



Article

Unequal Exposure, Equal Vulnerability, Unequal Incidence: Unemployment Duration and Hypertension Risk Across Race in the United States

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Abstract

Unemployment is known to deteriorate physical health through income loss and psychological stress; yet it remains unclear whether racial health disparities stem from differential vulnerability to joblessness or unequal exposure to it. Using a case-crossover design on National Longitudinal Survey of Youth (NLSY79) data from 1983 to 2018, this case-crossover study accounts for unobserved, time-invariant heterogeneity to examine how unemployment duration influences hypertension risk across Black and non-Black respondents. Descriptive analyses reveal striking structural inequities: Black respondents experience significantly longer unemployment duration. Conditional logit models show that longer unemployment duration markedly increases the odds of a hypertension diagnosis for all individuals, with interaction models confirming that the health penalty per duration unit does not differ significantly by race. Nevertheless, although there is no differential hypertension vulnerability to joblessness across racial groups, the disproportionate exposure of Black individuals to prolonged unemployment translates directly into a higher cumulative incidence of hypertension. These findings demonstrate that racial health disparities in joblessness are driven by unequal exposure to prolonged unemployment, rooted in labor market discrimination, rather than a differential biological or psychological response. Consequently, structural interventions to reduce unemployment exposure can improve overall population health while simultaneously narrowing racial gaps in cardiovascular disease.

Keywords: unemployment; social determinants of health; case-crossover methods; hypertension; health disparities; racial and ethnic disparities



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1. Introduction

Unemployment can adversely affect health through economic, behavioral, and psychosocial pathways. The loss of employment benefits and reductions in current and future income can undermine material security, while unemployment may also increase engagement in risky health behaviors (Burgard et al. 2012; Burgard and Lin 2013; Young 2012). Job loss can further threaten health by generating psychological stress and diminishing perceived social status. Together, these processes may contribute to poorer mental and physical health (Frech et al. 2022; Stauder 2019; Tøge and Blekesaune 2015). Unemployment has also been associated with an increased risk of cardiovascular events (Wang et al. 2023; Zagozdzon et al. 2014), highlighting the importance of examining its relationship with cardiovascular risk factors such as hypertension.

Although unemployment can be stressful across racial groups, exposure to unemployment and the resources available to cope with it are unequally distributed. Black workers face consistently lower chances of reemployment compared to White workers (Emeka 2009; Moore 2010). The significant wealth gap between Black and White Americans further impacts their ability to weather the financial shocks of unemployment (Keister 2000; Killewald et al. 2017). Additionally, racial disparities in social networks, which play a key role in job searches (Pedulla and Pager 2019), and unequal access to unemployment benefits (Mar et al. 2022), contribute to these divergent experiences. These inequalities suggest that both unemployment exposure and its health consequences may differ across racial groups.

Building on this body of research, this study addresses two key research questions: how does unemployment duration affect hypertension diagnosis, and does this effect vary by race? First, drawing on recent research showing that long-term patterns of unemployment impact both physical and mental health (Frech et al. 2022; Krug and Eberl 2018; Strandh et al. 2014; Tøge and Blekesaune 2015), with long-term unemployment being particularly detrimental to physical health, such as hypertension (Acevedo et al. 2020; Strandh et al. 2014; Virtanen et al. 2013), this study investigates how unemployment duration influences the risk of developing hypertension.

Second, although racial inequalities in unemployment experiences are well documented, evidence on racial differences in their health consequences remains mixed, particularly for physical health. Studies suggest that unemployment is associated with greater mental health disadvantages among Black individuals than among White individuals (Diette et al. 2018; Lo and Cheng 2014). However, the impact on physical health is less consistent. While some studies find no evidence of racial or ethnic differences in health outcomes following involuntary job loss (Strully 2009), others report that racial/ethnic minorities in areas of high unemployment are at a greater risk of liver cancer mortality (Singh et al. 2013). Therefore, this study aims to examine how unemployment affects hypertension diagnosis, considering it as an indicator of a physical health outcome to fill the gaps in previous research.

To investigate the impact of unemployment duration on the risk of hypertension, we employed a case-crossover study design using data from the National Longitudinal Survey of Youth (NLSY) spanning the years 1983–2018. This design compares two distinct time periods: the case period, which refers to the time immediately preceding the hypertension diagnosis, and the control period, an equivalent length of time before the case period. Covariates are measured during both periods. Since each individual is observed across both periods, respondents serve as their own controls, effectively creating a self-matching design. When combined with a conditional logit model (i.e., a fixed-effects approach), this self-matching method allows for the adjustment of unmeasured time-invariant and slowly time-varying characteristics, such as childhood socioeconomic status, health status, genetics, and other unmeasured factors that could affect hypertension risk. This study adds to the literature on the social determinants of health by examining the specific role of unemployment on physical health outcomes, such as hypertension diagnosis, and exploring potential racial differences in this relationship.

2. Literature Review

2.1. *The Impact of Job Loss on Psychological and Physical Health*

A substantial body of literature has examined the impact of job loss on social-psychological well-being. Job loss triggers acute stress due to the immediate disruption of a key social role and leads to chronic stress arising from economic, social, and psychological strain. Empirical research has consistently shown that displaced workers report higher levels of depressive symptoms, somatization, anxiety, and a loss of psychosocial resources

(Brand 2015; Catalano et al. 2011). Several mechanisms explain the relationship between job loss and psychological well-being. Economic deprivation and downward socioeconomic mobility contribute to psychological distress, which intensifies with longer periods of unemployment.

Additionally, job loss can diminish self-esteem, aspirations, and time structure, while fostering resignation, apathy, uncertainty, and stigmatization, all of which are linked to depressive symptoms (Brand 2015). The impact of job loss, however, extends beyond psychological well-being to physical health. Unemployment has been linked to poorer self-rated health, physical disability, and other medical conditions. Unemployment is recognized as one of the social determinants of hypertension (Wang et al. 2023; Zagozdzon et al. 2014). Additionally, frequent job losses and short employment gaps significantly increase the risk of cardiovascular events (Dupre et al. 2012).

The psychological effects of job loss can shed light on its broader impact on physical health. Research indicates that stress-related biosocial mechanisms significantly contribute to negative health outcomes. For instance, experiences of perceived discrimination, when internalized as stress, add to allostatic load, the cumulative ‘wear and tear’ on bodily systems, thereby increasing the risk for conditions like hypertension and obesity (Goosby et al. 2018). Additionally, recent studies have emphasized the role of psychosocial stressors, including low socioeconomic status, negative emotional states, divorce, and unemployment, in the onset or progression of hypertension (Marwaha 2022). Given this established link between job loss and its impact on physical health through stress-related mechanisms, we focus on hypertension, a condition closely associated with stress and perceived discrimination.

Furthermore, previous research has highlighted the role of prolonged unemployment in exacerbating both psychological and physical health risks. As the duration of unemployment increases, so do financial strain and psychological stress (McKee-Ryan et al. 2005). Additionally, declines in earnings and job quality tend to worsen with extended periods of unemployment (von Wachter 2010). Empirical evidence suggests that long-term unemployment is associated with heightened risk of physical health issues, such as hypertension (Acevedo et al. 2020), and even increased all-cause mortality (Garcy and Vågerö 2012). Considering that cumulative stress effects intensify over time with increases in unemployment duration, we propose the following hypothesis:

Hypothesis 1 (Cumulative Stress Hypothesis). *Each additional week of unemployment is associated with increased odds of receiving a hypertension diagnosis.*

2.2. The Nexus Between Race, SES, and Physical Health

The relationship between socioeconomic status (SES) and health is one of the most consistent and enduring findings in the health disparities literature. Higher SES is consistently associated with better physical well-being (Braveman et al. 2010; Elo 2009). While there is ongoing debate about whether the mechanisms linking SES to health arise from differential access to material resources or are primarily psychosocial in nature (Link et al. 2013; Seeman et al. 2014), scholars argue that SES is a fundamental cause of health disparities (Clouston and Link 2021; Link and Phelan 1995; Phelan et al. 2010).

Despite this association’s seemingly well-established nature, a growing body of literature suggests that the association between SES and health depends on race. Phelan and Link (2015) argue that racial inequalities in health persist because racism drives racial differences in SES, and SES is a fundamental cause of health inequalities. Systemic racism embodies flexible resources that advantage whites, including the domination of whites in major government and commercial institutions, individual resources, and social and psychological advantages that sustain whites (Phelan and Link 2015). Moreover, regardless of socioeconomic status, race is associated with flexible resources, such as prestige, power,

beneficial social connections, and freedom. Additionally, racism is related to multiple health outcomes via multiple mechanisms—racial bias in medical care, stress from experiences of discrimination, and societal stigma of inferiority, independent of SES (Phelan and Link 2015; Williams et al. 2010). Racial disparities across multiple domains form an integrated system that is self-perpetuating through reciprocal feedback loops, making the elimination of racial disparities increasingly difficult (Phelan and Link 2015; Reskin 2012).

While unemployment affects health negatively through psychosocial and financial mechanisms (Burgard et al. 2012; Burgard and Lin 2013; Krug and Eberl 2018), systemic racism affects the unemployment system, leading to different unemployment outcomes across races. Firstly, unemployment rates vary considerably across racial lines, with a persistent disparity between Black and non-Black groups; this racial dichotomy largely explains unemployment trends (Emeka 2009; Williams 1999). Black applicants not only face persistent hiring discrimination but also have lower reemployment chances compared to White counterparts with similar qualifications (Bertrand and Mullainathan 2004; Pager et al. 2009). Secondly, racial disparities extend to savings, homeownership, social networks, and access to unemployment benefits. White middle-class men typically experience less insecurity following job losses due to better financial cushioning (Damasko 2021) and broader social networks that more effectively facilitate job searches (Pedulla and Pager 2019). Conversely, Black workers are more likely to be unemployed without unemployment insurance (Mar et al. 2022). Given these disparities, it is crucial to explore how these inequalities translate into health outcomes.

Previous studies examining the nexus of race, unemployment, and health reveal complex interactions, with mixed findings on the differential impact of unemployment on health across racial groups. Strully (2009) highlights two contrasting hypotheses that may explain these variations. The ‘Double Jeopardy’ hypothesis posits that, due to economic disparities and discrimination, displaced Black workers have fewer resources to cope with job loss, leading to more significant health declines. Conversely, the ‘Reverse Double Jeopardy’ hypothesis suggests that White workers, having more economic stability and more to lose, may experience more severe health declines following unemployment. While research on the nexus of race, unemployment, and physical health is scarce, studies focusing on mental health outcomes present a mixed picture: some researchers find that unemployment affects the mental health of Black respondents more severely than White respondents (Diette et al. 2018; Lo and Cheng 2014), while Strully (2009) finds no significant racial or ethnic differences in health outcomes after job loss. Additionally, there is no significant difference between unemployed and employed Black individuals, in contrast to White individuals, in predicting depression and well-being (Rodriguez et al. 1999).

Although findings are mixed, racial disparities in socioeconomic status (SES) and the impact of structural racism shape the unemployment experience differently across racial groups (Mar et al. 2022; Pedulla and Pager 2019). Building on the double jeopardy hypothesis, we might expect that displaced Black respondents, facing greater economic disparities and discrimination, have fewer resources to cope with job loss, potentially leading to a stronger association between unemployment duration and hypertension diagnosis than among non-Black respondents. At the same time, the mixed evidence reviewed above leaves open the possibility that this association does not differ significantly by race, whether because job-related stress operates as a relatively universal cardiovascular risk factor across racial groups, or because other, unmeasured processes obscure a true underlying difference. Given this tension between theoretical expectation and prior empirical evidence, we test the following hypothesis:

Hypothesis 2 (Double Jeopardy Hypothesis). *The association between unemployment duration and hypertension diagnosis differs across Black and non-Black groups.*

3. Data and Methods

3.1. Data and Sample

To test the hypotheses, we used the National Longitudinal Surveys of Youth (NLSY) 79, a nationally representative longitudinal survey of people born between the years 1957 and 1964 and living in the United States in 1979. The NLSY79 began surveying 12,686 youth ages 14–21 in 1979 and continued annual surveys through 1994, after which surveys were conducted biennially. The survey questions include sociodemographic information, such as education, employment status, gender, race, and marital status, as well as biomarker health indicators (e.g., hypertension, BMI) and health behaviors (e.g., alcohol consumption, exercise habits), making this dataset well suited for analyzing the relationship between unemployment and hypertension diagnosis.

We first limited our sample to respondents aged 26 or older, since some individuals may still be attending college by age 25 and thus not yet fully entered the labor market; several previous studies have adopted the same age-26 threshold to examine the role of employment on health status (Frech et al. 2022; Zheng and Yu 2022). Consequently, our study encompasses survey years starting in 1983, when the earliest birth cohort (born in 1957) first reached age 26. Because the case-crossover design requires data only from individuals who experienced the outcome of interest, our analytic sample is further restricted to respondents who received a doctor's diagnosis of hypertension. To assess the impact of unemployment exposure on the likelihood of this diagnosis, we additionally excluded individuals diagnosed before age 30 or after 2012, since respondents at these ages were more likely to not yet have entered, or to have already exited, the labor force through schooling or retirement rather than experiencing unemployment in the conventional sense; the resulting sample comprises respondents diagnosed with hypertension between 1992 and 2012.

Missingness increased over the course of the panel, suggesting that attrition may have contributed to missing data. We applied observation-level deletion, excluding case- and control-period observations with missing values on any analysis variable. Respondents were retained only if they contributed at least one complete case-period observation and one complete control-period observation, forming an informative matched set for the conditional logistic regression analysis. After these exclusions, including those for missing sex, U.S. citizenship status, educational attainment, health-related work limitations, marital status, and poverty status, the final analytic sample comprised 2027 respondents. Appendix A Tables A1–A3 document sample attrition and comparisons between retained and excluded respondents. Respondents excluded following observation-level deletion were more likely to be Black and female, to have experienced poverty at age 25, to have lower educational attainment, and to report more weeks of unemployment. These differences suggest that socioeconomically disadvantaged respondents may be underrepresented in the final analytic sample, although their implications for the direction of potential selection bias remain unclear.

3.2. Study Design: Rationale for Case-Crossover Approach

This study applied the case-crossover method to examine the role of unemployment duration on hypertension diagnosis (see Figure 1). The case-crossover method is especially effective in investigating how acute exposures influence the risk of certain events. This method utilizes a fixed-effect approach for non-repeated events by applying conditional logistic regression to discrete-time data. The case-crossover method only includes a sam-

ple of individuals who have experienced events ('cases') and records the values of their covariates at the time of the event (Allison and Christakis 2006). Additionally, it identifies the control period, which is the same length of time before the case period, and records the values of their covariates at that time. Considering that it focuses on two different time periods from the same individuals, each respondent acts as their own control, moving back and forth between case and control periods (Maclure 1991). The advantage of this method is that it eliminates unmeasured time-invariant and slow-varying factors by self-matching, such as childhood SES/health status, genetics, past psychiatric illness, and many other characteristics of respondents not recorded in the survey that might affect hypertension risks. Conditional logit regression was conducted using Stata 18.



Figure 1. Case-crossover study design.

The case-crossover design is routinely used to examine associations between transient exposures and acute events, but its applications are not limited to outcomes with abrupt onset. Maclure and Mittleman (2000) describe applications involving single changes in exposure, gradual effects on risk, and outcomes with insidious onset. More recently, Wei et al. (2026) discuss extensions to longer exposure windows, noting that self-matching becomes less effective at controlling for slowly varying confounders as the time scale increases.

In our study, the case-defining event is a self-reported physician diagnosis of hypertension, rather than disease onset. We compare the total number of weeks unemployed during the previous calendar year between case and control periods within the same individual. This annual exposure window reflects the temporal resolution of our unemployment measure and our focus on cumulative exposure within a year. We also adjust for measured time-varying covariates. This approach enables us to examine within-person associations between annual unemployment exposure and hypertension diagnosis.

Building on this precedent, we employed a case-crossover design to study the impact of unemployment on hypertension diagnosis for several practical reasons. First, the NLSY79 dataset had significant missing data for key control variables, such as health insurance, occupation, and unemployment status, making it difficult to analyze the long-term effects of unemployment using a longer observation window. This challenge was especially pronounced for individuals over age 50, among whom hypertension diagnoses are more common, but responses on employment status, unemployment duration, and health behaviors were frequently missing. Second, although we initially considered a Cox proportional hazards model, it could not account for unmeasured time-invariant confounders, such as genetic or environmental factors, that might significantly influence hypertension risk. The results from a Cox proportional hazards model are included in Table A6. The case-crossover design, using a conditional logit model with a fixed-effects approach, offers an alternative that directly addresses this unobserved heterogeneity by design rather than through modeling assumptions.

3.3. Measures

3.3.1. Dependent Variable: Hypertension Diagnosis

The outcome is a first-time diagnosis of hypertension by a doctor during the observation period. The diagnosis is based on a question in the NLSY79 questionnaire: “Has a doctor ever diagnosed you with high blood pressure or hypertension?” Responses were coded as 0 for ‘no’ and 1 for ‘yes.’ For respondents who answered ‘yes,’ the survey asked about the year and month of diagnosis. Using this information, we defined the case period as the four years preceding the hypertension diagnosis and the control period as the four years preceding the case period, with each individual having their own specific case and control periods. The four-year window was determined a priori, based on the measurement structure of the NLSY79 and on the plausible etiological window linking unemployment to hypertension, rather than through post hoc comparison of alternative window lengths. NLSY 79 was conducted annually through 1994 and biennially thereafter. Therefore, health and employment status are directly observed only once every two years; a window shorter than four years would not allow the case and control periods to each align with a distinct survey wave, and covariate values within a single-wave window would have insufficient variation to support meaningful comparison. A four-year window, spanning two full survey waves, is therefore the shortest interval at which case and control periods can be anchored to directly observed covariate values. This structural constraint is also consistent with the etiological plausibility that the physiological burden of unemployment (e.g., chronic stress) accumulates over a period of multiple years (Acevedo et al. 2020; Garcy and Vågerö 2012), and that the resulting diagnosis, while dependent on intermittent physician contacts, can reasonably be treated as a discrete, dateable event relative to that accumulated exposure.

3.3.2. Independent Variable: Unemployment Duration

Our main independent variable is the total number of weeks unemployed during the previous calendar year, measured using an NLS-created summary variable for survey years 1983–2018. Values range from 0 to 52 or 53 weeks and are grouped into four categories: 0 weeks (reference), 1–26 weeks, 27–44 weeks, and 45 weeks or more. The 26-week cutoff reflects the typical maximum duration of regular unemployment benefits in most U.S. states. This measure captures annual cumulative unemployment exposure in the last calendar year, which may include multiple spells, rather than the duration of a single continuous spell. Spells crossing calendar-year boundaries contribute only the weeks within the reference year, regardless of the length of unemployment before the reference year. Following the transition to biennial interviewing after 1994, this measure does not cover the entire interval between interviews. We compare case and control periods within the same individual to examine whether differences in annual unemployment exposure are associated with the likelihood of a hypertension diagnosis.

3.3.3. Covariates

Other control variables include sociodemographic and work-related factors that may influence hypertension diagnosis (Commodore-Mensah et al. 2018; Meneton et al. 2015; Zagozdzon et al. 2014). These include time-varying measures, such as occupation, poverty status, and marital status, and time-invariant measures, such as citizenship status, educational attainment, and health-related work limitations, based on the original questionnaire. Occupation is categorized into five groups: (1) managerial and professional (reference); (2) technicians, sales, and administrative support; (3) service; (4) farming, forestry, fishing, construction, precision production, craft, and repair; and (5) transportation. Poverty status is coded as (1) not in poverty (reference) or (2) in poverty. Marital status includes three cate-

gories: (1) married (reference); (2) never married; and (3) divorced, separated, or widowed. Gender is coded as a binary variable (1 = female [reference], 2 = male). Citizenship status is categorized as (1) non-U.S. citizen (reference) or (2) U.S. citizen. Educational attainment is a continuous variable ranging from 3 to 20 years, representing years of education completed by age 25. Health insurance status is time-varying, coded as 0 for not having health insurance (reference) and 1 for having health insurance.

We also included a time-varying covariate for weekly working hours, centered around the mean to align it with other binary and categorical measures, given prior evidence linking longer working hours to elevated hypertension risk (Yoo et al. 2014). To address potential selection effects between unemployment and health, we incorporated a time-invariant binary variable for “work limitations due to health,” based on respondents’ reports at age 25 (yes = 1, no = 0), as recommended by prior research (Frech et al. 2022).

We also controlled for overweight status, using respondents’ height and weight data to create a binary variable (0 = not overweight [BMI < 25, reference], 1 = overweight [BMI ≥ 25]). Binge drinking is a dummy variable coded 1 if the respondent reported having six or more drinks on a single occasion at least once in the past 30 days, and 0 otherwise. Physical inactivity is a dummy variable coded 1 if the respondent reported no moderate or vigorous physical activity, and 0 otherwise. Because of substantial missingness (up to 30%) in these health behavior measures, we excluded them from the main analysis and examined them only in a sensitivity analysis (see Appendix A).

3.3.4. Race/Ethnicity

The NLSY79 classifies race/ethnicity into three categories: Non-Hispanic & Non-Black, Hispanic, and Non-Hispanic Black. The Non-Hispanic & Non-Black group includes individuals who self-reported as white or belonging to “other” racial groups, such as Japanese, Chinese, Vietnamese, Asian Indian, Native American, Korean, Eskimo, Pacific Islander, or another race besides Black or white (NLSY79). The Non-Hispanic Black category (hereafter, Black) includes individuals who self-identified as Black or Afro-American. The Hispanic category includes individuals who self-identified as Hispanic. We created a binary race variable to examine differences between Black and non-Black respondents, combining Non-Hispanic & Non-Black and Hispanic individuals into a single Non-Black category (coded 0) and coding Non-Hispanic Black individuals as Black (coded 1). The final sample includes 803 Black respondents and 1224 Non-Black respondents.

3.3.5. Analytical Strategy

This study follows three steps to examine the role of unemployment duration in hypertension diagnosis. First, we present descriptive statistics comparing exposure to unemployment duration across racial groups, using chi-square tests and independent-samples t-tests, along with descriptive statistics for the case and control periods. Second, to test H1, the overall association between unemployment duration and hypertension diagnosis, we estimated a conditional logit model for the full sample. Third, to test H2, whether this association differs by race, we estimated a conditional logit model including an interaction term between race and unemployment duration; this formal interaction test constitutes our primary test of effect modification by race. As a descriptive complement, we also present race-stratified models in Table A4.

4. Results

Descriptive Statistics

Table 1 presents descriptive statistics for non-Black and Black respondents, calculated at the respondent level using information from each respondent’s case and control periods

(see the table note). Group differences were assessed using chi-square tests for categorical variables and independent samples *t*-tests for continuous variables. Compared with non-Black respondents, Black respondents had higher percentages of unemployment lasting 1–26 weeks (11.58% vs. 9.40%), 27–44 weeks (2.62% vs. 1.31%), and 45–52 weeks (0.87% vs. 0.49%). The overall distribution of unemployment duration differed significantly between the two groups ($p < 0.05$).

Table 1. Descriptive statistics of respondents who received a hypertension diagnosis.

Variables	Non-Black	Black	Chi-Square Test/ <i>t</i> -Test
Time-invariant variables			
Male (%)	55.31	45.33	***
Non-US-citizen (%)	7.60	1.37	***
Educational attainment in years, at age 25, mean (SD)	12.62 (2.29)	12.67 (1.91)	n.s.
Health limits kind of work R can do, at age 25 (%)	4.00	3.61	n.s.
Time-varying variables			
Age, mean (SD)	40.91 (6.28)	40.53 (5.91)	n.s.
Unemployment duration (%)			*
Not unemployed	88.81	84.93	
1–26 weeks	9.40	11.58	
27–44 weeks	1.31	2.62	
45–52 weeks	0.49	0.87	
Average working hours, mean (SD)	38.57 (12.58)	38.09 (13.65)	n.s.
Marital status (%)			***
Married	64.79	38.48	
Never married	15.11	34.74	
Separated/Divorced/Widowed	20.10	26.77	
In poverty (%)	9.95	19.71	***
Occupation (%)			***
Managerial and professional	29.58	21.30	
Technicians, sales, administrative support	24.35	23.04	
Service	14.87	24.91	
Farming, forestry, fishing, operators, inspectors	19.53	22.54	
Precision production, craft, repair	11.68	8.22	
No health insurance (%)	18.42	20.63	n.s.
Overweight (BMI ≥ 25) (%)	80.29	85.54	**
Drinking (6+ drinks in last 30 days) (%)	34.98	27.25	***
Physically inactive (%)	17.03	22.82	***
<i>n</i>	1224	803	

Note: Time-invariant variables reflect each respondent's fixed value. Time-varying continuous/binary variables reflect each respondent's average across all case and control period observations (each respondent weighted equally regardless of number of periods). Time-varying categorical variables with more than two categories (unemployment duration, marital status, occupation) reflect status at the control period closest to the diagnosis (case) period. Drinking and physical inactivity had additional missingness, so their reported percentages are based on a smaller subsample than the *n* shown below. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, n.s. = not significant.

Among Non-Black respondents, 55.31% are male, compared to 45.33% among Black respondents. Regarding citizenship status, 7.6% of Non-Black respondents and 1.37% of Black respondents are non-U.S. citizens. Mean educational attainment by age 25 is 12.62 years ($SD = 2.29$) for Non-Black respondents and 12.67 years ($SD = 1.91$) for Black respondents. Additionally, 4% of Non-Black respondents report a health limitation affecting their ability to work, compared to 3.61% of Black respondents. Average age is similar between groups: 40.91 years ($SD = 6.28$) for Non-Black respondents and 40.53 years ($SD = 5.91$) for Black respondents. Non-Black respondents work longer hours per week on average (38.57, $SD = 12.58$) than Black respondents (38.09, $SD = 13.65$).

Marital status differs significantly between the two groups. Among Non-Black respondents, 64.79% are married and 15.11% are never married, compared to 38.48% married and 34.74% never married among Black respondents, as indicated by the chi-square test. Additionally, 9.95% of Non-Black respondents are in poverty, compared to 19.71% of Black respondents. Regarding occupation, a higher proportion of Non-Black respondents work

in managerial and professional roles (29.58%) compared to Black respondents (21.30%). Regarding health insurance, a significantly larger percentage of Black respondents lack coverage (18.42%) compared to Non-Black respondents (20.63%). Overall, Table 1 indicates that unemployment duration, marital status, occupation, gender, nativity, and health behaviors differ significantly between the two racial groups.

Table 2 presents respondents' characteristics during the case and control periods, stratified by racial group. In both periods, Black respondents were less likely than non-Black respondents to report no unemployment (control period: 84.13% vs. 88.62%; case period: 88.17% vs. 90.39%). Both racial groups worked more hours during the control period than during the case period, and non-Black respondents worked longer hours than Black respondents in both periods. The proportions of respondents who were married, held managerial or professional occupations, and were physically inactive were higher during the case period than during the control period. Conversely, the proportion of respondents without health insurance was higher during the control period than during the case period.

Table 2. Characteristics of Respondents During Control and Case Period by race.

Variables	Control: Non-Black	Control: Black	Case: Non-Black	Case: Black
Unemployment duration (%)				
Not unemployed	88.62	84.13	90.39	88.17
1–26 weeks	9.74	12.79	7.20	7.94
27–44 weeks	1.14	2.21	1.26	2.15
45–52 weeks	0.51	0.87	1.14	1.74
Averaged working hours, mean (SD)	40.11 (15.22)	39.05 (16.09)	38.71 (16.37)	38.48 (17.95)
Marital status (%)				
Married	64.88	39.58	66.38	40.37
Never married	15.94	35.63	12.64	30.28
Separated/Divorced/Widowed	19.18	24.78	20.98	29.35
In poverty (%)	8.81	18.75	9.23	17.93
Occupation (%)				
Managerial and professional	29.26	21.84	34.57	25.36
Technicians, sales, administrative support	25.17	24.05	23.63	22.18
Service	14.17	24.25	13.97	23.41
Farming, forestry, fishing, operators, inspectors	19.48	21.84	18.45	21.62
Precision production, craft, repair	11.93	8.04	9.38	7.43
Not having health insurance (%)	18.59	19.62	16.40	18.55
Overweight (BMI $\geq$ 25) (%)	77.36	83.26	82.31	87.50
Drinking (6+ drinks in last 30 days) (%)	35.24	27.81	26.29	16.47
Physically inactive (%)	16.25	23.73	18.15	25.22
<i>n</i>	1224	803	1224	803

Note: Case-crossover studies use a fixed-effect approach that removes the effect of time-invariant characteristics. Table 2 therefore shows only time-varying variables, separately for case and control period person-period observations, by race. Values reflect respondent characteristics pooled across all case-period (or control-period) observations, restricted to non-missing observations; unlike Table 1, no person-level averaging is applied.

5. Results from Case-Crossover Studies

Table 3 presents results from multivariable conditional logistic regression models examining the association between unemployment duration and hypertension diagnosis. Model 1 adjusts for sociodemographic characteristics and health insurance status, and Model 2 additionally adjusts for overweight status. In Model 1, reporting 45–52 weeks of unemployment in the previous calendar year was associated with approximately 2.2 times the odds of a hypertension diagnosis compared with reporting no unemployment, within the same individual (OR = 2.197, $p < 0.01$). This association remained largely unchanged after adjustment for overweight status in Model 2 (OR = 2.147, $p < 0.01$). In contrast, reporting 1–26 weeks of unemployment was associated with lower odds of a hypertension diagnosis (OR = 0.645, $p < 0.001$). These findings support H1 with respect to long-term

unemployment: unemployment lasting 45–52 weeks was associated with higher odds of a hypertension diagnosis.

Table 3. Results from the conditional logit model for the overall sample.

Variable	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Unemployment duration (ref = 0 week)		
1–26 weeks	0.645 *** (0.55, 0.76)	0.645 *** (0.54, 0.76)
27–44 weeks	0.899 (0.62, 1.31)	0.930 (0.64, 1.36)
45–52 weeks	2.197 ** (1.32, 3.65)	2.147 ** (1.29, 3.58)
Working hours (centered at mean)	0.988 *** (0.98, 0.99)	0.988 *** (0.98, 0.99)
Occupation (ref = Managerial and professionals)		
Technicians, sales, admin support	0.584 *** (0.49, 0.70)	0.582 *** (0.49, 0.70)
Service	0.630 *** (0.51, 0.78)	0.619 *** (0.50, 0.77)
Farming, forestry, fishing, construction	0.514 *** (0.41, 0.65)	0.514 *** (0.41, 0.65)
Precision production, craft, repair, transportation	0.379 *** (0.29, 0.50)	0.374 *** (0.28, 0.49)
Having health insurance	1.263 ** (1.08, 1.48)	1.257 ** (1.07, 1.47)
In poverty	0.941 (0.78, 1.13)	0.946 (0.79, 1.14)
Marital status (ref = married)		
Never married	0.019 *** (0.01, 0.05)	0.020 *** (0.01, 0.05)
Divorced/separated/widowed	1.562 *** (1.27, 1.92)	1.623 *** (1.32, 1.99)
Overweight		2.504 *** (2.03, 3.09)
Observations	8982	8982
Persons	2027	2027
Log-likelihood	−3738.1	−3699.9

Note: Exponentiated coefficients (OR) with 95% CI. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Sample: $n = 2027$ respondents (8982 person-periods), using consistent row-level deletion across all covariates, including unemployment duration. Time-invariant covariates (health limitation at age 25, education at age 25, race/ethnicity, gender, US-born status) are controlled but not displayed, per standard conditional logit practice.

Regarding occupation, individuals employed in precision production, craft, or repair jobs are significantly less likely to receive a hypertension diagnosis than those in managerial and professional roles (OR = 0.374, $p < 0.001$). Having health insurance is also associated with significantly higher odds of a hypertension diagnosis (OR = 1.257, $p < 0.001$), likely reflecting greater access to diagnostic screening.

To formally test H2, whether the association between unemployment duration and hypertension diagnosis differs between Black and non-Black respondents, we estimated a conditional logit model including an interaction term between race and unemployment duration (Table 4). The main effect of unemployment duration, representing the association among non-Black respondents (the reference group), remained significant and consistent with the pooled estimate reported above (OR = 2.271, $p < 0.05$). However, the Black $\times$ unemployment duration interaction term was not statistically significant, indicating that the strength of the association did not differ meaningfully by race. This finding does not support H2.

This result is inconsistent with the descriptive pattern noted earlier (Table 2), where the direction of the case–control difference in unemployment duration diverged between racial groups at the level of simple means; the formal interaction test indicates that this divergence does not translate into a statistically distinguishable difference in the within-person association once the full model is estimated. Although stratified models (Table A4) show a significant association among non-Black respondents (OR = 2.3, $p < 0.05$) but not among Black respondents (OR = 2.015, n.s.), this pattern should not, on its own, be read as evidence of effect modification.

Beyond unemployment duration, the stratified models suggest exploratory differences in the associations between control variables and hypertension diagnosis (Table A4). Employment in precision production, craft, or repair occupations, relative to managerial and

professional occupations, was associated with lower odds of hypertension diagnosis among both non-Black respondents (OR = 0.324, $p < 0.001$) and Black respondents (OR = 0.477, $p < 0.01$), with a lower point estimate among non-Black respondents. Being divorced, separated, or widowed was associated with higher odds of hypertension diagnosis, with a larger point estimate among Black respondents (OR = 1.889, $p < 0.001$) than among non-Black respondents (OR = 1.513, $p < 0.01$). These between-group differences were not formally tested using interaction terms and should therefore be interpreted as exploratory rather than confirmatory. We highlight them as potential directions for future research rather than as evidence of racial differences in these associations.

Table 4. Results from the Conditional logit model including the interaction term between Black and unemployment duration.

Variable	OR (95% CI)
Black (main effect)	not estimable (time-invariant)
Unemployment duration (ref = non-Black)	
1–26 weeks	0.725 ** (0.58, 0.90)
27–44 weeks	0.917 (0.54, 1.55)
45–52 weeks	2.271 * (1.10, 4.70)
Black × Unemployment duration (ref = non-Black × 0 week)	
Black × 1–26 wks	0.755 (0.54, 1.06)
Black × 27–44 wks	1.008 (0.48, 2.13)
Black × 45–52 wks	0.883 (0.32, 2.44)
Working hours (centered at mean)	0.988 *** (0.98, 0.99)
Occupation (ref = Managerial and professionals)	
Technicians, sales, admin support	0.583 *** (0.49, 0.70)
Service	0.617 *** (0.49, 0.77)
Farming, forestry, fishing, construction	0.515 *** (0.41, 0.65)
Precision production, craft, repair, transportation	0.373 *** (0.28, 0.49)
Health insurance	1.259 ** (1.07, 1.48)
In poverty	0.945 (0.79, 1.14)
Marital status (ref = married)	
Never married	0.020 *** (0.01, 0.05)
Divorced/separated/widowed	1.622 *** (1.32, 1.99)
Overweight	2.500 *** (2.02, 3.09)
Observations	8982
Persons	2027
Log-likelihood	−3698.6

Note: Exponentiated coefficients (OR) with 95% CI. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Black is a time-invariant characteristic; because conditional logistic regression conditions out (drops) time-invariant main effects via person-level strata, the Black main effect is not separately identifiable and is not estimated. This model was estimated on the same analytic sample as Table 3, ensuring that the test of H1 and the test of H2 are directly comparable.

Sensitivity Analysis

This study also conducted a sensitivity analysis incorporating health behaviors, given that prior research suggests these factors may confound the relationship between unemployment and hypertension risk (Méjean et al. 2013; Virtanen et al. 2013). Because health behavior variables carried substantial missingness, their inclusion in the main models would have sharply reduced the analytic sample; we therefore examined them here as a robustness check rather than in the primary specification. This additional adjustment for missing data reduced the sample considerably, to 744 respondents (Table A5).

After adjustment for these health behaviors, binge drinking and physical inactivity, long-term unemployment in the previous calendar year remained associated with higher estimated odds of hypertension diagnosis relative to periods of no unemployment within the same individual (OR = 2.45); however, the association was no longer statistically significant. Although the significance level attenuated somewhat with the smaller sample,

as would be expected given the substantial loss of statistical power, the direction and approximate magnitude of the association held across all models (Figure A1 in Appendix A), providing some reassurance that the exclusion of health behaviors from the main models is unlikely to have driven the reported findings.

6. Conclusions and Discussion

This study used a case-crossover design to investigate the role of unemployment duration in hypertension diagnosis, controlling for time-invariant heterogeneity such as genetics and childhood socioeconomic status. By comparing case and control periods within the same individual, this approach accounts for stable measured and unmeasured confounders. Compared with periods with no reported unemployment, spells with 1–26 weeks of unemployment were associated with lower odds of hypertension diagnosis ($OR = 0.645, p < 0.001$), whereas spells with 45–52 weeks were associated with significantly higher odds, consistent with H1. These results suggest a non-monotonic association between annual unemployment exposure and hypertension diagnosis. One possible explanation for the lower odds associated with 1–26 weeks is selection related to health, resilience, and socioeconomic resources. Some spells in this category may reflect manageable employment transitions during which individuals with more robust health and greater resilience return to work more quickly. Another explanation is that eligible individuals for unemployment benefits (up to 26 weeks in the majority of the states) might provide an additional financial buffer without work-related stress. It is a tentative interpretation because the survey does not have direct measures of resilience, rapid reemployment, benefit receipts, or differences in working conditions.

A formal test of H2, whether this association differs between Black and non-Black respondents, did not find evidence of significant effect modification by race, despite a suggestive divergence in the race-stratified estimates. Nevertheless, the supplementary Cox models showed a higher hazard of hypertension diagnosis among Black respondents (Table A6), consistent with prior research documenting higher hypertension incidence among Black than White adults (Thomas et al. 2018).

This null finding for H2 diverges from the prediction of the Double Jeopardy hypothesis (Strully 2009), which anticipated a stronger association among Black respondents given their greater structural vulnerability to job loss and its consequences. At the same time, it is consistent with a broader body of mixed evidence on race and the health effects of unemployment, including null findings for racial differences in both physical and mental health outcomes following job loss (Rodriguez et al. 1999; Strully 2009). Descriptively, a higher percentage of Black respondents in our sample experienced longer unemployment duration than non-Black respondents (Table 1), reflecting well-documented structural inequalities in hiring, unemployment insurance access, and job search networks (Mar et al. 2022; Pedulla and Pager 2019). That this greater exposure did not translate into a statistically distinguishable difference in the association between duration and hypertension, however, suggests that the mechanisms linking unemployment to hypertension may operate similarly once unemployment occurs, even as the racial distribution of exposure to unemployment itself remains highly unequal.

Several plausible mechanisms may help explain why a significant racial difference did not emerge in the interaction test, even if true differences exist. First, a healthy worker effect may operate differentially by race: individuals in poorer health may be more likely to exit the labor force early, and if this selection process differs by race, it could attenuate a true underlying interaction. We note that Black respondents in our analytic sample reported somewhat lower rates of health-limiting conditions at age 25 than non-Black respondents (3.61% vs. 4%; Table 1), a pattern that is at least consistent with differential selection into

this sample, though our data cannot directly confirm it. Second, the psychosocial and physiological stressors associated with job loss and prolonged unemployment, such as financial strain, loss of routine, and diminished self-esteem, may function as relatively universal cardiovascular risk factors, affecting Black and non-Black respondents similarly regardless of the broader structural context of unemployment. Third, macro-level factors not directly measured here, such as neighborhood socioeconomic conditions, differential healthcare access, and the cumulative effects of systemic racism operating independently of individual employment history, may exert a stronger influence on hypertension risk than unemployment duration itself. We emphasize that these explanations are conjectural, offered as directions for future research rather than as conclusions supported by the present data.

Several limitations should be considered when interpreting these findings. First, our four-year case and control windows are considerably longer than the exposure windows typically used in classical case-crossover studies, which rely on short (day-, week-, or month-scale) intervals precisely to minimize the likelihood that time-varying confounders shift within the window. While we have argued that this longer window is necessitated by the biennial structure of the NLSY79 and by the detection lag inherent to hypertension diagnosis, it correspondingly leaves more room for unmeasured, time-varying factors within the case and control windows to influence results; case-crossover methods effectively control time-invariant heterogeneity but are less suited to rapidly changing confounders (Maclure 1991). Relatedly, because our four-year case-control window spans a study period (1983–2018) covering multiple macroeconomic cycles, our estimates may be subject to residual time-trend bias if the case and control periods for individual respondents were unevenly distributed across periods of differing aggregate unemployment (Bateson and Schwartz 1999). While our fixed, symmetric case-control interval limits this risk by design, we were unable to formally test for residual confounding of this kind, and we flag it as a priority for future work.

Second, our data cannot rule out reverse causation, as unmeasured factors may influence both unemployment duration and hypertension risk; poor health can itself increase the likelihood of unemployment (Hoffmann et al. 2019; Virtanen et al. 2013). Although we controlled for work-limiting health conditions at age 25, health deterioration over time could still shape unemployment experiences. Missing data on health behaviors further limits our ability to account for other confounders, though our sensitivity analysis suggests the core results are not substantially altered by their inclusion.

Third, our analysis assumes that selection out of the labor force through disability, retirement, or other pathways not captured by our unemployment measures does not differ systematically by race; if such selection is race-differential, as suggested above, it could obscure a true underlying racial difference that our interaction test was unable to detect.

Fourth, “hypertension diagnosis” as an outcome measure is subject to underdiagnosis bias: prolonged unemployment may itself restrict healthcare access, leaving hypertension cases undetected and potentially leading to an underestimation of unemployment’s true impact. Prior research indicates that delayed diagnosis is more common among individuals of lower socioeconomic position, members of racial and ethnic minority groups, and those without health insurance (Dieteren et al. 2021; Lu et al. 2025; Salazar Flórez et al. 2023). Although our models include time-varying indicators of socioeconomic position, such as occupation, working hours, health insurance coverage, and poverty status, they cannot represent all determinants of diagnostic delay, and unmeasured factors may remain. Moreover, the longer the latent period before diagnosis, the greater the associated health risk (Lu et al. 2025). The groups most likely to remain undiagnosed are therefore also those

facing the highest cardiovascular risk, so our estimates are likely to represent a conservative lower bound on the true health burden of unemployment.

Finally, hypertension is measured by self-reported physician diagnosis and its self-reported date. Although the item refers to a formal clinical diagnosis, which requires confirmation across multiple appointments and is therefore less prone to false positives than one-time screening, we cannot rule out false positives arising from misreporting, false negatives arising from undiagnosed or unreported cases, or measurement error in the self-reported date of diagnosis (Althubaiti 2016). Future work using physicians' clinical records rather than self-reported diagnosis would help establish the magnitude of this gap.

Despite these limitations, this study offers meaningful insights by isolating the association between unemployment duration and hypertension diagnosis while controlling for time-invariant unmeasured heterogeneity, such as genetics and childhood socioeconomic status, that is not addressed by the Cox proportional hazards models commonly used in the previous literature. Even within a relatively constrained four-year case and control window, longer unemployment duration was associated with significantly higher hypertension risk, consistent with prior research linking prolonged unemployment to adverse health outcomes (Strandh et al. 2014; Virtanen et al. 2008). By extending existing research on the health consequences of unemployment, historically concentrated on mental health outcomes, to a physical health outcome, this study also underscores that racial disparities in exposure to unemployment, rather than in the strength of its health consequences per se, may be the more consequential driver of racial inequities in unemployment-related hypertension risk. Future research with larger samples and direct measures of labor force selection, universal versus race-specific stress pathways, and macro-level context would help adjudicate among the explanations proposed above.

These findings nonetheless carry policy relevance. Black respondents in this sample experienced substantially longer and more frequent unemployment spells than non-Black respondents, a disparity well documented in the broader literature on labor market discrimination and unequal access to unemployment insurance (Mar et al. 2022; Pedulla and Pager 2019). Policies that reduce unemployment duration and expand access to unemployment benefits and reemployment support would therefore likely benefit Black workers' cardiovascular health disproportionately, even absent a statistically distinguishable racial difference in the underlying association between duration and hypertension risk. More broadly, because unemployment duration was associated with elevated hypertension risk across the full sample, policies that shorten unemployment spells and support reemployment may yield public health benefits regardless of race.

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Appendix A

Table A1. Sample Attribution Table.

Sample Selection Step	Remaining Sample	Excluded	% of Original Sample Excluded
Initial NLSY79 sample	12,686		—
Excluded non-black/non-Hispanic supplemental	11,043	1643	12.95%
Excluded military sample	9763	1280	10.09%
Excluded missing responses in hypertension	7660	2103	16.58%
Selected people with hypertension diagnosis	2836	4824	38.03%
Keep people who have an 8-year lookback window	2715	121	0.95%
Excluded via row-level complete-case deletion	2027	688	5.42%

Table A2. Comparison of Respondents Retained and Excluded Based on the Eight-Year Lookback Requirement.

Variable	Has 8-yr Window (<i>n</i> = 2715)	Excluded, Insufficient Window (<i>n</i> = 121)	<i>p</i>
Race/ethnicity (%)			0.896
Non-Black, Non-Hispanic	41.80	41.30	
Black	41.20	43.00	
Hispanic	17.10	15.70	
Male (%)	49.60	54.50	0.333
US-born (%)	95.10	94.20	0.821
Education at age 25 years, mean	12.45	12.31	0.471
In poverty at age 25, proportion, mean	0.22	0.20	0.624
Hypertension diagnosis year, mean	2005.96	1992.46	<0.001
Age at diagnosis, mean	45.46	32.17	<0.001

Table A3. Comparison of Respondents Retained and Excluded Following Observation-Level Deletion.

Variable	Included, Final Sample (<i>n</i> = 2027)	Excluded, Row-Level Deletion (<i>n</i> = 688)	<i>p</i>
Race/ethnicity (%)			0.008
Non-Black	60.4	54.3	
Black	39.60	45.80	
Male (%)	51.40	44.50	0.002
US-born (%)	94.90	95.80	0.390
Education at age 25 years, mean	12.64	11.90	<0.001
In poverty at age 25, proportion, mean	0.19	0.31	<0.001
Hypertension diagnosis year, mean	2006.00	2005.83	0.547
Age at diagnosis, mean	45.40	45.61	0.473
Mean unemployment duration across own observed periods (weeks)	2.21	3.49	<0.001

Table A4. Results from the conditional logit model for Non-Black and Black respondents.

Variable	Non-Black OR (95% CI)	Black OR (95% CI)
Unemployment duration (ref = 0 week)		
1–26 weeks	0.725 ** (0.58, 0.91)	0.548 *** (0.42, 0.71)
27–44 weeks	0.916 (0.54, 1.56)	0.953 (0.56, 1.63)
45–52 weeks	2.300 * (1.11, 4.79)	2.015 (0.98, 4.13)
Working hours (centered at mean)	0.988 *** (0.98, 0.99)	0.988 *** (0.98, 0.99)
Occupation (ref = Managerial and professionals)		
Technicians, sales, admin support	0.589 *** (0.47, 0.74)	0.580 *** (0.43, 0.79)
Service	0.602 *** (0.45, 0.80)	0.661 * (0.47, 0.94)
Farming, forestry, fishing, construction	0.453 *** (0.33, 0.61)	0.623 * (0.43, 0.91)
Precision production, craft, repair, transportation	0.324 *** (0.23, 0.46)	0.477 ** (0.30, 0.76)

Table A4. *Cont.*

Variable	Non-Black OR (95% CI)	Black OR (95% CI)
Having health insurance	1.289 * (1.04, 1.59)	1.215 (0.95, 1.55)
In poverty	1.024 (0.79, 1.33)	0.869 (0.67, 1.13)
Marital status (ref = married)		
Never married	0.016 *** (0.00, 0.07)	0.025 *** (0.01, 0.08)
Divorced/separated/widowed	1.513 ** (1.18, 1.94)	1.889 *** (1.31, 2.73)
Overweight	2.564 *** (1.96, 3.35)	2.386 *** (1.68, 3.38)
Observations	5537	3445
Persons	1224	803
Log-likelihood	−2305.5	−1390.6

Note: Exponentiated coefficients (OR) with 95% CI. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Models estimated separately by race. Compare with Table 4's interaction terms, which formally test whether these apparent differences are statistically significant.

Table A5. Results from the Conditional logit model including health behaviors.

Variable	OR (95% CI)
Unemployment duration (ref = 0 week)	
1–26 weeks	0.824 (0.55, 1.23)
27–44 weeks	1.584 (0.64, 3.93)
45–52 weeks	2.450 (0.91, 6.56)
Working hours (centered at mean)	0.987 ** (0.98, 0.99)
Occupation (ref = Managerial and professionals)	
Technicians, sales, admin support	0.582 ** (0.39, 0.88)
Service	0.402 *** (0.24, 0.68)
Farming, forestry, fishing, construction	0.575 (0.32, 1.05)
Precision production, craft, repair, transportation	0.156 *** (0.07, 0.34)
Having health insurance	1.674 ** (1.18, 2.38)
In poverty	0.793 (0.52, 1.20)
Marital status (ref = married)	
Never married	0.065 ** (0.01, 0.50)
Divorced/separated/widowed	1.867 ** (1.16, 3.00)
Overweight	2.471 *** (1.48, 4.13)
Drinking	0.575 ** (0.41, 0.81)
Physically inactive	0.853 (0.67, 1.08)
Observations	2013
Persons	744
Log-likelihood	−671.6

Note: Exponentiated coefficients (OR) with 95% CI. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Adjusting for drinking and physical inactivity does not reverse the direction or substantially change the magnitude of the 45–52 week association (OR = 2.64 without vs. 2.45 with these controls). Statistical significance is borderline ($p = 0.051$ and $p = 0.075$, respectively) due to the much smaller sample available for this specification ($n = 744$ persons) from high missingness in the drinking and physical inactivity measures, not confounding by these health behaviors.



Figure A1. Comparison of Point Estimates Across Analytic Samples (45–52 week unemployment). Note: points indicate odds ratios (ORs) and horizontal bars indicate 95% CI for 45–52 weeks of unemployment relative to the reference group, estimated from conditional logistic regression models. The dashed vertical line marks OR = 1 (no association); intervals crossing this line are not statistically significant at $\alpha = 0.05$. The x-axis is on a logarithmic scale. n denotes the number of respondents contributing to each model.

Table A6. Results from Cox Proportional Hazard Models (Shared Frailty and Standard Cox Regression).

Variable	Shared Frailty HR	95% CI	Regular Cox HR	95% CI
Unemployment duration (ref = 0 week)				
1–26 weeks	0.914	(0.79, 1.06)	0.914	(0.79, 1.06)
27–44 weeks	1.119	(0.86, 1.46)	1.119	(0.86, 1.46)
45–52 weeks	0.860	(0.65, 1.13)	0.860	(0.65, 1.13)
Working hours (centered at mean)	0.999	(1.00, 1.00)	0.999	(1.00, 1.00)
Occupation (ref = Managerial and professionals)				
Technicians, sales, admin support	0.957	(0.86, 1.07)	0.957	(0.86, 1.07)
Service	1.159 *	(1.03, 1.31)	1.159 *	(1.03, 1.31)
Farming, forestry, fishing, construction	1.040	(0.92, 1.18)	1.040	(0.92, 1.18)
Precision production, craft, repair, transportation	1.026	(0.88, 1.20)	1.026	(0.88, 1.20)
Having health insurance	1.200 ***	(1.08, 1.34)	1.200 ***	(1.08, 1.34)
In poverty	1.191 **	(1.06, 1.33)	1.191 **	(1.06, 1.33)
Marital status (ref = married)				
Never married	0.962	(0.86, 1.07)	0.962	(0.86, 1.07)
Divorced/separated/widowed	0.994	(0.90, 1.09)	0.994	(0.90, 1.09)
Health limitation at age 25	1.140	(0.94, 1.38)	1.140	(0.94, 1.38)
Education at age 25 (years)	0.965 ***	(0.95, 0.98)	0.965 ***	(0.95, 0.98)
Male	1.041	(0.96, 1.13)	1.041	(0.96, 1.13)
US-born	1.382 ***	(1.16, 1.65)	1.382 ***	(1.16, 1.65)
Black	1.696 ***	(1.56, 1.84)	1.696 ***	(1.56, 1.84)
Overweigh	2.265 ***	(2.03, 2.52)	2.265 ***	(2.03, 2.52)
Observations (person-periods)	85,656		85,656	
Events	2705		2705	
Persons	7305		7305	
Frailty term (test of unobserved individual heterogeneity for shared frailty model)				
Statistic			Value	
Variance of random effect (frailty)			5×10^{-5}	
Chi-square			0.133	
Degrees of freedom			0.135	
p-value			0.447	

Note: hazard ratios (HR) are reported with 95% CI. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The frailty variance is essentially zero and not statistically significant ($p = 0.447$), indicating little evidence of residual unobserved heterogeneity across individuals beyond what is explained by the included covariates.

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