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Occupational Racial Composition and Nonfatal Work Injuries

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Is there an association between occupational racial composition and nonfatal workplace injuries? Guided by several labor market theories (queuing, social closure, devaluation, poor market position, and human capital), we use occupational data from the U.S. Census and Dictionary of Occupational Titles combined with individual data from the National Longitudinal Survey of Youth to answer this question. Hierarchical generalized linear models of individuals within occupations show that there is an association between occupational racial composition and workplace injuries, but this association is only statistically significant for white men in the model controlling for relevant occupational and individual level characteristics. A 10 percent increase in the occupation percent black is associated with a 28 percent increase in injury risk. Contrary to expectations, white men have the highest adjusted odds of injury; white women and black men have significantly lower odds of injury than white men. Additionally, occupation-level environmental hazards and individual-level education, hours worked per week, jobs with insurance benefits, working in the South, and specific industries are associated with differential injury risk. These findings are consistent with labor market theories that suggest social closure, market position, and individual skills contribute to differential labor market outcomes. We demonstrate that sociological theories of labor market inequality are useful for understanding workplace injury risk, and that workplace injuries should be studied as an outcome of social inequality. Keywords: occupational racial composition, work injury, health, labor markets, and social inequality.

In 2005, work establishments reported 4.2 million nonfatal workplace injuries to the Bureau of Labor Statistics (BLS 2006). Across the private industry workforce, 4.6 full-time workers per 100 experienced an officially reported work injury. Recent evidence suggests that, like many health outcomes, nonfatal workplace injuries are not equally distributed across social groups, particularly by occupation and race (Murray 2003). Nonfatal work injuries are most common for truck drivers, health aides, nurses, laborers, construction workers, janitors, and cooks (BLS 2006). Of the top ten high-injury occupations, black workers were overrepresented in seven occupational categories. For example, although blacks comprised 12 percent of the working age population in 2001 (McKinnon 2003), they comprised 14.4 percent of truck drivers, the occupation with the most nonfatal injuries that year. Research on workplace inequality leads us to suspect that occupational racial composition may be one of the mechanisms through which racial minorities not only have lower wages, autonomy, and promotion opportunities, but also worse health. Our expectation is that racially segregated work is more hazardous and that occupational segregation by race preserves the best (most safe) jobs

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for the most privileged groups. We examine this hypothesis using occupational data from the U.S. Bureau of the Census (Ruggles et al. 2004) and the Dictionary of Occupational Titles (DOT) (England and Kilbourne 1988) and individual data from the National Longitudinal Survey of Youth (NLSY) (CHRR 2002).

Prior Research on Workplace Injuries

Before turning to theoretical reasons to expect an association between occupational racial composition and workplace injuries, we first review current public health literature on the incidence of work injuries and racial differences, highlighting gender findings when possible. Studies of fatal injuries show that minorities, particularly men of color, are more likely than whites to die from a work injury. Dana Loomis and David Richardson (1998) analyzed mortality data from North Carolina (1977–1991) and found that black workers (both men and women) were 30 to 50 percent more likely to die from an occupational accident compared to similar white workers. Most of these differences were explained by employment in hazardous occupations (although a 13-percent increase for men remained). More recent data indicate that black men are subject to more occupational fatalities in specific industries. For example, black agriculture workers' fatal injury rate is 26.9 per 100,000 workers, compared to 21.2 for whites (DHHS 2004).

Studies of nonfatal injuries present an inconsistent pattern of racial disparities—some finding a disparity and others finding none or even a reversal of risk patterns. This is especially the case when researchers analyze large nationally representative data. One study using a national sample found that blacks were not more likely than whites to report nonfatal injuries (Oh and Shin 2003). Another study found that although blacks had lower rates of injury compared to whites (Strong and Zimmerman 2005), blacks took more time off from work compared to whites, suggesting that the injuries were more severe. One study of hospital workers in a large institution found that black workers were more likely to suffer nonfatal work injuries than whites, even after controlling for physical demands (Simpson and Severson 2000).

Injury rates among women are much lower than injury rates among men (DHHS 2004). Of all work injuries reported to the Occupational Safety and Health Administration (OSHA) in 2001, 33 percent were reported by women workers. Because of the high degree of gender segregation in the U.S. economy, the kinds of injuries that women experience tend to differ from the kind that men experience. Men suffer more fatalities and injuries overall, but women are more likely to suffer from repetitive strain injuries such as tendonitis (DHHS 2004) and carpal tunnel syndrome (Tanaka et al. 1994) that develop slowly over time. Women are also more likely than men to suffer from work-related stress disorders (DHHS 2004) and are often overrepresented in service industries with highly emotional labor demands that lead to mental health distress (Boyd 2002). Finally, high-injury occupations for women, such as nursing, combine both physical and emotional demands. Studies that analyze women rarely specify the possibly unique experience of women of color. There is considerable evidence that both racial and gender dynamics are important for understanding employment experiences (Browne and Misra 2003).

Public health studies suggest several characteristics that contribute to differences in work injuries that have also been used in studies of wages, including schedule type, hours worked per week, union status, and education. Workers with rotating work schedules have been more vulnerable to work injuries than those with fixed shifts (Horwitz and McCall 2004). Schedule instability increases fatigue and contributes to poor nutrition. Working at night or on the weekends creates difficulties for maintaining family and social interactions and is associated with more hazards (e.g., night clerks in gas stations are vulnerable to violent crime). Blacks are more likely than Latinos or whites to work nonstandard hours including rotating shifts, and this could contribute to racial disparities (Presser 2003). Fixed work schedules are less common among contingent and temporary workers. Rotating work schedules may be

more common in occupations with poor market position. Working long hours is an established risk factor for injuries (Dembe et al. 2005). A previous analysis of NLSY data (Dembe et al. 2005) showed that working long hours was associated with higher risk of injury for all workers, even after controlling for job hazards. Union representation should be associated with increased work injuries because health and safety issues are a major reason for organizing and joining unions. Many unions have specific health and safety committees to address workplace safety (Murphy 2000). The union movement arose partly in response to dangerous working conditions and had the most success in high-hazard industries and occupations (for railroad example, see Kim and Fishback 1993).

Public health research on the association between education and work injuries shows a strong relationship between low education and increased work injury risk (Robinson 1984). For example, Joong-Hwan Oh and Eui Hang Shin (2003) found that risk of injury was 56 percent greater among high school graduates compared to college-educated workers, and that risk of injury was 46 percent greater among those without a high school degree compared to college-educated workers.

This review demonstrates that several individual worker characteristics used in public health studies are associated with workplace injuries. We next describe the theoretical frameworks that guide our analyses of the association between occupational racial structures and the odds of work place injury.

Theoretical Frameworks

Theories of occupational segregation specify a number of mechanisms that lead to unequal occupational racial composition and unequal rewards. First, social closure and queuing theories explain how unequal distributions of minority workers across occupations occur because of exclusionary behavior and racial bias. Minority workers face a limited opportunity structure and are overrepresented in lower paying, less prestigious, and more hazardous occupations. Second, cultural devaluation causes those occupations with more minorities to deteriorate because of their association with a lower status social group. Third, minorities are often concentrated in the periphery sector of low status jobs with poor market position. Finally, because of a history of racial discrimination, average skill levels and individual human capital may be lower among blacks.

For our analysis of occupational racial composition and workplace injury, we borrow extensively from theories first developed to explain occupational gender inequality and earnings, and subsequently extended to explain racial inequality and earnings. Although unique characteristics of workplace injuries make the direct application of these theories challenging, we use them as a starting point to begin assessing the association between occupational racial composition and the odds of workplace injury. In the process, we identify limitations of existing theories and fertile ground for new theorizing. Data limitations prevent us from definitively ruling out competing explanations for an association between occupational racial composition and workplace injuries. Instead, we derive measures and models based on theoretical perspectives of workplace inequality and evaluate how well the results support various perspectives.

Below we summarize prominent sociological theories of the association between occupational racial composition and wages (social closure, queuing, devaluation, poor market position, and human capital), and we describe issues involved in extending these theories to understanding work injuries.

Social Closure and Queuing Theories

Applied to labor market discrimination, social closure occurs when workers with more status strive to maintain their privilege by excluding others from gaining access to scarce resources

(e.g., higher paying jobs, more safe jobs, etc). In workplaces, coworkers and employers can act in ways that maintain their social positions but result in out-group members having less training, poor quality training, less access to informal safety information, or shouldering more onerous/hazardous work tasks, resulting in more injuries. The dynamics of social closure operate in individual jobs and also across occupational categories. Kim A. Weeden (2002) describes how social closure operates through occupational credentialing and educational requirements, thus regulating the supply of workers in an occupational group and maintaining privilege for those who possess the required degrees/certifications. If minority workers seldom hold the required credentials or educational degrees, access to higher status (and less dangerous) work may be difficult to obtain. Increased work injury could be another byproduct of social closure processes involving the maintenance of privilege for workers in the inner circle.

In addition to discrimination based on social closure, queuing theory specifies how exclusionary processes and racial stereotypes lead to disproportionate minority employment in less desirable occupations. Queuing theory presumes that women and minorities have fewer alternative occupations available to them, and are therefore concentrated in lower paid, lower status occupations (Reskin and Roos 1990). From a queuing perspective, both the supply of labor and the strength of employer preferences for whites and men drive differential access to jobs. Because of racially biased employer decisions (conscious or nonconscious), black workers are channeled into jobs with lower wages and worse working conditions. Applying this theory to workplace injuries, occupations with more black workers should be associated with higher risk of injury because blacks are lower in the labor queue than whites. The extension from predicting wages to predicting injuries for women is problematic. Gender-based expectations for white women that lead to lower wages (e.g., see Ridgeway and Correll 2004) could also lead to safer working conditions for white women. The cultural rationale for lower wages paid to black women is different from white women and includes racially based expectations for physically demanding work (Collins 2000). When injuries are the outcome, men may actually be more disadvantaged than women.

We suspect that the same gendered dynamics that contribute to a wage advantage for men also channel men into the most dangerous work. These male-dominated jobs are consistent with masculinity norms but are inconsistent with femininity norms. Nevertheless, many feminized jobs are both physically demanding and hazardous (e.g., hotel room cleaner, manicurist, and nurse), but few women have had access to the most obviously dangerous occupations (e.g., military combat, SWAT teams, construction, fishing, trucking, etc.). Gendered expectations for workers could result in patterns of few women in highly risky occupations, but racial dynamics could lead to further differentiation by race. Thus, black women should have more injuries than white women.

Devaluation

While social closure and queuing perspectives explain how minorities are channeled into low-status, low-skilled, and low-waged occupations (leading to occupational segregation), devaluation theory attempts to explain how occupations are degraded because of their association with a low-status group (women and/or minorities). Cultural devaluation was originally developed by Paula England and colleagues (1994) to explain the differential wages of workers in more or less feminized occupations with similar skill levels. Jobs done predominately by women were paid less in part because of their association with feminine cultural attributes that carried less social value (England et al. 1994). Applying this cultural devaluation argument to racial segregation and earnings is complicated and has produced mixed results, partly because studies differ in units of analysis (job, occupation, industry, occupation/industry cell) and levels of aggregation (national, regional, state, or local urban labor market). Findings from job-level studies gain reliability from measures of racial segregation based on the particular job individuals occupy compared to studies based on national levels of segregation. Two studies using job-level data showed that increases in the percentage of

minority workers were associated with lower wages and worse working conditions (Kmec 2003; Tomaskovic-Devey 1993a). Matt L. Huffman and Philip N. Cohen (2004) used an approximation of local jobs and find that job-level percent black is associated with lower wages for workers, regardless of the local labor market conditions and size of the black population. They also found that the degree of racial segregation was greater in metropolitan areas with larger black populations. In contrast to these job-level studies, Jerry A. Jacobs and Mary Blair-Loy (1996) analyzed 1990 census data and local labor markets. They did not find that minority composition depressed wages. Reid analyzed NLSY data and found that the percentage of black and Latino workers was not consistently related to depressed wages (Reid 1998).

In a unique study of occupational change, Lisa Catanzarite (2003) analyzed occupations over time and found that increases in minority workers in an occupation lead to lower wages, supporting occupational devaluation and poor market position perspectives. If devaluation occurs, those occupations with more minorities should have more injuries and the effects should hold for all workers, not just minorities. In addition to lower wages, devaluation can impact the work process in ways that make it more or less hazardous. For example, workers in devalued occupations may receive less safety training, lower quality tools, poorly constructed work areas, and have less autonomy. All of these factors could be associated with increased injury risk for all workers in occupations with higher minority concentrations.

Poor Market Position

Catanzarite (2003) argues that the association between occupational racial composition and wages not only reflects devaluation but also reflects the consequences of poor market position. Market forces that contribute to deskilling also contribute to an overall deterioration of working conditions in occupations (lower pay, few/no benefits, dangerous working conditions). Occupations in some industries (e.g., service, construction) have experienced widespread deskilling and downgrading in recent decades, while high-skilled occupations have made wage gains (McCall 2001). Widespread use of contingent work arrangements and part-time and/or temporary jobs is likely to lead to concentrations of inexperienced workers, pressure for fast work, and higher turnover, contributing to challenges maintaining workplace safety (Quinlan, Mayhew, and Bohle 2001). These changes could also lead to increased injury risk because deteriorating working conditions take their toll on people physically and mentally. Labor market sorting processes contribute to higher concentrations of minority workers being in sectors of the economy undergoing downsizing, outsourcing, declining wages, declining benefits and job security, and increased work hours. Therefore, an association between occupational racial composition and work injuries could reflect higher concentrations of minority workers in occupations with poor market position.

It is possible that state-level and local-level political and economic environments influence how health and safety are maintained in the workplace. States with more minority workers have greater levels of racial segregation (as found by Huffman and Cohen 2004—although the *effect* of occupation percent black on wages did not vary by black population size). Even in local areas with lower minority concentrations, it is possible that OSHA enforcement varies by state (see Wahl, Gunkel, and Sanchez 2000). Perhaps more important is the fact that local labor supply differences by race will impact the level of occupational racial segregation and may subsequently alter how occupational context matters for work injury.

Human Capital

Rather than focus on racial discrimination as an explanation for inequality, human capital theory focuses on individuals' choices about jobs and investments in education. If workers with less human capital (education and work experience) are more likely to be in the minority and more likely to work in dangerous jobs (e.g., more environmental hazards or physical demands) then what appears to be an occupation-level association actually reflects clustering

of individual skills, education, risk, and minority workers. Because education levels are also predicted by race and gender it is difficult to make a definitive hypothesis about individual human capital and workplace injuries. There is ample evidence that educational inequality is a major mechanism that maintains racial disadvantage in the labor market. Therefore, the association between occupational racial composition and work injuries may reflect either lower education among minority workers, or that the same factors that lead to lower education levels for minorities also lead to employment in more dangerous and demanding occupations.

Compensating Differentials

Economists developed the compensating differentials theory to explain why some workers are willing to take more risky jobs. Proponents of this theory argue that workers will take more risky jobs only if they are paid more or otherwise compensated (Brown 1980). According to this perspective, higher wages should be associated with higher injury risk (Purse 2004). It is possible that compensating differentials are offered to white workers and not minority workers because labor market dynamics provide more options for white workers. If this occurs, we could find that wages are only associated with more risk for white workers. Health insurance benefits offered by employers should be associated with injuries if jobs with insurance have more injury risk, particularly if workers view health insurance as compensating injury risk. Union membership can also be conceptualized as compensating injury risk. Many unions negotiate higher wages and benefits specifically to address health and safety issues.[1]

Individual and Occupational Racial-Gender Inequality

A central question in research on wage inequality is the extent to which inequality is conditioned by occupation-level factors. From a devaluation perspective, entire jobs or occupations are the affected units, and higher minority concentration leads to lower wages for all workers, regardless of individual race (Kmec 2003; Tomaskovic-Devey 1993a). If devaluation is the driving process, we would not expect an interaction between individual race and occupational racial composition. Previous studies, however, show that individual racial inequality is conditioned by occupational context. For example, Eric Grodsky and Devah Pager (2001) find that individual black-white wage inequality is greater in private-sector occupations with higher average earnings, indicating a larger penalty for high-status jobs. Matt L. Huffman (2004) finds that the negative effect of percent black on wages is stronger for blacks than for whites, indicating greater inequality for blacks in higher percent black jobs.

Extension of Theories to Workplace Health Outcomes

Each of the perspectives summarized was developed to explain racial wage differentials, but they should also be useful in understanding work injury differentials. Both wages and injuries are indicators of quality working conditions and should be influenced by social power

1. Preference for risk also plays a role in the compensating differentials perspective. Risk-averse workers trade lower wages for safe work, and employers offer higher wages to compensate workers for hazardous working conditions, otherwise jobs go unfilled. Because of social closure processes minority workers may not be compensated for engaging in risky work. Establishing whether or not workers are compensated for risk is not a goal of the present study. However, these dynamics could explain racial differences in reported work injuries, especially if some groups are more likely to be offered a wage premium for taking on hazardous work. We tested for compensating differentials in HGLM models of wages in the 1988 wave of the NLSY for two measures of risk: physically demanding work and environmental exposures (analyses available upon request). In controlling for a host of individual and occupation characteristics, we found that physically demanding work was indeed compensated with higher wages ($b = .06$, $p = .022$) and the wage premium did not differ across race-gender subgroups. In contrast, men (both black and white) did not receive a wage premium for environmental exposure, but white women had a slight premium when working in occupations with more exposure. The opposite pattern was found for black women; black women were actually paid less when they worked in jobs with more environmental hazard exposures.

and occupational context. Both are likely to be related to the labor process, the occupational division of labor, and prestige or status differences of typical workers. They also differ in critical ways. While wages are easy to measure with great precision, self-reported work injuries are not. Workers may not be aware of how their injuries are related to work or may minimize their experiences or forget about them. Workers undergoing work-related health problems may not want to admit or report injuries because of stigma or fear of retribution (Weddle 1996).

Hypotheses

We derived and will evaluate the following hypotheses from prior research and occupational segregation theoretical frameworks:

1. Workers employed in occupations with higher concentrations of black workers should have increased odds of workplace injury;
2. The association between occupational racial composition and workplace injury risk will be explained by occupational working conditions;
3. Individual characteristics will explain the occupational racial composition effect. We expect that black men will have the highest risk, followed by white men, black women, and finally white women;
4. At least some of the occupation-level effects on workplace injuries will be explained by the composition of workers with similar characteristics concentrating in occupations;
5. The association between occupation percent black and injury risk will be modified by individual race-gender.

Analytic Strategy

We evaluate these hypotheses using multi-level models designed to estimate the separate and combined effects of both occupational characteristics and individual characteristics. We begin our analysis with descriptive comparisons of injured and noninjured workers in 1988. We then move to the heart of our analysis, hierarchical generalized linear models (HGLM) of work injury outcomes, using the 1988 wave of the NLSY combined with occupation-level data from the U.S. Bureau of the Census and the Dictionary of Occupational Titles.[2] We estimate a series of two-level hierarchical generalized linear models to answer our primary research questions. These HGLMs appropriately estimate occupation-level and individual-level predictors of the dichotomous outcome: workplace injury.

Model Strategy to Address Research Questions

In the main set of models, individual NLSY respondents in 1988 (n = 6,634) are nested within national occupational aggregates (n = 428). The individual worker is considered a level 1 unit and each individual i is nested within an occupation j as the higher level 2 unit. The baseline model is summarized in the following mixed-model equations:

$$\log[P_{ij}/(1 - P_{ij})] = B_{00} + U_{0j}$$

$$\text{Level 1 variance} = P_{ij}/(1 - P_{ij})$$

2. For our cross-sectional models we chose to analyze data from the NLSY in 1988, the first year of our analysis. Our rationale for using this year is based on our analytic sample. We selected the sample based on employment in 1988, and thus we have the most cases in this year. We presume this year is most representative (closest to the original sample).

The values of the dependent variable are transformed from 1 (= injury) and 0 (= no injury) to a linearized log odds of injury. The B_{00} term represents the average odds of injury across all the occupations. The U_{0j} error term represents the level 2 random or unique effect relative to the overall average across all occupations. Because the outcome is dichotomous, we specify a Bernoulli model with a logit link. The level 1 variance is fixed by the proportion injured. Consequently, the proportion of variance cannot be apportioned within and between occupations as is customarily done with hierarchical linear models (HLMs). HGLMs also differ from standard HLM models because an appropriate deviance statistic cannot be estimated for assessing the change in model fit.

Because our primary interest is in occupational racial composition, we include percent black in the occupation in the first model to assess our first hypothesis—is there an association between percent black in an occupation and individual risk of injury? To assess whether other occupation characteristics explain this association, we add measures of working conditions and skill demands in Model 2. In Model 3, we remove all of the occupation-level characteristics except percent black and add in the individual characteristics to assess if these characteristics explain the association between occupational racial composition and self-reported injury. We then bring the remaining occupation characteristics back into the model to assess the associations of occupation and individual characteristics simultaneously (Model 4). Finally, we add cross-level interactions of individual race-gender and occupation-level percent black to assess if subgroups experience occupational racial context effects differentially (Model 5).

As is the convention in multilevel model research, we provide the equation for the final full model below in mixed equation format. This model has one random effect (the intercept), and all continuous variables are grand mean centered.

Mixed model equation:

$$\begin{aligned}\text{Log}[P_{ij}/(1-P_{ij})]\ \text{Injury} = {} & \gamma_{00} + \gamma_{01} * (\text{Occupation \% Black}_j) + \gamma_{02\text{-}05} * (\text{Occupation-level factors}_j) + \\ & \gamma_{10} * (\text{Black men}_{ij}) + \gamma_{20} * (\text{White women}_{ij}) + \gamma_{30} * (\text{Black women}_{ij}) + \\ & \gamma_{40\text{-}280} * (\text{Individual-level factors}_{ij}) + \\ & \gamma_{11} * (\text{Occupation \% Black}_j * \text{Black men}_{ij}) + \\ & \gamma_{21} * (\text{Occupation \% Black}_j * \text{White women}_{ij}) + \\ & \gamma_{31} * (\text{Occupation \% Black}_j * \text{Black women}_{ij}) + U_{0j}\end{aligned}$$

The error term for the intercepts, U_{0j}, provides an estimate of the variance in the odds of injury between occupations. These coefficients provide information about effects of individual, occupational, and both combined on injury risk, adjusting for the lack of independence introduced by workers nested within occupations (Hox 2002; Luke 2004; Raudenbush and Bryk 2002).[3]

3. Interpretation of variance components for multi-level models with nonlinear outcomes is more complicated than it is with standard HLM models. In HGLM, the outcome is nonlinear and the level 1 variance (R_{ij}) = P (1-P_j) is a function of the mean and is not a free parameter for estimation. We used a logit link function for the estimation, therefore the outcome is the log odds of injury [logit(P_j)] = Gamma0 + U_{0j}] (Lee and Nelder 1996). Snijders and Bosker (1999) state that deviance statistic is not appropriate for comparing nested model testing using nonlinear estimation, and the HLM6 program therefore does not provide the deviance statistic in the output. In addition, because we evaluate the population average coefficients (following Diaz 2007, and similar to Wallace et al. 2007), no variance components are estimated for comparing models. Finally, because self reported workplace injuries are rare, the residuals are not normally distributed (despite modest cluster sizes of approximately 15 cases ranging in size from 1 to 341), possibly influencing the estimation of variance component standard errors. We therefore focus our interpretations primarily on the fixed coefficients.

Additionally, we provide a robustness check by estimating two-level HGLMs of change in risk of injury over a 12-year period.[4] Our focus here is to expand the generalizability of our main analysis to incorporate data from multiple years. These HGLMs are identified by both within-person change and between-person variance in the odds of work injury. In this analysis (See Table A1 in the Appendix) the dependent variable is now the log-odds of injury within people across measurement observations. Individuals are the higher-level units and observations are nested within individuals. These estimates provide information about the association between changes in occupational characteristics and changes in injury risk across people and time points.

Data and Sample

National Longitudinal Survey of Youth (NLSY)

The National Longitudinal Survey of Youth (NLSY) 1979 cohort survey is a nationally representative panel study funded by the U.S. Department of Labor. The NLSY includes extensive questions about labor market histories for respondents, including questions about job history, wages, occupation, union membership, sector, work status, and work injuries (CHRR 2002). Multistage stratified area probability sampling with an oversampling of blacks ensures adequate numbers for analyses. Our analytical sample includes those 6,634 respondents who had complete data on all study variables in 1988. The NLSY is representative of youth in 1979, thus our sample is relatively young (age range 23 to 31 in 1988 and 33 to 41 in 2000) and consists of workers in the early and middle phases of typical work histories. We follow this cohort across eight waves of data collection spanning a 12-year period (1988, 1989, 1990, 1993, 1996, 1998, and 2000) aggregating 39,871 person-period observations for the supplemental longitudinal analysis.[5]

Data at the occupation level come from two sources. First, we construct measures of occupational racial composition from the 1-percent 1990 Public Use Microdata Sample (IPUMS) (Ruggles et al. 2004). For each of the occupations with the necessary data in the IPUMS and the NLSY (428 of 503 total possible occupations), we estimate the percentage of black workers in that occupation. For each occupation we also construct average potential work experience and education for white men workers, ages 18 to 64. Second, we merge occupational data from the Dictionary of Occupational Titles (DOT) to this occupation-level data set. For our measures of environmental hazard exposure and physical demands, we use two constructed scales from the DOT data set originally developed by Paula England and Barbara Kilbourne (1988). These variables were merged with individual NLSY data using three-digit census occupation codes.

4. The longitudinal analyses were also conducted using a two-level HGLM. In the longitudinal models, the occupation effects are treated as person-period time varying covariates, similar to the individual job characteristics. Stable individual characteristics (e.g., human capital such as initial education, initial work experience, and work experience squared, as well as individual race-gender) are measured in the first year of this study (1988) and incorporated in the HGLM analysis as time-invariant person (level 2) variables representing differences between people. The intercept or grand mean in this model is now the average odds of injury when all level 1 variables are zero (or grand mean for continuous independent variables) and the slopes for level 1 predictors represent changes in job and occupational characteristics. We prefer this parsimonious model to a cross-classified model with observations nested within worker-occupation cells. A cross-classified model would introduce many empty cells (6.634 people by 428 occupations) and made adjusting for sample weights and cross-level by within-level interactions impossible to model in HLM 6.06.

5. All of the analyses are conducted using weights for the complex sample design employed by the NLSY. The NLSY PERWT88 variable was used to weight the cross-sectional within occupation models, and a custom panel weight variable was used to weight the longitudinal within person models.

Missing Data

Missing data is an issue for most studies. We used a subset of data based on employment in 1988. Workers who were not interviewed or were not employed in 1988 are not included in our sample. The response rate for the entire 1979 sample was 90.2 percent in 1988 and 86.7 percent in 1998 (CHRR 2002). Because we are examining work injuries and selecting on employment status in 1988, our sample is representative of employed black and white workers and those workers with less severe injuries. This sample may also have a bias towards safer occupations, because workers who were in more dangerous occupations may have left the "worker" status prior to 1988, the first year in the analytic sample and nine years after data collection started. Of the respondents included in our analyses, black men and black women were significantly more likely to die after 1988 compared to their white counterparts (black men 4.6 percent, white men 1.6 percent, black women 1.5 percent, white women .8 percent). Deaths may or may not be related to workplace injuries, but do make the remaining sample more biased towards healthier individuals employed in safer occupations.

Measurement

Workplace Injury or Illness

Respondents were asked if they experienced an incident at work leading to an injury or illness in the past year or since the last interview. This indicator forms a dichotomous dependent variable for each wave. Respondents can report an injury in more than one wave.

Occupation-Level Variables

Occupational racial composition is measured by a variable consisting of the percentage of blacks in detailed occupations. Each respondent's current or most recent job was categorized into an occupation in the NLSY using 503 different 1980 three-digit Census occupation codes. We estimated the percent black in each occupation using a separate data set (the 1990 Census, collected near the beginning of the observation period for this analytic sample) and merged these values into the NLSY analytic sample. Therefore we do not know the percent black in the specific job that each worker inhabits but create an estimate using detailed occupation as of 1990.

We measure the educational requirements and experience level of each occupation by aggregating individual education and potential experience information for white men aged 18 to 64 in the 1-percent IPUMS sample of 1990 Census data. Education was measured by years of schooling. We measure employment experience as age-education-5. The individual case values were aggregated to three-digit census occupation codes, and these constructed variables were then merged onto the NLSY three-digit Census occupation codes.

We use two occupational hazard measures based on the DOT data set developed by England and Kilbourne (1988). *Physical demands* is a scale ranging from 0 to 4 and is a count of the following activities: (1) climbing/and or balancing, (2) stooping, kneeling, crouching, and/or crawling, (3) reaching, handling, fingering, and/or feeling, and (4) seeing. Jobs requiring none of these activities are coded as 0, and jobs requiring all of them are coded as 4. This scale lacks a measure of repetitive motions, therefore limiting sensitivity to injuries caused by repetitive strain. *Environmental hazards* is a count measure (values range from 0 to 6) of whether or not the following environmental conditions were found in the occupation: (1) extreme cold, (2) extreme heat, (3) wet conditions, (4) extreme noise, (5) other hazards, and (6) negative atmospheric conditions. If occupations with more blacks carry a higher injury risk it at least partly could be due to the concentration of black workers in more dangerous occupations.

Occupational working conditions, such as the level of hazardous substance exposure and physical demands, should be associated with higher injury risk.

Individual-Level Variables

The next set of variables measures various aspects of jobs related to workplace injury outcomes. *Hours worked per week* is the average number of hours usually worked per week. *Log hourly wages* are coded for each respondent's main/current job in each survey wave. We log this variable to normalize its distribution. *Union* is a dichotomous variable coded so 1 indicates union representation and 0 indicates no union representation. *Employer sponsored health insuranc*e is a dichotomous variable where workers with health insurance benefits are coded as 1 and workers without health insurance are coded 0. Respondents who usually work a *fixed schedule* are coded as 1 and workers with rotating or unpredictable hours are coded as 0.

We include three measures of individual human capital: education, cumulative work experience in 1988, and job tenure. *Education* is coded as the respondent's highest year of schooling completed. This variable is continuous and ranges from 0 to 20, with 39 percent reporting finishing exactly twelve years of schooling. *Lifetime work experience* is measured as the number of weeks employed between 1979 (the first year of the NLSY) and 1987 (the first year with work injury data). This measure does not represent job-specific experience, rather it measures lifetime work experience. Because more work experience can also capture longer exposure to injuries or greater strain/fatigue, we include a squared term to capture a possible nonlinear association. *Organizational tenure* is the number of years worked in the respondent's current or most recent job in 1988 (and subsequent years for the longitudinal models).

Regional variations in the percentage of black workers available could confound the occupation-level association between occupational racial composition and risk of injury, therefore we include indicator variables for being employed in the *West, South,* or *Northeast* compared to the *North Central* region. Because *self-employed* workers have much greater control over their work environment (and thus more autonomy to avoid injuries), we include a variable indicating self-employment status. Occupations span a variety of *industries*, thus unevenly exposing workers to varying risk based not only upon their occupation, but also within the specific industry employed. We control for the 13 industries measured in the census by including 12 dichotomous variables and using "finance" as the reference industry.

We construct a set of three dichotomous variables to represent the four *individual race-gender* groups in the analyses. White women, black women, and black men are measured by separate variables coded 1 for each group and compared to white men, the reference group in the multi-level regression models. For the simple slopes analysis of interaction effects, we use another dichotomous variable for white men in comparison to the other three groups. We operationalize race-gender groups in order to fully capture the distinct position of women and men of color in relation to their white counterparts and to facilitate comparisons. Finally, we control for *age* in years; the NLSY respondents ranged in age from 23 to 31 in 1988.

Findings

Descriptive Results

Consistent with our primary focus, average occupation percent black is significantly higher among the injured compared to the noninjured (Table 1). Additionally, physical demands and environmental hazards are higher among the injured than among the noninjured. Contrary to expectation, there is no association between occupation-level experience and injury, but average occupation years of education are significantly lower among the

Table 1 • *Descriptive Statistics for the NLSY 1988 Sample of Workers by 1988 Injury Status, Weighted*

	Not Injured		*Injured*	
	Mean	*SD*	*Mean*	*SD*
Occupational characteristics				
Occupation % black	11.252	6.503	12.293	6.716**
Physical demands	1.780	.855	2.102	.896***
Environmental hazards	.479	.641	.795	.723***
Average potential experience	20.327	3.989	20.584	3.850
Average education	11.076	1.545	10.458	1.378***
Individual characteristics				
White men	.441	.497	.630	.483***
Black men	.070	.255	.044	.204**
White women	.422	.494	.274	.446***
Black women	.066	.249	.053	.224
Education	13.300	2.291	12.486	2.007***
Lifetime weeks worked	316.691	116.209	330.091	110.658
Hours worked per week	40.465	11.243	44.090	10.783***
Log hourly wages	2.065	.577	2.058	.512
Union	.133	.340	.189	.392***
Health insurance	.631	.482	.735	.441***
Works fixed shift	.851	.357	.808	.394
Organizational tenure	145.278	149.371	156.270	149.065*
Self-employed	.074	.261	.052	.221*
Agriculture	.022	.147	.032	.177
Mining	.010	.098	.009	.092
Construction	.074	.262	.118	.322*
Manufacturing	.185	.389	.258	.438***
Transportation	.060	.238	.063	.242
Wholesale trade	.033	.179	.033	.179
Retail trade	.169	.375	.194	.396
Business service	.078	.268	.037	.188***
Personal service	.046	.209	.034	.180*
Entertainment	.018	.134	.027	.162
Professional	.185	.388	.139	.346
Financial service	.074	.262	.023	.149***
Public sector	.045	.208	.034	.182
Private sector	.824	.381	.855	.352*
South	.349	.477	.282	.450**
West	.155	.362	.181	.385
Northeast	.207	.405	.194	.396
North Central	.287	.453	.342	.474*
$N = 6{,}634$				

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

injured. These bivariate associations provide initial confirmation that occupation-level characteristics, including occupational racial concentration, are associated with injury status.

Several individual characteristics are also associated with injury status. White men comprise a higher proportion of the injured group, whereas the inverse is true for black men. As expected, women are less represented in the injured group than the noninjured group, but

the difference is not significant for black women. We expected black women to have elevated risk, but find instead similar proportions of black women workers among the injured and noninjured. At the individual level, injured workers had lower average education and worked more hours per week. Although injured workers did not have higher wages, they had higher levels of insurance benefits and union membership. There is no difference between workers with and without fixed work schedules. Also contrary to expectations, lifetime work experience and job tenure did not distinguish the injured from the noninjured. At the bivariate level, experienced workers and long-term workers had similar levels of workplace injury.

Agriculture and mining industries did not distinguish injured and noninjured workers. This is very surprising because these are two of the most hazardous industries with high-fatality rates. Transportation is another high-injury industry for which we find no difference in the proportion injured. These findings may reflect a loss of fatally injured workers from the NLSY sample. The other industrial differences are more consistent with prior research (e.g., higher proportions of injury for manufacturing and construction industries and lower injury proportions for service and finance industries). We also note here that the proportion of injured workers was lower in the South and greater in the North Central region.

It is useful to understand the range of values for the occupation percent black variable. Only 6 of the 428 occupations in this study have no black workers in them. Slightly more than 30 percent of the occupations have more than 13 percent black workers, and none have a value higher than 56 percent. Therefore almost all of the occupations, like the United States as a whole, are predominantly white. Most occupations have fewer than 10 percent black workers. In our study, as in past research, these percentages reflect over- or under-representation of black workers, rather than purely black-dominated occupations. None of the occupations reach total segregation by race.

Multilevel Regression Results

Hypothesis 1: Workers employed in occupations with higher concentrations of black workers should have increased odds of workplace injury (Model 1).

Model 1 confirms our expectation that increases in occupation percent black are significantly associated with higher individual odds of injury (OR = 1.026**). Therefore this occupational context measure is relevant for understanding within-occupation differences in workplace injuries. We anticipated that an association might not emerge because of the coarse nature of the national aggregate data available for the occupations we studied (compared to the specificity of information about particular jobs that would better characterize each worker's occupational context). An increase of one standard deviation in the percent black in an occupation (about 7 percent) would result in an approximately 21 percent increase in the odds of injury. That a significant association emerges despite measurement error suggests that the association is strong. We next assess whether other between-occupational characteristics explain this association.

Hypothesis 2: The association between occupational racial composition and workplace injury risk will be explained by occupational working conditions (Model 2).

If the mechanism for the association between occupational racial composition and injury operates through the channeling of black workers into more physically demanding, hazardous, or low-skilled work, then controlling for these occupation characteristics should eliminate the percent black to injury association. The HGLM findings in Model 2 (Table 2) support the hypothesis that working conditions explain the association between occupational racial context and workplace injuries. The occupation percent black coefficient is no longer statistically significant. Two occupation characteristics, environmental hazards (OR = 1.395**) and average education (OR = .813**), are associated with workplace injuries. A

Table 2 • *Cross-Sectional HGLMs of Odds of Work Injury*

	Model 1				*Model 2*				*Model 3*				*Model 4*				*Model 5*			
	B	*SE*	*OR*	*P*	*B*	*SE*	*OR*	*P*	*B*	*SE*	*OR*	*P*	*B*	*SE*	*OR*	*P*	*B*	*SE*	*OR*	*P*
Intercept	−2.439	.069	.087	.000***	−2.518	.072	.081	.000***	−3.111	.307	.045	.000***	−3.058	.323	.047	.000***	−3.070	.323	.046	.000***
Occupation characteristics																				
Occupation % black	.025	.009	1.026	.005**	.001	.010	1.001	.893	.032	.010	1.032	.002**	.020	.011	1.020	.082	.027	.013	1.028	.042*
Physical demands					.013	.108	1.013	.907					.017	.123	1.017	.892	.015	.123	1.016	.900
Environmental hazards					.333	.116	1.395	.005**					.266	.122	1.305	.029*	.273	.122	1.314	.026*
Average potential experience					−.001	.014	.999	.925					−.021	.016	.979	.178	−.021	.016	.979	.194
Average education					−.207	.065	.813	.002**					−.088	.075	.916	.242	−.088	.075	.915	.236
Individual characteristics																				
Black men									−.890	.168	.411	.000***	−.885	.166	.413	.000**	−.689	.196	.502	.001**
White women									−.499	.122	.607	.000***	−.429	.131	.651	.001**	−.422	.126	.656	.001**
Black women									−.264	.147	.768	.072	−.207	.156	.813	.186	−.082	.167	.921	.622
Education									−.151	.026	.860	.000***	−.013	.029	.987	.000***	−.134	.029	.875	.000***
Lifetime weeks worked									.003	.002	1.003	.246	.003	.002	1.003	.263	.003	.002	1.003	.280
Lifetime weeks worked squared									.000	.000	1.000	.319	.000	.000	1.000	.342	.000	.000	1.000	.361
Hours worked per week									.023	.004	1.023	.000***	.023	.004	1.023	.000***	.023	.004	1.023	.000***
Log hourly wages									−.015	.109	.985	.891	.008	.111	1.008	.941	.012	.112	1.012	.915
Union									.105	.126	1.110	.406	.081	.127	1.084	.523	.077	.127	1.081	.541
Insurance benefits									.640	.152	1.896	.000***	.649	.154	1.913	.000***	.653	.154	1.922	.000***
Fixed work schedule									−.256	.138	.774	.063	−.260	.141	.771	.065	−.256	.142	.774	.071
Organizational tenure									.000	.000	1.000	.296	.000	.000	1.000	.270	.000	.000	1.000	.267
Northeast									−.073	.150	.929	−.076	−.076	.153	.927	.621	−.072	.153	.930	.635
West									.062	.159	1.064	.696	.049	.162	1.050	.763	.045	.162	1.047	.778
South									−.390	.126	.677	.002**	−.391	.129	.676	.003**	−.394	.129	.674	.003**
Self-employed									−.282	.374	.754	.451	−.280	.372	.756	.452	−.275	.374	.760	.462
Agriculture									1.172	.384	3.227	.003**	.896	.413	2.450	.030*	.905	.412	2.472	.028*
Mining									.348	.489	1.416	.477	.076	.501	1.079	.879	.072	.501	1.075	.886

Construction	.809	.332	2.247	.015*	.523	.355	1.687	.141	.526	.355	1.692	.139
Manufacturing	.843	.249	2.323	.001**	.682	.273	1.977	.013*	.681	.273	1.976	.013*
Transportation	.451	.302	1.569	.136	.350	.320	1.419	.275	.344	.320	1.411	.282
Wholesale trade	.752	.348	2.121	.031*	.626	.375	1.870	.095	.636	.376	1.889	.090
Retail trade	.966	.278	2.628	.001**	.827	.302	2.286	.007**	.824	.302	2.281	.007**
Business services	−.046	.306	.955	.880	−.183	.312	.833	.557	−.175	.313	.840	.577
Personal services	.755	.449	2.129	.092	.669	.453	1.952	.140	.680	.454	1.974	.134
Entertainment	1.309	.402	3.702	.002**	1.173	.423	3.233	.006**	1.174	.422	3.236	.006**
Professional	.722	.259	2.059	.006**	.737	.279	2.089	.009**	.744	.279	2.105	.008**
Public sector	.465	.366	1.592	.204	.351	.399	1.420	.379	.359	.398	1.431	.368
Cross-level interactions												
Occupation % black × black men									−.055	.022	.947	.013*
Occupation % black × white women									−.009	.017	.991	.596
Occupation % black × black women									-.031	.017	.970	.065

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

Note: Full information maximum likelihood, PQL estimation, all continuous variables are grand mean centered.

one-unit increase in environmental hazards is associated with almost a 40-percent increase in the odds of injury. Because this scale goes from 0 to 6, a one unit increase is fairly large. The association for education is negative. One additional year of average education in an occupation is associated with almost a 19-percent decrease in the odds of injury. These patterns suggest that the association between occupational racial composition and workplace injuries is explained by the higher concentrations of low-skilled workers and environmental hazards in higher percent black occupations. The next model assesses the contribution of individual level characteristics in explaining the association of occupational racial concentration to workplace injuries.

Hypothesis 3: Individual characteristics will explain the occupational racial composition effect. We expect that black men will have the highest risk, followed by white men, black women, and finally white women (Model 3).

To assess the expectations in our third hypothesis we removed the occupation-level characteristics and added the individual-level characteristics to the model with only occupation percent black (see Model 3 in Table 2). We find only partial support for this hypothesis. Including individual characteristics in the model does not eliminate the association between occupation percent black and workplace injury (OR = 1.032**). Consistent with hypothesis 3, however, several individual characteristics are associated with workplace injury risk. As expected, higher educated workers were less likely to report a work injury (OR = .86***). Higher job hours (OR = 1.023***), jobs with insurance benefits (OR = 1.896***), and several industries compared to finance (agriculture (OR = 3.227**), construction (OR = 2.247*), manufacturing (OR = 2.323**), wholesale trade (OR = 2.121*), retail (OR = 2.628**), entertainment (OR = 3.702**), or in a profession (OR = 3.059**) have higher odds of injury. Several characteristics were not significant but had been in previous studies (e.g., lifetime weeks worked, wages, work schedule, and organizational tenure).

These results suggest mixed evidence for measures of job-level social closure or compensating differentials. In this model that adjusts for individual characteristics, union workers do not face greater injury risk, but those with health insurance benefits do have significantly increased odds of reporting injuries. Jobs with benefits may be subject to more social closure. If the most hazardous work is compensated, white men could view these jobs as desirable and attempt to maintain them when faced with competition from nonwhites. Health insurance offers could partially capture possible compensating differentials, or tendencies for higher risk jobs to be more highly rewarded with greater benefits. The most relevant characteristic for compensating differentials is hourly wages, but this variable is not associated with the odds of work injury.

Other factors that could indicate occupations with poor market position and that have predicted workplace injuries in past research include working a fixed shift, hours worked per week, and industry type. Contrary to expectation, fixed shift positions are not associated with increased odds of injury, but job hours and several industries are associated with the odds of injuries in the expected directions. In the full model, agriculture workers are more than three times as likely to be injured compared to finance workers. Workers in the mining industry, however, were not more likely to face injuries. Differences for construction and manufacturing workers are as expected (more than double the risk of injury for these industries). Interestingly, in the full model wholesale and retail trades also faced a more than two-fold increase in injury risk. The largest industry differential was observed for entertainment (OR = 3.702) workers. Self-employment was not associated with risk of injury in model 4 with all individual characteristics, but public sector workers had a greater risk of injury compared to private sector workers.

Controls for region did not explain the effect of occupation percent black on injury risk. We view these variables as broadly reflecting possible local variation (although admittedly

using the four Census regions is very broad). We did find one regional effect: people who live in the South (OR = .677**) have a lower risk of injury compared to those residing in the North Central region. In a supplemental analysis (available upon request) we estimated a model with an interaction for the occupation percent black and region. In this model, we did not find evidence that occupational context effects differ across regions.

Contrary to expectation, white men have the highest probability of injury (p = .05) and black men have the lowest probability of injury (OR for "Black" = .411). Consistent with expectations, however, black women have a slightly (but not significantly) higher probability of reporting a workplace injury (OR for "Black women" = .768) than white women (OR for "White women" = .860). We explore this unexpected pattern of higher probability of injury for white men and lower probability of injury for black men in the discussion section of this paper. The individual-level, worker-specific characteristics included in this model do not explain the higher injury risk associated with higher occupation percent black.

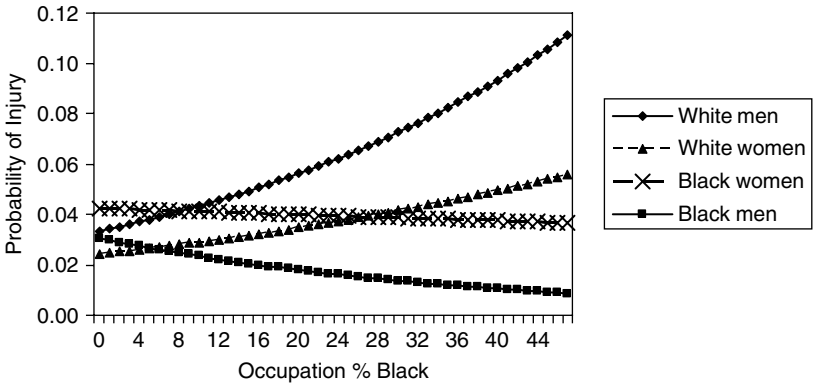
Hypothesis 4: At least some of the occupation-level effects on workplace injuries will be explained by the composition of workers with similar characteristics concentrating in occupations (Model 4).

Thus far, we have separately examined individual-level and occupation-level explanations for the association between occupation percent black and individual odds of workplace injury. The next step simultaneously examines occupation-level measures and individual-level worker measures (Model 4 of Table 2). The biggest difference between models 3 and 4 is that occupation-level education is no longer statistically significant, but individual-level education remains significant. Thus Model 4 suggests that individual-level education explains the occupation skill-level association with work injuries. The context effect of environmental hazards, however, remains significant. This finding indicates that the measure of workplace environmental hazards captures injury-relevant exposures that operate regardless of the characteristics of the individuals in the occupation.

Hypothesis 5: The association between occupation percent black and injury risk will be modified by individual race-gender (Model 5).

If social closure is operating, individual black workers should have higher risk than individual white workers, and this could explain the positive effect of occupation percent black. If the occupation percent black and individual race-gender interactions are not significant, this is evidence of an occupational devaluation or downgrading interpretation. It is possible that both of these forces are operating. To assess the association between occupation percent black and injury risk by individual race-gender, we included cross-level interaction terms in Model 5. The association between percent black in an occupation and risk of workplace injury is statistically significant in this model (OR = 1.028*). This coefficient now represents the association for white men only, because the interaction terms for the other race-gender categories provide the differences for those groups from this main effect slope. The interaction results indicate that the slopes are only significantly different for black men and white men. We assessed the significance of the slope for occupation percent black for each race-gender group by re-estimating the full model separately with each group taking a turn as the omitted category (the simple slopes test suggested by Leona S. Aiken and Stephen G. West [1991] and Grayson N. Holmbeck [2002]). Our conclusion remains the same: the association between occupation percent black and risk of injury is only significantly different from zero for white men.

Rather than exacerbating risk, increasing percent black in an occupation has no effect for black workers, although the trend is towards lower risk. These patterns are illustrated in Figure 1. We estimated the probability of injury within each group by solving the equation for each value of percent black, assuming that all of the other variables have the value 0



Note: Only the slope for white men is significantly different from zero. Only the slope for black men is significantly different from the slope for White men.

Figure 1 • ***Probability of Injury by Occupation Percent Black and Individual Race/Gender***

(the mean for the continuous variables because of grand mean centering and the omitted category for the dichotomous variables). There are parallel positive lines for white men and white women (with the white women's line lower), and parallel negative lines for black men and black women (with the black men's line lower). We explore these finding further in the discussion section.

These models provide evidence that higher percent black occupations are associated with more risk of injury for white men. Because the data are cross-sectional, however, it is possible the effect is not generalizable across time. In order to provide a robustness check for our findings, we replicate the final cross-sectional model and assess the focal association between changes in occupational racial composition and changes in injury risk in a longitudinal analysis of NLSY workers during the period 1988 through 2000.

The Appendix provides the results of the longitudinal analyses. The dependent variable is now a person-period varying variable representing the log-odds of injury across 1988 through 2000 time period, rather than the log-odds of injury in 1988. In this model the occupation and job characteristics are measured within individuals and vary over time. Stable individual characteristics are now measured at level 2 (e.g., race-gender and education level in 1988). We show only the final model, but the percent black effect remains statistically significant in all of the models (available upon request). The coefficient for percent black (OR = 1.016**) now indicates the effect of an occupational racial context on individual work injury risk across 1988 through 2000 time frame. The final conclusion is very similar. Assessing the effect of different reference groups (rotating through different excluded groups) again shows that the occupation percent black slope is only significant for white men, and that the difference in slopes is only significantly different between white men and black men.

Discussion

We found that higher concentrations of black workers in occupations are associated with increased injury risk. This risk was not explained by greater levels of physical demands or environmental hazard exposures. Predictions from queuing, devaluation, and social closure perspectives led us to expect that controlling for these characteristics would explain much of the racial concentration effect, via lack of access to safe jobs (queuing or social closure) or via

deteriorating working conditions associated with devalued racial status or poor market position. While these factors are clearly important for predicting injury risk, they did not explain the effect of percent black. Moreover, we found that it is white men, not black workers or white women, who suffer from higher risk of injury in occupations with greater minority concentrations.

It is clear from our findings that in addition to wage inequality, occupational context influences workplace injury outcomes. Grodsky and Pager (2001) demonstrated how the occupational structure matters for inequality in wages, and our study now demonstrates that occupational structure matters for inequality in workplace health outcomes. The educational or skill requirements at the occupation level, as well as environmental hazards, prove to be related to injury risk. As in previous studies of work injuries (Oh and Shin 2003; Robinson 1984), we also conclude that individual education is associated with work injury risk. Our findings are consistent with human capital and social closure theories because both suggest that occupations with more black workers will contain lower skilled (and more vulnerable to injury) workers who are kept out of higher experience/educated positions. That these characteristics may be more common in occupations with poor market position indicates that low-skilled workers suffer an injury risk burden associated with the types of occupational contexts in which they work. We suspected that these individual characteristics could explain a link between occupational racial composition and work injuries, but find that only the occupation context variables eliminate the effect of occupational racial concentration, and only in the model that does not include the separate race-gender coefficients.

Racial devaluation is a less-likely explanation and is inconsistent with our findings. A true test of this theory requires detailed job-title data, which we do not have. Job-level racial segregation is substantially greater than occupation-level racial segregation (Kmec 2003; Tomaskovic-Devey 1993b). At the national level, conceptualizing occupations as black-dominated is impossible because blacks make up only 11 percent of the U.S. population of workers and because they are segregated regionally. In contrast, occupations are much easier to conceptualize as female-dominated because women make up approximately half of the workforce nationally. Nevertheless, we do find an association between national occupational racial concentration and workplace injuries. Because we use national occupation-level data and self reports of injuries, our findings probably underestimate the true effects of racial composition on workplace injuries. We assume the relationship in our models is attenuated because of measurement error.

We, like Catanzarite (2003) and Huffman and Cohen (2004), conclude that poor market position is a more plausible explanation for our findings than a simple cultural devaluation explanation alone. The poor market position perspective is consistent with the overrepresentation of black workers in occupations with lower education requirements. Michael Quinlan, Claire Mayhew, and Philip Bohle (2001) argue that less skilled occupations are more subject to market pressures that make work less safe. Workers with insurance benefits, fixed work schedules, and shorter hours have better injury outcomes and therefore are likely to work in jobs that are buffered from weak market position. If occupations with greater numbers of minority workers also suffer greater exposure to more market pressures and weaker safety controls (e.g., tight profit margins, low wages, and low-skilled workers) then these factors could contribute to increased injury risk at the occupation level.

Scope Limitations

The NLSY is a longitudinal survey of a single cohort of youth entering the labor force in 1979. Our conclusions are therefore limited to a restricted age range of workers, and this has implications for our findings. It is possible that racial-gender differences change across age groups. It is also possible that occupational racial composition plays a role for other age groups that may differ from mid-career workers.

Second, in our analysis of mortality black men have a higher mortality rate than white men or women (analysis available upon request). The NLSY codes confirmed death as a reason for nonresponse, and we find that compared to the other groups black men have a higher drop-out rate due to death. We do not know the cause of death but assume that injury fatalities are one source of this mortality differential. If black men have more severe injuries that result in fatalities, we could be underestimating the risk of injury for this group. Moreover, we are probably underestimating the incidence of injury for all groups because we cannot code for fatal injuries. Additionally, we do not know how many people are permanently disabled by a work injury and are therefore not employed. Individuals with more severe injuries are less likely to be included in this sample of workers.

Finally, we suspect that broader economic forces, including poor market position, will have ramifications that vary by local labor market conditions. The role of racial devaluation and social closure on racial disparities in injury is likely to depend on the local economic environment and labor supply. We note that wage-gap research finds that local occupational context matters for racial wage inequality (Huffman and Cohen 2004; McCall 2001). Moreover, as Ana-Maria Wahl, Steven E. Gunkel, and Thomas W. Sanchez (2000) found in their study of meatpacking in the Midwest, state variation in union density and policies regarding worker health and safety influence how much protection workers have on the job. While these local contexts surely play a role for worker health and safety, we can rule out regional differences as explanations for our findings using nationally aggregated occupation-level data. It is also possible that devaluation operates in the theoretically predicted manner, and that a finer measure of job racial composition would more accurately reflect the true level of segregation. This is an area that deserves much attention and future research.

Conclusion

Using national aggregates to represent the degree of racial segregation, we found that occupational racial composition was associated with individual work injury outcomes. We explored the possibility that compensating differentials operate and found some evidence that physically demanding work is compensated with higher wages, but this did not explain the occupation percent black effect. In a way, our study brought up more questions than it answered. We found clear evidence that occupational characteristics matter for work injuries and that racial segregation is related to injury risk, but the relationship is more complicated than we expected.

This initial study of occupational context effects on workplace injuries suggests the need for data that can answer remaining questions. Field research and case studies of individual work settings (Scherzer, Rugulies, and Krause 2005; Simpson and Severson 2000) show much higher levels of work injuries than are typically found in national survey data or in reported workers' compensation cases. There is a great need for better survey measures and for studies of vulnerable populations. We believe some of our findings may reflect the difficulty in measuring work injuries for those most at risk for them. In the United States, we have poor tracking of work injuries and tend to be better at capturing fatalities. For all of these reasons, we view our study as a starting point that should stimulate additional analyses of worker safety using sociological perspectives.

Given the large and persistent socioeconomic and racial health disparities in the United States, research on workplace inequality gives researchers many ways of analyzing the link between work and health (Link et al. 2008). Our analyses demonstrate that sociological theories of labor market inequality should be included in research on workplace injury risk, and workplace injuries can be added to the list of outcomes influenced by race-based social inequality.

Appendix

Table A1 • *Longitudinal HGLM of the Change in Odds of Work Injury*

	Baseline					*Full Model*			
	B	*SE*	*OR*	*P*		*B*	*SE*	*OR*	*P*
Intercept	−2.679	.024	.069	.000	***	−3.521	.146	.030	.000
Occupation characteristics									
Occupation % black	.028	.003	1.028	.000	***	.016	.006	1.016	.009**
Physical demands						.025	.047	1.025	.600
Environmental hazards						.251	.043	1.286	.000***
Average potential experience						.005	.007	1.005	.482
Average education						−.110	.035	.896	.002**
Individual characteristics									
Black men						−.371	.077	.690	.000***
White women						−.170	.066	.844	.010*
Black women						−.215	.087	.807	.013*
Education						−.104	.015	.902	.000***
Lifetime weeks worked						.002	.001	1.002	.041*
Lifetime weeks worked squared						.000	.000	1.000	.005**
Hours worked per week						.016	.002	1.016	.000***
Log hourly wages						−.046	.041	.955	.258
Union						.309	.065	1.362	.000***
Insurance benefits						.405	.060	1.499	.000***
Fixed work schedule						−.108	.065	.898	.099
Organizational tenure						.000	.000	1.000	.190
Northeast						−.058	.076	.944	.448
West						.138	.076	1.148	.067
South						−.097	.060	.908	.106
Self-employed						−.201	.109	.818	.064
Agriculture						.768	.219	2.155	.001**
Mining						.224	.264	1.251	.397
Construction						.621	.151	1.861	.000***
Manufacturing						.697	.128	2.008	.000***
Transportation						.579	.145	1.785	.000***
Wholesale trade						.641	.164	1.899	.000***
Retail trade						.722	.133	2.058	.000***
Business services						.370	.143	1.448	.010*
Personal services						.513	.182	1.671	.005**
Entertainment						1.060	.195	2.886	.000***
Professional						.711	.131	2.037	.000***
Public sector						.674	.169	1.963	.000***
Cross-level interactions									
Occupation % black × black men						−.022	.010	.978	.034*
Occupation % black × white women						−.009	.008	.991	.279
Occupation % black × black women						−.009	.009	.991	.328

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)
Note: Full information maximum likelihood, PQL estimation, all continuous variables are grand mean centered.

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