economic well-being may vary by racial/ethnic group is essential for effective policy development and program planning, and it may ultimately help better address disparities in both health and economic status in the United States.

There are well-documented differences in financial capital (economic resources), health capital (poor health), and human capital (education) among races in the United States (Orsi, Margellos-Anast, and Whitman 2010; Shapiro, Meschede, and Sullivan 2010; Musu-Gillette et al. 2016) because of the long history of racial discrimination and differential effect of poverty on health between whites and racial minorities (Orsi, Margellos-Anast, and Whitman 2010; Shapiro, Meschede, and Sullivan 2010; Taylor et al. 2011; Musu-Gillette et al. 2016). Certain racial/ethnic minorities, including African Americans and Hispanics, have low levels of human capital, health capital, and financial capital as compared to non-Hispanic whites (Orsi, Margellos-Anast, and Whitman 2010; Shapiro, Meschede, and Sullivan 2010; Taylor et al. 2011; Musu-Gillette et al. 2016). In general, limited financial capital is believed to lead to poor

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health. However, the relationship between economic status and health out-comes within racial groups is inconsistent. For example, there is some evidence that the association of low income to chronic conditions is stronger among non-Hispanic white adults than among other racial/ethnic groups (Crimmins, Hayward, and Seeman 2004). Furthermore, Hispanics with low income generally report better mental and physical health than expected, which is referred to as the "Hispanic paradox" (Abraido-Lanza et al. 1999; Hummer et al. 2007). Similarly, African Americans report better mental health than non-Hispanic whites in the same economic strata (Barnes, Keyes, and Bates 2013), often referred to as the "racial paradox of mental health."

Several cross-sectional studies have reported differences in the relationships between economic indicators and health across different racial groups (Shea, Miles, and Hayward 1996; Braveman et al. 2010; McMillan et al. 2010; Pollack et al. 2013). A large, population-based cross-sectional study in the United States observed a strong association between income and health among white and African American adults but a weak relationship among Hispanics (Braveman et al. 2010). Pollack et al. used two cross-sectional samples from the Survey of Consumer Finances (25–64 years) and the Health and Retirement Survey (50 years and older) to assess the relationship between net wealth and self-rated health (Pollack et al. 2013). Pollack et al. reported that higher net wealth was associated with better health among African Americans and whites, and no such relationship was observed among Hispanics (Pollack et al. 2013). However, longitudinal studies are lacking, and to our knowledge, no systematic and rigorous investigation of the potential racial/ethnic variation in the relationship between economic indicators and health has yet been conducted. To help address this gap, this study evaluates the relationship between labor income and two measures of physical and mental health, with analyses stratified by racial/ethnic groups. We also examine the effects of loss in labor income on mental and physical health by race/ethnicity. Because labor income is more sensitive to economic shocks (e.g., great recession of 2007–2009) (Tomaskovic-Devey and Lin 2011), this study focuses on labor income among working-age adults (18–64 years).

CONCEPTUAL MODEL

Various economic frameworks and psychosocial theories have been proposed to explain the link between economic status and health. From a health economics point of view, all individuals are born with a fixed health capital stock

(health capital), which declines with age because of biological processes (Case and Deaton 2005). According to Grossman, the health of an individual can be improved by investing in education (human capital) because educated individuals are more likely to improve their health care (Grossman 1972). Grossman further posits that individuals with lower human and financial capital may be more likely to suffer earlier and more rapid declines in health, and to have poorer health at any given point in time than those with higher human and financial capital. In the field of sociology, social causation and social selection have been proposed to explain the link between economic status and health (Warren 2009). Social causation theory assumes that economic status is a causal determinant of health, positing that experiencing an economic shock increases the risk of health decline (Warren 2009). On the other hand, social selection theory assumes that health is a causal determinant of economic status, positing that environmental and genetic factors contribute to the health decline, which, in turn, leads to a decrease in economic resources (Warren 2009). In this study, we investigate economic status as a potential causal determinant of health.

DATA AND METHODS

Data Sources: Panel Study of Income Dynamics

The Panel Study of Income Dynamics (PSID) is a longitudinal study of U.S. population which started in 1968 with a national probability sample of U.S. families (McGonagle and Schoeni 2006). Currently, the individuals in any panel come from one of three sources: the original 1968 sample; the 1997 refresher sample of post-1968 immigrants; and births and marriages in existing families (McGonagle et al. 2012). In this study, both family and cross-year individual files were combined to derive information on households. The PSID has been including questions regarding self-rated health since 1984 and diagnosed chronic health conditions since 1999. Additional items regarding information on psychological distress and specific psychological illnesses were added beginning in 2005.

Study Design

The study utilized a retrospective observational longitudinal design with repeated measures of labor income and health measures. To examine the relationship between labor income and self-rated health, a sample of heads of households was followed for a period of 14 years (1991–2013) using eight

waves of the PSID. Further, another sample of household heads was followed for a period of 6 years (2007–2013) using four waves of the PSID to examine the relationship between labor income and psychological distress.

Study Sample

Two samples were used for the purpose of this study. The first sample comprised heads of households who participated in all the eight waves of the PSID from 1999 through 2013 and who were aged between 18 and 50 years in 1999 ($N = 2,693$). These waves were selected due to the availability of information on self-rated health and chronic conditions. The second sample comprised heads of households who participated in all the four waves of the PSID from 2007 through 2013 and who were aged between 18 and 58 years in 2007 ($N = 4,867$). We selected the four waves because psychological distress and mental health measures were continuously available only in these four waves.

Health Measures

Self-Rated Health (SRH). PSID queried each respondent regarding their perceived health ("would you say your health in general is excellent, very good, good, fair, or poor?") The responses to the question were scored on a scale of 1 to 5, with higher scores representing better health (5 = excellent, 4 = very good, 3 = good, 2 = fair, and 1 = poor). Ware and colleagues transformed the SRH to a 0–100 scale using a linear relationship between item scores and the underlying health concept (Ware et al. 2000).

Psychological Distress. Psychological distress was measured using the Kessler-6 Non-Specific Psychological Distress Scale (Kessler et al. 2010); this scale includes six items: "In the past 30 days, about how often did you feel: (1) so sad nothing could cheer you up? (2) nervous? (3) restless or fidgety? (4) hopeless? (5) that everything was an effort? (6) worthless?" Responses to these six questions are scored on a scale of 1 to 5 as follows: 5 = all of the time, 4 = most of the time, 3 = some of the time, 2 = a little of the time, and 1 = none of the time. In this study, the summary score from the Kessler-6 scale was used to measure psychological distress.

Change in Health Measures. SRH: (1) *Increases in SRH*: A binary indicator variable with the value of 1 representing improvements in SRH from one wave to the next and zero representing no change or a decline in SRH scores from one

wave to the next. (2) *Decreases in SRH:* A binary indicator variable with the value of 1 representing declines in SRH from one wave to the next and 0 representing no change in SRH or an increase in SRH scores from one wave to the next.

   Psychological Distress: (1) *Increases in psychological distress:* A binary indicator variable with the value of 1 representing increases in psychological distress scores from one wave to the next and 0 representing no change or declines in psychological distress scores from one wave to the next. (2) *Decreases in psychological distress:* A binary indicator variable with the value of 1 representing improvements in mental health (i.e., a decline in psychological distress scores from one wave to the next) and 0 representing no change or increases in psychological distress scores from one wave to the next.

Labor Income.   We measured labor income of the head of the household. Labor income included all money earned from wages and salaries, bonuses, overtime, tips, commissions, professional practice, or any job-related income including farm or business income. In this study, we categorized labor income into quartiles based on the distribution of this variable in each wave.

Other Exogenous Explanatory Variables.   This included demographic, lifestyle, and other factors shown in prior studies to be associated with mental and physical health (Chaney et al. 2007; Scott et al. 2008; Velten et al. 2014). For each head of the household, we measured the following health practices variables in each wave: number of chronic conditions categories (no condition, one condition, ≥ 2 chronic conditions); body mass index (BMI) (kg/m^2) (underweight [<18.5], normal [18.5–24.9], overweight [25.0–29.9], or obese [≥ 30.0]); smoking status (smoker, not a smoker); and alcohol use (user, nonuser). Also, considered in the analyses were other factors potentially affecting economic status including age, marital status (married, widowed, separated or divorced, and never married), number of children under 18 years of age, health insurance, external financial support, and financial liabilities to others.

STATISTICAL ANALYSES

Arellano–Bond Generalized Method of Moments (GMM) Estimator

Under the Arellano and Bond approach, lags of SRH are used as instruments to address the endogeneity between economic indicators and SRH (Arellano and Bond 1991). Nevertheless, weak instruments problem may occur in the Arellano–Bond approach because lagged values of the endogenous variables

may be weakly correlated with the regressors in the first-difference model. Thus, Blundell and Bond proposed a system-GMM estimator (Blundell and Bond 1998). System-GMM estimator uses lagged differences as instruments for the level model and lagged levels as instruments for the first-difference model. Economic status is considered as a predetermined variable, and all the feasible lags of economic status and health measures ($t-1$ and thereafter) are used as instrumental variables. However, we found that using only four lags of health measures as IVs increased the efficiency of the models (based on the second order autocorrelation test and the Hansen J statistics on overidentifying restrictions). Further, we found that adjusting for three SRH lags increases the efficiency of system-GMM models. We also applied finite sample correction to the robust two-step covariance matrix calculated for system-GMM estimator to reduce overidentification caused by too many IVs (Roodman 2006).

Lewbel (2012) Estimator Using Heteroskedastic Errors as Valid Instruments

The main advantage of this technique is its ability to produce valid estimators where external instruments are unavailable or potentially weak (Lewbel 2012; Baum and Schaffer 2017). Due to the absence of suitable instruments, we used the Lewbel (Lewbel 2012; Baum and Schaffer 2017) method to examine the association between labor income and psychological distress. This method generates external instruments which are associated with the endogenous variable, but not with the exogenous variables.

The Effect of Economic Loss on Health Decline and Economic Gain on Health Improvement

First-difference (FD) and *Lagged-fixed effect estimators* were used to examine the dynamic relationships between economic loss and decline in health as well as economic gain and health improvement. All analyses were weighted using 2013 longitudinal weights provided by the PSID.

RESULTS

Characteristics of the Study Samples

The first sample including data from waves 1999 to 2013 was used to examine the relationship between labor income and SRH. The sample consisted of 2,693 heads of households, who were between age 18 and 50 in 1999. Table 1

displays the weighted percentages of selected characteristics of the first sample in 1999. Most the adults in the sample were non-Hispanic whites (*N*: 1,576, 75.1%) followed by African Americans (*N*: 848, 13.2%) and Hispanics (*N*: 155, 7.8%). Further, the participants were predominantly men (81.5%). Education level showed considerable variation by race/ethnicity, with 36.9% of non-Hispanic white adults indicated a college degree versus 15.4% of African American and 11.1% of Hispanic participants.

Data from the second sample (waves 2007 to 2013) were used to examine the relationship between labor income and psychological distress scores. Table 1 presents the weighted percentages of selected characteristics of the second sample in 2007. The sample comprised 4,867 heads of households aged 18 to 58 as of 2007. Again, most of the participants in this sample were non-Hispanic whites (*N*: 4,867, 77.1%) followed by African Americans (1,782, 17.0%) and Hispanics (*N*: 375, 9.3%). The vast majority of whites (72.6%), African Americans (83.3%), and Hispanics (87.7%) lived in a metropolitan area. Most of the study sample were men (76.5%) because the convention of selecting men as the household head in the PSID.

Labor Income and Health Measures over Time

Figure 1 presents the means of labor income of the heads of households by race and quartiles across the waves. White adults in the highest quartile had higher averages values than African Americans and Hispanics in the highest quartile across the waves. Whites, African Americans, and Hispanics in labor income quartiles 2, 3, and 4 had comparable averages values across the waves. There were fluctuations in the averages values across the waves for all racial groups. Figure 2 displays the means of SRH and psychological distress by race across the waves. Non-Hispanic white adults averaged higher SRH scores than did African Americans and Hispanics across all waves, although mean SRH deteriorated over time in all racial/ethnic groups. Whites and African Americans averaged greater psychological distress than did Hispanics, although psychological distress scores increased over time in the latter group.

The Relationship between Labor Income and SRH by Race

Table 2 presents the parameter estimates and standard errors of labor income on SRH from system-GMM by race. In system-GMM, there was a significant relationship between labor income quartiles and SRH across the racial

Table 1:   Weighted Percentages of Selected Characteristics of Working-Age Adults: Panel Study of Income Dynamics

	Sample 1: 1999 (N = 2,693)			Sample 2: 2007 (N= 4,867)		
	White	African American	Hispanic	White	African American	Hispanic
All (%)	75.1	13.2	7.8	71.1	16.7	9.3
Sex						
Men	86.0	84.6	84.6	81.6	51.2	81.4
Women	14.0	15.4	15.4	18.4	48.8	18.6
Age in years						
18–39 years	50.6	58.4	61.1	39.4	43.4	41.7
40–49 years	43.6	39.6	34.9	29.1	32.4	38.0
50–64 years	5.8	2.0	4.0	31.5	24.2	20.3
Marital status						
Married	64.9	25.8	67.3	57.9	22.8	62.7
Widowed	0.9	2.2	0.6	1.7	2.5	1.3
Separated/divorced	14.8	24.2	17.9	18.0	26.3	18.3
Never married	19.5	47.9	14.2	22.4	48.4	17.7
Education						
LE high school	9.7	21.2	60.4	9.0	18.0	43.0
High school	28.7	36.3	14.0	29.0	37.0	26.0
Some college	24.7	26.1	14.6	25.0	27.0	16.0
College, +	36.9	16.4	11.1	37.0	17.0	15.0
Employment status						
Employed	92.3	82.8	91.0	88.4	71.7	92.0
Not employed	7.7	17.2	9.0	11.6	28.3	8.0
Smoking status						
Smoker	24.3	27.9	19.0	24.3	26.5	17.4
Nonsmoker	75.7	72.1	81.0	75.7	73.5	82.6
Alcohol use						
Yes	73.1	55.2	62.2	74.4	58.7	50.8
No	26.9	44.8	37.8	25.6	41.4	49.2
Body mass index categories						
Underweight	0.7	0.5	0.5	0.9	1.1	1.3
Normal	33.8	29.1	30.4	28.2	24.2	19.8
Overweight	43.5	34.2	47.1	42.7	34.8	45.5
Obese	22.0	36.2	22.0	28.2	40.0	33.4
Light physical activity						
GE 3 times/week	65.8	61.0	61.8	62.3	49.1	38.4
LT 3 times/week	34.2	39.0	38.2	37.7	50.9	61.6
Heavy physical activity						
GE 3 times/week	34.3	25.5	25.7	46.9	34.0	38.0
LT 3 times/week	65.7	74.5	74.3	54.0	66.0	62.0
Chronic physical conditions						
No conditions	69.2	65.3	83.1	54.5	50.9	69.5
One condition	21.3	25.2	13.7	27.6	26.8	19.7

Continued

Table 1 *Continued*

	Sample 1: 1999 (N = 2,693)			Sample 2: 2007 (N= 4,867)		
	White	*African American*	*Hispanic*	*White*	*African American*	*Hispanic*
GE 2 conditions	9.4	9.5	3.2	17.9	22.3	10.8
Metro status						
Metro	73.5	81.4	88.7	72.6	83.3	87.7
Urban	22.9	17.4	10.0	23.4	15.5	12.1
Rural	3.6	1.2	1.3	4.0	1.2	0.2
Region of residence						
Northeast	21.2	15.5	4.0	20.8	14.3	5.4
North central	30.4	19.8	9.9	30.5	21.9	8.3
South	26.2	58.4	24.6	28.0	56.5	29.0
West	21.2	6.1	59.9	20.1	7.3	55.2
Alaska, Hawaii	0.4	0.0	0	0.2	0	0.2
Other	0.6	0.3	1.7	0.5	0	1.9

Sample 1: Based on 2,693 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 1999 and 2013.
Whites: 1,576; African Americans: 848; Hispanics: 155.
Sample 2: Based on 4,867 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 2007 and 2013.
Whites: 2,568; African Americans: 1,782; Hispanics: 375.
GE, Greater than or equal to; LE, Less than or equal to; LT, Less than.

groups. White adults in labor income quartiles 2 ($\hat{\beta} = 4.869$, $p < .001$), 3 ($\hat{\beta} = 3.541$, $p < .001$), and 4 ($\hat{\beta} = 4.120$, $p < .001$) had significantly better SRH than white adults in the lowest quartile. Similarly, African Americans in labor income quartiles 2 ($\hat{\beta} = 3.687$, $p < .001$), 3 ($\hat{\beta} = 4.499$, $p < .001$) and 4 ($\hat{\beta} = 4.089$, $p < .001$) had significantly better SRH than those in the lowest quartile. Hispanics in labor income quartiles 2 ($\hat{\beta} = 6.306$, $p < .001$), 3 ($\hat{\beta} = 4.145$, $p < .01$), and 4 ($\hat{\beta} = 8.283$, $p < .001$) had significantly better SRH than those in the lowest quartile.

*The Relationship between Labor Income and Psychological Distress Scores by Race*

Table 2 displays the parameter estimates and standard errors of labor income on psychological distress scores from adjusted heteroscedasticity-based instruments regressions. After adjustment for the endogeneity, white adults in labor income quartiles 2 ($\hat{\beta} = -1.494$, $p < .001$), 3 ($\hat{\beta} = -1.457$, $p < .001$), and 4 ($\hat{\beta} = -1.646$, $p < .01$) had significantly lower scores than those in the lowest quartile. Similarly, African American adults in labor income quartiles 2 ($\hat{\beta} = -1.708$, $p < .01$), 3 ($\hat{\beta} = -2.538$, $p < .001$), and 4 ($\hat{\beta} = -2.604$, $p < .001$)

Figure 1:   Average Labor Income by Quartiles
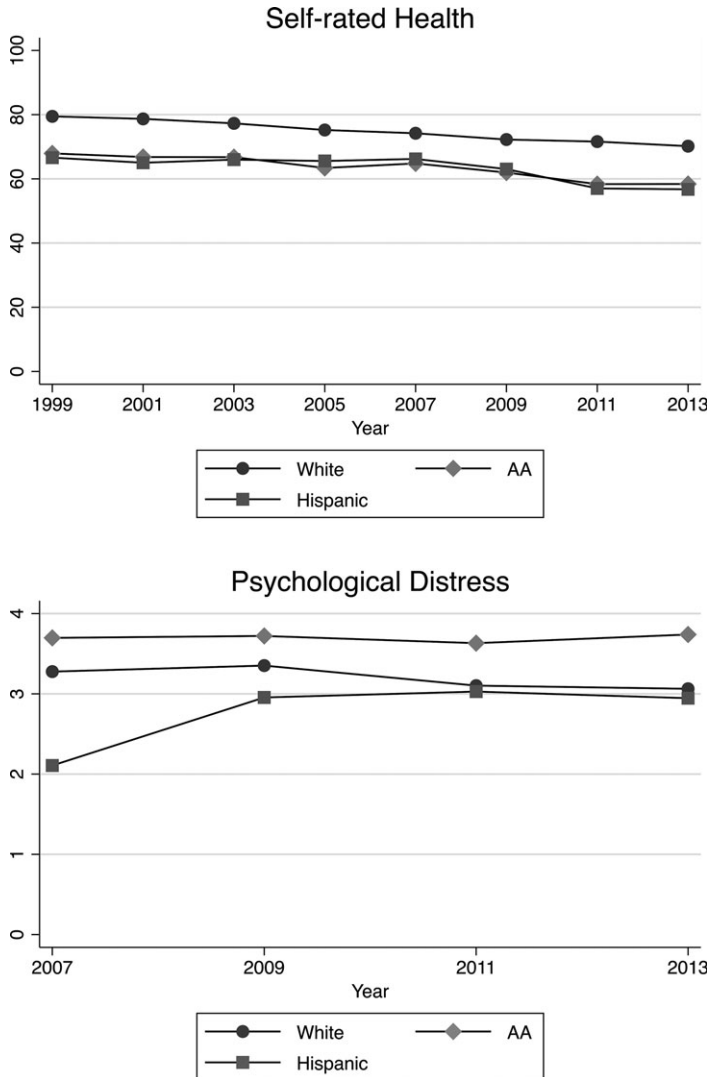
Sample 1, 1999-2013
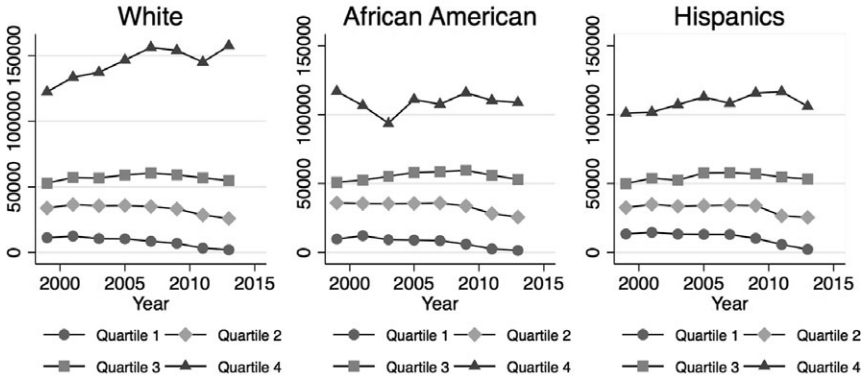
Sample 2, 2007-2013
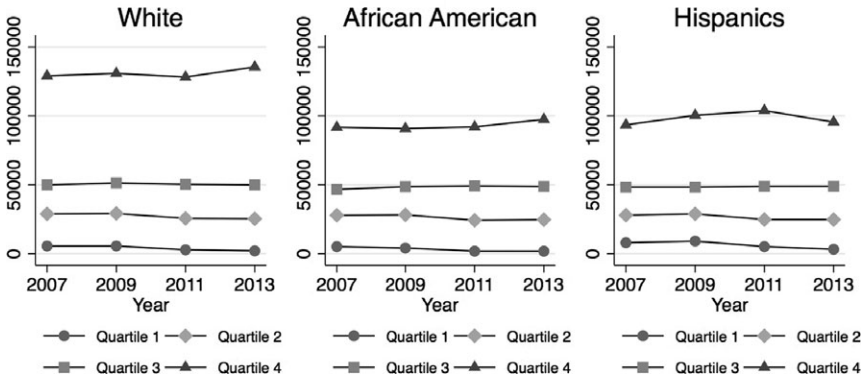
Notes: Sample 1 is based on 2,693 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 1999 and 2013. Whites: 1,576; African Americans: 848; Hispanics: 155. Sample 2 is based on 4,867 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 2007 and 2013. Whites: 2,568; African Americans: 1,782; Hispanics: 375.

had significantly lower psychological distress scores than those in the lowest quartile. Conversely, there was no relationship between labor income quartiles and psychological distress scores among Hispanics.

Figure 2: Average Self-Rated Health and Psychological Distress by Race/
Ethnicity

Changes in Labor Income and Changes in SRH by Race
Increases in Labor Income and SRH by Race. Increases in labor income were not associated with SRH improvement among non-Hispanic white, African American, or Hispanic participants in adjusted FD analyses.

Loss in Labor Income and SRH by Race. In the adjusted FD analyses, the transition from a higher labor income quartile to a lower was associated with a 3.4 percentage point increase in the probability of SRH improvement among whites. Similarly, in lagged-fixed effects models, the transition from a higher

Table 2:   Parameter Estimates and Standard Errors of Labor Income on (a) SRH. Arellano–Bond (System-GMM). Working-age U.S. Adults (18–64 Years). The Panel Study of Income Dynamics, 1999–2013 ($N = 2,693$). (b) Psychological Distress. Heteroscedasticity-Based Instruments (Lewbel 2012). Working-Age Adults (18–64 Years). Panel Study of Income Dynamics, 2007–2013 ($N = 4,867$)

	White	*African American*	*Hispanic*
(a)			
Quartile 1		Reference	
Quartile 2	4.869*** (1.010)	3.687*** (1.106)	6.306*** (1.660)
Quartile 3	3.541*** (1.053)	4.499*** (1.332)	4.145* (2.033)
Quartile 4	4.120*** (1.142)	4.089** (1.418)	8.283*** (1.622)
#IV		118	
Hansen J	$\chi^2(85)$: 79.37; $p = .652$	$\chi^2(85)$: 109.24; $p = .039$	$\chi^2(85)$: 99.72; $p = .131$
(b)			
Quartile 1		Reference	
Quartile 2	−1.494*** (0.412)	−1.708** (0.492)	−0.1543 (0.831)
Quartile 3	−1.457** (0.457)	−2.538*** (0.485)	−0.553 (0.696)
Quartile 4	−1.646*** (0.368)	−2.604*** (0.430)	−0.853 (0.651)

Notes: SRH is based on 2,693 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 1999 and 2013.
Whites: 1,576; African Americans: 848; Hispanics: 155.
System-GMM adjusted for age, number of chronic conditions, body mass index, alcohol use, smoking status, light physical activity, marital status, number of children under 18 years of age, health insurance, external financial support, and financial liabilities to others.
Psychological distress is based on 4,867 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 2007 and 2013.
Whites: 2,568; African Americans: 1,782; Hispanics: 375.
Heteroscedasticity-based instruments regressions adjusted for age, body mass index, alcohol use, smoking status, light physical activity, marital status, number of children under 18 years of age, health insurance, external financial support, and financial liabilities to others.
***$p < .001$; **$.001 \leq p < .01$; *$.01 \leq p < .05$.

labor income quartile to a lower had a negative impact on SRH among white ($\hat{\beta} = -1.394$, $p < .05$) and African American adults ($\hat{\beta} = -4.542$, $p < .05$).

Changes in Labor Income and Changes in Psychological Distress Scores by Race
Increases in Labor Income and Psychological Distress by Race. Adjusted FD analyses revealed that gains in labor income were associated with a 4.5 percentage point increase in the probability of mental health improvement (as measured by decline in psychological distress scores) among whites, but not African American or Hispanic adults (Table 3). Conversely, lagged-fixed effects analyses indicated no association between increases in labor income and psychological distress scores.

Loss in Labor Income and Psychological Distress by Race. In the adjusted FD analyses, the transition from an upper labor income quartile to a lower quartile was associated with a 4.3 percentage point increase in the probability of increases in psychological distress scores among white adults. In lagged-fixed effects analyses, the transition from an upper labor income quartile to a lower quartile was associated with increases in psychological distress scores ($\hat{\beta} = 0.455$, $p < .01$) among white adults.

DISCUSSION

We examined the relationships between labor income and two measures of health, stratified by race/ethnicity. Findings of this study suggest that labor income is positively associated with SRH in both white and African American adults. In these two racial groups, those who experienced a decline in labor income also experienced a decline in SRH. Collectively, the findings of this study support a need for policies that provide safety nets for adults experiencing income loss to prevent further deterioration in health. Our results also highlight the need for initiatives that improve individual health by incorporating health considerations into decision making across all policy areas, referred to as "Health in All Policies" (Rudolph et al. 2013). Health in All Policies was developed by the public health facilitators of the California Health in All Policies Task Force (Rudolph et al. 2013). Under this approach reshaping individuals' economic, physical, social, and service environments can help improve health (Rudolph et al. 2013). Our results revealed also that the economic stability plays an important role in individuals' health. Our results revealed a

Table 3:   The Relation of Changes in Labor Income to Changes in Physical and Mental Health

	FD (Adjusted)			Lagged-Fixed Effects		
	White	African American	Hispanic	White	African American	Hispanic
Gain in labor income and SRH						
Change in labor income quartile	0.017 (0.012)	0.002 (0.030)	0.035 (0.036)	0.980 (0.628)	2.689 (1.374)	4.171 (2.771)
Loss in labor income and SRH						
Change in labor income quartile	0.034* (0.014)	0.040 (0.028)	0.004 (0.044)	−1.394* (0.637)	−4.542* (1.777)	−1.403 (1.982)
Gain in labor income and mental health						
Change in labor income quartile	0.045* (0.018)	−0.008 (0.033)	0.079 (0.049)	−0.166 (0.159)	−0.169 (0.397)	0.280 (0.554)
Loss in labor income and mental health						
Change in labor income quartile	0.043* (0.018)	0.024 (0.034)	0.070 (0.050)	0.455** (0.161)	−0.535 (0.363)	0.579 (0.566)

Notes: SRH is based on 2,693 households' head participants of the Panel Study of Income Dynamics and for whom data were available for all years between 1999 and 2013.
Whites: 1,576; African Americans: 848; Hispanics: 155.
Psychological distress is based on 4,867 head of household participants of the Panel Study of Income Dynamics and for whom data were available for all years between 2007 and 2013.
Whites: 2,568; African Americans: 1,782; Hispanics: 375.
*** $p < .001$; ** $.001 \leq p < .01$; * $.01 \leq p < .05$.
Health improvement (SRH): A binary indicator variable measuring one-period change in SRH with the value of 1 representing improvements in SRH and 0 representing no change or worsening health.
Health decline (SRH): A binary indicator variable measuring one-period change in SRH with the value of 1 representing decline in SRH and 0 representing no change or health improvement.
Decline in mental health: A binary indicator variable with the value of 1 representing an increase in psychological distress scores from one wave to the next and 0 representing no change or decreases in psychological distress scores from one wave to the next.
Improvements in mental health: A binary indicator variable with the value of 1 representing decline in psychological distress scores from one wave to the next and 0 representing no change or increase in psychological distress scores from one wave to the next.
In FD model, the outcome is health improvement (or decline) and the key endogenous variable is economic gain (or loss). FD adjusted for one-period changes in age, number of chronic conditions (only SRH), body mass index, alcohol use, smoking status, light physical activity, marital status, number of children under 18 years of age, health insurance, external financial support, and financial liabilities to others.
In lagged-fixed effects model, the outcome is the SRH or psychological distress at time t. The key independent variable is either economic gain or loss. Lagged-fixed effects model included the following variables measured at t-1: health measures, economic indicator, age, number of chronic conditions (SRH only), body mass index, alcohol use, smoking status, light physical activity, marital status, number of children under 18 years of age, health insurance, external financial support, and financial liabilities to others.
Economic gain: The transition from a lower quartile to an upper quartile.
Economic loss: The transition from an upper quartile to a lower quartile.
SRH: Self-rated health.

significant relationship between low labor income and ill health. However, the studies on the effect of income supplementation and state funded welfare programs are limited (Connor, Rodgers, and Priest 1999; Adams et al. 2006). Clearly, further research on the effect of income supplementation programs on health outcome is warranted.

Among Hispanic participants, we found a significant positive relationship between labor income and SRH. However, Hispanics who experienced a decline in income did not show a corresponding decline in SRH. We also found that there was no relationship between labor income and psychological distress and no relationship between change in labor income and change in mental health among Hispanics. These findings may in part reflect baseline differences in overall mental health. In this study, Hispanic adults had lower psychological distress scores than whites or African Americans at all time points. Collectively, our results suggest the relationships of labor income to both physical and mental health are heterogeneous across racial/ethnic groups.

Although we did not control for social capital factors such as network of friends and families and religious affiliations, our findings appear consistent with prior literature supporting the "Hispanic health paradox." The Hispanic health paradox refers to the repeatedly documented observation that Hispanics living in the United States have better health than expected given their high prevalence of poverty, poor education, and lack of access to health care (Dominguez et al. 2015). A study by Dominguez et al. using four national datasets revealed that Hispanic adults have lower all-cause death rate and lower death rates for 9 of the 15 leading causes of death in the United States, although they were more likely to have lower income and be more poorly educated than white adults (Dominguez et al. 2015). This apparent paradox may in part reflect certain protective factors characterizing Hispanic communities. For example, foreign-born immigrants are reported to have better mental health due to social support and family ties (Viruell-Fuentes and Andrade 2016). Furthermore, foreign-born immigrants generally have better health than those who remain in their countries of origin because of the "healthy immigrant effect" or positive immigrant selectivity (Singh and Hiatt 2006).

After adjustment for the endogeneity between labor income and psychological distress, we found non-Hispanic whites and African Americans in the upper quartiles of labor income distribution have significantly lower levels of psychological distress than their counterparts in the lowest quartile of labor income distribution. A study conducted using a nationally representative sample of U.S. adults identified cutoffs for four levels of psychological distress (no psychological distress = 0, low psychological distress = 1–5, moderate

psychological distress = 6–10, and high psychological distress = 11–24) among U.S. population (Forman-Hoffman et al. 2014). These categories correspond with approximately 50, 35, 10, and 5 percent of the adult population in the representative sample. Based on these cutoffs by Forman-Hoffman et al. and our data, our study findings suggest that a decline in labor income would increase the risk from low to moderate or moderate to severe psychological distress for nearly 20% of working-age adults.

Additionally, we observed that whites who experienced a decline in labor income also experienced a decline in mental health. However, this was not the case with African Americans or Hispanics. Ulbrich et al. found that socioeconomic status (SES) interacts with race to increase psychological symptoms of distress and that lower SES whites were more vulnerable to economic concerns than lower SES African Americans (Ulbrich, Warheit, and Zimmerman 1989). Furthermore, a study by Steele indicated that American whites who experienced downward mobility in the social class feel more dependent than their counterparts (Steele 1978).

The differences in vulnerability to the economic stressors may be due to differences in perceptions of downward mobility. There is some evidence of this in the work of the anthropologist Newman in her book entitled *Falling from grace: Downward mobility in the age of affluence*, which describes her findings from interviews of both blue collar and white collar workers as well as participant observations (Newman 1988). Based on the interviews and her own observation, she concluded that the adjustment to loss in status varied across groups. Middle-class individuals who blamed failures on themselves and who perceived falling income as overwhelming had difficulty in adjusting to their downward mobility. Furthermore, many white working Americans perceive that their economic situation has gotten worse than their parents (Newman 1988). Many of them fear that their children will also experience a continued downward mobility, which may contribute to the greater psychological distress among white Americans.

Another explanation for the differences in the vulnerability to the economic stressors is the "race mental health paradox." Race mental health paradox refers to the paradoxical observation of better mental health outcomes among African Americans compared to whites (Barnes, Keyes, and Bates 2013) despite being at high risk due to exposure to violence, poor educational outcomes, persistent poverty, and discrimination (Keyes 2009). This paradox may reflect certain protective factors typifying black communities, including higher social capital and better developed social networks (Keyes 2009).

Collectively, these findings indicate that lower SES whites respond to economic stressors differently.

The current study has several strengths, including the prospective, population-based design, and relatively large sample size. To our knowledge, the current study is the first longitudinal study to examine the relationship between change in labor income and change in health status, and the first to investigate the potential variation in these relationships by race/ethnicity. The present study is also the first to investigate the effect of loss in labor income on SRH and psychological distress. We also employed rigorous novel econometric approaches to address the endogeneity between labor income and health measures. In this study, we were able to control for multiple potential confounders, including demographic, socioeconomic, lifestyle, and health-related factors.

However, this investigation also has some limitations. First, our analyses were restricted to heads of households. Thus, our estimates may not be generalizable to other demographic groups underrepresented in this sample, including married women. Second, we did not include time-invariant factors such as sex because inclusion of these factors contradicts the specifications of the dynamic panel models. Third, neither SRH nor psychological distress can capture all domains of physical and mental health. Also, we used self-reported psychological distress rather than diagnosed depression in our analyses. Finally, Hispanics were underrepresented in this study, and the power to detect differences was smaller in Hispanics because of the sample size.

CONCLUSION

Findings of this cohort study suggest relationships between labor income and physical and mental health are heterogeneous across racial/ethnic groups. Additional rigorous prospective studies are needed to confirm these findings and to further investigate the effects of the social factors. Our results highlight the need to provide safety nets for adults who experience a decline in income to prevent further deterioration in health. Our results also revealed that economic stability plays an important role in individuals' health.

ACKNOWLEDGMENTS

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SUPPORTING INFORMATION

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Appendix SA1: Author Matrix.