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List of Terms of Abbreviations

ABSM	area-based socioeconomic measure
CI	confidence interval
CT	census tract
EOD	Experiences of Racial Discrimination instrument
GIS	geographic information systems
NIOSH	National Institute for Occupational Safety and Health
OR	odds ratio
UFH	United For Health study

Abstract

Reducing occupational health disparities is a priority of NIOSH's National Occupational Research. Recognizing that workers' susceptibility to occupational and social hazards in the workplace is further shaped by their social and environmental context beyond work, we undertook this study to enrich the *United For Health* study (UFH; R01 OHO7366-01; PI: Barbeau) of occupational and social hazards among a working class population with contextual data on workers' residential neighborhoods and workers' commuting time and distance.

We were able to geocode 93% of study subjects' residential addresses to the census tract level with high accuracy, with the remaining 7% geocoded based on ZIP code centroid. We calculated commuting distance and time for each participant based on an analysis of the street network, and found that measures calculated using a variety of algorithms yielded very similar results (r>0.95). Individual socioeconomic position (SEP) and area-based socioeconomic measures (ABSMs) were mildly correlated, with substantial variability of ABSMs within categories of individual SEP. Black participants were more likely to live in socioeconomically disadvantaged neighborhoods and to have longer commutes.

While we observed significant gradients by individual SEP for selected health outcomes (self-rated health, smoking, systolic blood pressure, and asthma and wheeze), most gradients by ABSM were not significant, although point estimates suggested a pattern of worse health outcomes with increasing socioeconomic deprivation. Longer commutes were associated with a lower odds of wheeze in the full cohort and lower systolic blood pressures for Black and Latino participants.

We also evaluated the area-based measure CT % below poverty as a potential confounder and/or effect modifier of relationships between social and occupational hazards and selected health outcomes. Observed associations with workplace abuse (associated with self-rated health, smoking, asthma, and wheeze), sexual harassment (associated with systolic blood pressure), racial discrimination (associated with smoking and asthma), and occupational hazards (associated with wheeze) were not reduced by controlling for CT poverty or commuting distance, and in a few cases, were strengthened. While the observed associations with social and occupational hazards varied by racial/ethnic group, interaction models did not yield significant evidence of effect modification by CT poverty, although in some cases, point estimates suggested that the effect of social hazards was greater among residents of more impoverished neighborhoods.

Our study demonstrates the feasibility of using geocoding and area-based measures to broaden frameworks for analyzing occupational health disparities. Racial/ethnic and socioeconomic disparities in exposure to social hazards (such as sexual harassment, workplace abuse, and racial discrimination) and occupational hazards, can be conceptualized within the framework of the ***inverse hazard law***, by which the accumulation of health hazards tends to vary inversely with the power and

resources of the populations affected. Policies and interventions to address occupational health disparities should thus consider how racial/ethnic minorities and socioeconomically disadvantaged workers are multiply disadvantaged by the clustering of adverse socioeconomic circumstances and social and occupational hazards. This perspective can inform occupational health and environmental health practitioners, regulators, and advocates, urban planners, community based groups, and worker organizations about ways to create healthier communities and jobs.

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Section 1.

Significant (Key) Findings

The key aims of our study were (1) to demonstrate the feasibility of geocoding workers' residential and workplace addresses in the *United For Health* study, in order to enhance the available socioeconomic information on participants with contextual data on neighborhood socioeconomic position and to calculate commuting distance and time, (2) to assess the extent to which individual and area-based socioeconomic measures, both separately and jointly, are associated with self-rated health, smoking, systolic blood pressure, and respiratory symptoms (asthma and wheeze), and (3) to assess ABSMs and commuting distance as potential effect modifiers of established relationships between social and occupational hazards and health.

Specific Aim 1

Geocoding and area based socioeconomic measures. We found that residential addresses of virtually all subjects in the United For Health cohort could be geocoded with high accuracy to the census tract level. We observed significant variation within categories of individual socioeconomic categories, suggesting that the area-based measures may reflect an additional dimension of contextual socioeconomic experience not captured by the individual measures.

Commuting distance and time. Commute distance and time as calculated using different algorithms were highly correlated, demonstrating that assessment of commuting distance in this sample was robust to the assumptions used to determine the street network traversed. Our results confirm that commuting distance can be easily calculated based on the street network for studies that have geocoded residential and workplace addresses.

Racial/ethnic and socioeconomic patterns in ABSMs and commute distance. Subjects in this working class sample lived in relatively deprived census tracts as measured by a variety of ABSMs. Racial/ethnic disparities in socioeconomic and commuting variables reflect the "*inverse hazard law*," by which the accumulation of health hazards tends to vary inversely with the power and resources of the populations affected. Thus, even in this primarily working class sample, Black participants were observed to live in more deprived CTs and to have longer commutes than their White or Latino counterparts.

Specific Aim 2

Associations between ABSMs, commute distance, and selected health outcomes.

We found significant associations between several health outcomes and individual and household measures of socioeconomic position. Thus, fair/poor self-rated health was associated with lower education and household income and smoking was associated with lower education; asthma was associated with lower education. Interestingly, the odds of being a current vs. non-smoker or ex- vs. non-smoker was observed to be higher among those with *higher* household incomes.

Associations with ABSMs, however, were not significant for most health outcomes and ABSMs. While, point estimates for many associations suggested that more deprived area socioeconomic circumstances were associated with adverse health outcomes, wide confidence limits precluded definitive conclusions about the strength of socioeconomic gradients. The large size of the confidence limits may also be due to non-linearity in the ABSM gradient, or be evidence of heterogeneity in the socioeconomic gradient by group. Future analyses will explore non-linear smoothing of the socioeconomic effect and possible effect modification.

One notable exception was that, among Blacks, residence in higher poverty census tracts was associated with lower systolic blood pressures. Differences in the magnitude and direction of socioeconomic gradients by race/ethnicity speak to the importance of considering how selection processes may differ by racial/ethnic group: it may be that Blacks living in the most impoverished census tracts and having higher and possibly uncontrolled blood pressures are not able to work and therefore not represented in our sample of employed workers.

As with ABSMs, we did not find strongly significant associations between commuting distance and select health outcomes, although wide confidence limits may have obscured patterns. There was some indication that longer commutes were associated with lower systolic blood pressure among Blacks and Latinos, and also with lower odds of wheeze in the full cohort. Inconsistent patterns in relation to commuting may reflect the effect of two countervailing tendencies: on the one hand, poorer, more disadvantaged individuals may be constrained in where they can afford to live, and may end up having to live farther away from their place of work. On the other hand, the tendency of suburbs to attract more affluent residents may also mean that some have longer commutes because of suburban residence. The former group would be expected to have worse health outcomes, while the latter would be expected to have better outcomes.

Specific Aim 3
ABSMs and commute distance as modifiers of relationships between social hazards and selected health outcomes.
We found strong associations between social and occupational hazards and health, some of which have not been previously reported in this cohort. These include the association of workplace abuse and occupational hazards with poor/fair health; higher odds of asthma with workplace abuse and racial discrimination; and higher odds of wheeze with workplace abuse, sexual harassment, and occupational hazards. We also confirmed previously reported associations of sexual harassment with systolic blood pressure (particularly among women) and associations of smoking behavior with workplace abuse, racial discrimination, and occupational hazards.

In most cases, these associations appear to be independent of ABSMs, as controlling for ABSMs did not substantially alter point estimates in multivariate models. Evaluation of effect modification by census tract poverty was inconclusive, as confidence limits for interaction effects were quite wide. However, there were some suggestions that the effect of social and occupational hazards were slightly stronger among those living in more deprived neighborhoods.

Translation of Findings

Our study demonstrates the feasibility of using geocoding and geographic information systems (GIS) methods to broaden frameworks for analyzing occupational health disparities, by taking into consideration neighborhood socioeconomic context and the commuting experience. Even within our predominantly working class sample, we observed racial/ethnic disparities in neighborhood socioeconomic circumstances and commuting distance. These disparities, and racial/ethnic and socioeconomic disparities in exposure to social hazards (such as sexual harassment, workplace abuse, and racial discrimination) and occupational hazards, should be conceptualized within the framework of what has been termed the inverse hazard law, by which the accumulation of health hazards tends to vary inversely with the power and resources of the populations affected. Policies and interventions to address occupational health disparities should thus consider how racial/ethnic minorities and socioeconomically disadvantaged workers are doubly or triply disadvantaged by the clustering of adverse socioeconomic circumstances and social and occupational hazards. This perspective can encourage and inform occupational health and environmental health practitioners, regulators, and advocates, urban planners, community based groups, and worker organizations, including unions, about ways to create healthier communities and jobs.

Outcomes/Impact

At present, the primary outcomes and impact of our study are potential, i.e. findings, results, or recommendations that could impact workplace risk if used. The technique of using geocoding and street network analysis to enhance study samples with data on neighborhood contextual socioeconomic circumstances and commuting distance can and should be used by other studies seeking to understand how workers' experiences outside of the workplace interact with exposure to occupational hazards within the workplace to shape workplace health disparities. Similar theoretical perspectives and methods have informed an ongoing study by our research group of racial discrimination and health in a socioeconomic diverse sample recruited from neighborhood health centers in Boston (Racial Discrimination & Risk of Chronic Disease, R01 AG027122-01, PI: Krieger).

Section 2. Scientific Report

BACKGROUND

The increasing diversity of the US workforce in recent decades has lead to the National Occupational Research Agenda[11] making reducing occupational health disparities a priority, and it is one of NIOSH's "Coordinated Emphasis Areas" [1]. To date, most research on occupational health disparities has focused on the disproportionate representation of racial/ethnic minorities and socioeconomically disadvantaged populations in high-hazard occupations [2, 3]. These studies highlight the importance of understanding and reducing exposure to job-related hazards at the worksite. These include both occupational hazards [4-6] (e.g. dusts/gases and chemical fumes, ergonomic strain, and noise), and, increasingly, social hazards (e.g. job strain (demand/control), racial discrimination, sexual harassment, and violence) [7-12].

New conceptual frameworks and research are beginning to recognize, however, that not only do workers simultaneously experience the occupational and social hazards of their jobs, but their susceptibility or resilience is further shaped by their social and environmental context beyond work, including at home and in their neighborhoods, and also by their commuting distance [13-17]. This more nuanced framework, for example, recognizes that an individual with few economic resources, from an impoverished neighborhood, and who faces a difficult commute to and from a hazardous job, experiences multiple insults that may interact additively or synergistically in their adverse effects on health.

Applying this conceptual framework to research on occupational health disparities requires us to supplement the data we collect on workers at their worksites with information about their households and communities of residence. Fortunately, a cost-effective, efficient, and valid methodology exists to link study subjects in newly collected as well as already existing occupational health datasets to area-based measures characterizing their neighborhoods of residence. Using this methodology, residential addresses are **geocoded**, which permits linking to a wide variety of georeferenced data, including socioeconomic measures derived from the US Census [18-30]. Employing more sophisticated geographic information systems (GIS) techniques, street maps can be further used to calculate commuting distance and travel times based on the network-connectivity of streets [31]. By creating a multilevel database with information on individual, household, worksite, and residential characteristics, and also commute distance and time, we can test hypotheses concerning the independent and synergistic contributions of individual, household, residential, and workplace conditions on workers' health.

Conceptual model: contextual determinants and embodied pathways

In Figure 1, we present our conceptual model, based on ecosocial theory, which addresses how social inequalities in health represent embodied biological expressions of cumulative experiences of physical and social disadvantage and advantage, across the lifecourse [32-36]. Our model delineates and distinguishes between: (a) **individual, household** and **neighborhood socioeconomic contexts**; (b) **workplace occupational** and **social hazards,** including the worksite neighborhood socioeconomic context; and (c) **direct** and **stress-mediated** pathways leading from exposure(s) to their embodied expression in both **health status** and **health behaviors**. We also introduce the **commute** as an experience that influences health through direct and stress-mediated pathways and contributes to occupational health disparities. We theorize that: (1) greater exposure to adverse socioeconomic context in both workers' neighborhoods of residence and the worksite neighborhood is linked to greater risk of the selected adverse health outcomes (above and beyond the risk associated with individual-level measures of socioeconomic position; (2) greater commute times are associated with increased risk of the adverse health outcomes, via multiple pathways involving both direct physiological stressors and other pathways (e.g. stress-mediated or behavioral); and (3) the combination of these different risks (social hazards, occupational hazards, socioeconomic context, commute time) is minimally (a) additive (i.e. covariates are independent predictors in the standard regression context, or, more likely, (b) synergistic (i.e. regression models admit potential interaction terms between the covariates).

Research informing our hypotheses includes studies providing evidence of direct physiological pathways involving workplace exposures, e.g., dust directly irritating the respiratory tract, thereby triggering respiratory symptoms [6, 37, 38]. Stress-mediated pathways, in turn, can be induced by both workplace occupational hazards (e.g. noise) and social hazards (e.g. racial discrimination, sexual harassment), with both types of hazards potentially provoking two kinds of health-damaging responses. These are (1) somatic responses involving the physiology of "fear" or "arousal", which, if chronic, may lead to dysregulation of the "autonomic nervous system, the hypothalamic-pituitary-adrenal (HPA) axis, and cardiovascular, metabolic, and immune systems, thereby increasing risk of cardiovascular disease, diabetes, and depression [39-41] and (2) harmful behavioral responses, resulting in harm to oneself (e.g. cigarette smoking) or others (e.g. perpetrating violence) [42, 43]. Note that these behavioral responses may be expressed not only at work but also outside the workplace.

A growing body of research likewise suggests exposures associated with neighborhood and commuting experiences can affect health via direct physiologic pathways and stress-mediated pathways [14,15, 44-46]. In the case of neighborhoods, for which a larger body of evidence exists, examples include the impact of neighborhood poverty (above and beyond household poverty), availability of affordable healthy food, crime rates, and environmental pollution on both health status and health behaviors [44, 47-50]. A small but suggestive body of research on commuting and health points to additional direct and stress-mediated exposures. Thus, studies have documented high exposures to air pollutants (including particulate matter, volatile organic compounds, carbon monoxide, ozone, sulfur dioxide, and nitrogen oxides) among motorists and bus riders who spend time in heavy traffic, with these exposures likely to increase risk of respiratory and cardiovascular disease [51-54]. Commuting by car may also have ergonomic effects due to long periods spent seated [55, 56]. Moreover, lengthy and difficult commutes can be stressful, with recent studies of commuters demonstrating associations between commute duration and elevated perceived stress, elevated salivary cortisol [57], and reduced heart rate variability [58]. Time spent commuting also can harm health by restricting the amount of time available for leisure, exercise, sleep, and health-promoting behaviors, including food shopping and preparing meals at home (as opposed to eating on the run or in fast food restaurants) [14, 15, 59, 60]. Indeed, suggesting a concern about commuting in relation to neighborhood context is appropriate, in qualitative interviews conducted for UFH, several participants mentioned major time crunches associated with their commutes, particularly among families where a single car is shared among all adults, which adversely affected their time for sleeping, healthy eating, exercise, and being with their family [13].

SPECIFIC AIMS

The specific aims of our study were to:

Specific Aim A.1. Geocode workers' residential and workplace addresses in the *United for Health* study cohort, in order to: (a) **append US census-derived area-based socioeconomic measures** (ABSMs) to characterize the socioeconomic characteristics of both their **residential and workplace contexts**, using US census tract data on poverty, income, and education, and (b) calculate the **physical commute travel distance and travel time** between the workers' residential address and their worksite.

Specific Aim A.2. Assess the extent to which individual socioeconomic position, residential and workplace ABSMs, and commute distance, both separately and jointly, are associated with the following selected adverse health outcomes, overall and in relation to race/ethnicity and gender:(a) fair or poor **self-rated health**; (b) **smoking**; (c) **elevated blood pressure**; and (d) **increased respiratory symptoms**.

Specific Aim A.3. Assess the role of residential and workplace ABSMs and commute distance as **modifiers** of previously established associations between the selected health outcomes and the documented **workplace physical hazards** (noise, dust/gases and chemical fumes, and ergonomic strain) and **social hazards** (workplace abuse, racial discrimination, sexual harassment, and job strain).

METHODOLOGY

Study Population

Our study was nested within *United for Health* (R01 OHO7366-01; PI: Elizabeth Barbeau), a study of unionized workers in the greater Boston area (MA) that was designed to explore links between: (a) *workplace occupational hazards*, (i.e. noise, dust/gases and chemical fumes, and ergonomic strain), (b) *workplace social hazards* (i.e. race- or gender-based discrimination, sexual harassment, and job strain) and (c) *adverse health status and health behaviors*. The study was conducted in 14 worksites, within four industries: meat processing (one worksite); electrical light manufacturing (two worksites); retail grocery (nine worksites); and school bus transportation (two dispatch yards). Details regarding recruitment have been previously published [13]. Briefly, subjects were recruited from labor unions between March 2003 and August 2004, and evaluated for eligibility (25-64 years old, employed at worksite ≥2 months, English or Spanish speaking); the study response rate was 72%. The main survey was administered to eligible subjects on-site, typically during work hours, in a private room, and consisted of a 40- to 45- minute survey, administered by computer (Audio-Computer Assisted Self-Interviewing (ACASI) in either English or Spanish), followed by a 15-minute health check. All subjects provided informed consent, and conduct of the study was approved by the institutional review boards of the Dana-Farber Cancer Institute, Harvard School of Public Health, and University of Massachusetts.

The Inclusion Enrollment Table is included in this Scientific Report as Table 1, on page 29. Additional selected sociodemographic and health characteristics of the final study population (n=1,202) and exposure to occupational and social hazards (described below) are presented in Table 2.

Exposure to **occupational hazards** (dust, chemical fumes, noise, and ergonomic strain) was assessed as part of the interviewer-administered survey, with exposures measured on a 4-point scale of no, low, moderate, or high exposure. Questions from the American Thoracic Society (ATS) Respiratory Symptom Questionnaire and European Community Respiratory Health Survey (ECRHS) were used to assess occupational exposure to *dusts* and *chemical fumes* [61]. Analogous questions were asked about jobs in which there had been exposure to mild, moderate or severe levels of *noise* [62, 63]. Respondents were asked to rate their *ergonomic* exposures to basic risk factors most commonly related to musculoskeletal disorders, including exposures to awkward and static postures, lifting and physical load, repetitive movements and other dynamic factors, and vibration using a scoring procedure based on OSHA's draft ergonomics standard [64]. We combined these data into a single occupational hazard score based on the number of types of exposures to which respondents had been exposed.

The *United for Health* dataset includes uniquely extensive data on multiple **social hazards**: job strain, workplace abuse, sexual harassment, and racial/discrimination [16]. *Job strain* was assessed using a set of questions adapted from the Karasek Job Content Questionnaire for demand-control [27]. The job strain variable was dichotomized into high (high/low demand, low control) and low (high/low demand, high control) strain. *Workplace abuse* was measured using a reduced eight-item version of the Generalized Workplace Abuse (GWA) instrument [65]. For each item, participants were asked whether the experience had happened "never," "once," or "more than once" in the last 12 months in their workplace setting. *Sexual harassment at work* was measured using five items adapted from two validated instruments: the widely used Sexual Experiences Questionnaire (SEQ) [66] and Goldenhar et al.'s measure of sexual harassment and discrimination [67]. Items focused on three domains -- sexual coercion, unwanted sexual attention, and gender-based hostility – which correspond to the legal construct of sexual harassment. *Experiences of racial discrimination* (EOD) were captured using the recently validated EOD questionnaire [68], an instrument based on the earlier closed-format questions developed by Krieger [10] and used in the CARDIA study [69] and other investigations regarding self-reported experiences of racial discrimination and health [50, 70, 71]. This instrument asks respondents whether they have "ever experienced discrimination, been prevented from doing something, or been hassled or made to feel inferior" in diverse specified situations "because of your race, ethnicity, or color." Psychometric validation of the instrument, conducted within a subset of the UFH cohort, found that scale reliability was high, as demonstrated by Cronbach's alpha (>0.74) and test-reliability coefficients (0.70). Overall, 85% of the cohort reported exposure to at least one of these three social hazards; exposure to all three reached 20 to 30% among black women and women and men in racial/ethnic groups other than white, black, or Latino [16].

Previously published analyses of the UFH cohort have demonstrated that: (1) smoking is positively associated with the three specified social hazards (racial discrimination, sexual harassment, and workplace abuse) [72, 73], (2) elevated systolic blood pressure is associated with sexual harassment among the women workers [74], and (3) psychological distress is independently associated with all three social hazards [75]. A prior UFH substudy validating our measures of racial discrimination [68] also found associations between self-reported experiences of racial discrimination and both psychological distress and risk of smoking, particularly among workers of color.

Geocoding Methodology

To address Aim 1, residential and workplace addresses for each UFH participant were geocoded to their latitude and longitude by a commercial geocoding firm (Mapping Analytics) as follows whose accuracy we have determined to be high (96%) in our previous research [30]. Fully 93% of residential addresses of the 1,202 United for

Health study participants could be geocoded with high accuracy to the census tract level, while the remaining 7% were assigned CT geocodes based on ZIP code centroids.

Area-based socioeconomic measures

Area-based socioeconomic measures at the CT level were extracted from the US Census 2000 Summary File 3 [76]. Based on the prior work of the *Public Health Disparities Geocoding Project*, we selected CT ABSMs that represent key domains of socioeconomic position [27], including % below poverty, median household income, % working class occupations (non-supervisory employees), % less than high school, and % crowding.

Calculation of commuting distance and travel time

To compute the estimated driving time and driving distance for each study subject between his/her residence and worksite, we utilized a procedure developed by Anders Hopperstead of the Harvard Center for Geographic Analysis [31]. Using ArcGIS 9.1 [77], we constructed a Network Dataset from ESRI StreetMap 9.1 street shapefiles which contain data for type of street, e.g. highway vs. secondary road, as well as data for speed limit. Assuming the individual travels at the speed limit, we used these variables to calculate driving time for each segment of road traveled to and from work. In addition, we used the Network Analyst extension to compute an Origin-Destination 'Cost' Matrix to determine the fastest and shortest paths from home to work for each participant, and characterized each by distance and travel time. To look at potential measurement error in computation of commute time, we compared estimates using different optimization algorithms (e.g. shortest distance vs. shortest time), and found that all measures were highly correlated with one another (r>0.95). Accordingly, we based all analyses on commute distance calculated using shortest distance optimization.

Outcome variables

We explored associations between the new contextual variables and four key health outcomes from the *United for Health* study: two self-reported measures of health status (self-rated general health and specific respiratory symptoms), a measure of health behavior (tobacco use), and an objective measure of cardiovascular health (blood pressure). Descriptive statistics on these health outcomes are presented in Table 3.

***Self-rated health**:* Study subjects were asked to rate their general health as "excellent," "very good," "good," "fair," or "poor," using the question asked in the SF-12, a validated and widely-used 12-item short-form health survey [78-80]. Self-rated health is predictive of risk of disease and mortality [79]. For these analyses, we dichotomized self-rated health as "fair/poor" vs. "excellent, very good, or good."

***Tobacco use*:** *Current tobacco use* was measured by self-report using standard measures used in the 1997 NHIS Sample Adult Core Questionnaire. For both cigarettes and smokeless tobacco, we assessed: (1) lifetime use, (2) frequency of use, (3) intensity of use, and (4) cessation attempts.

***Blood pressure*:** Two sets of 5 pulse/blood pressure readings were obtained using the Dinamap 8100 automated blood pressure recorder (Critikon, Tampa, FL), following the protocol of prior epidemiologic studies [81]. We took the average of the five "basal state" readings obtained soon after the participant arrived at the survey site. Additional variables were collected to aid in the interpretation blood pressure measurements including ambient temperature, prior diagnosis with hypertension, current use of anti-hypertensive medication, and time since last cigarette, caffeine, food, and alcoholic beverage.

Respiratory symptoms were assessed using portions of the validated American Thoracic Society (ATS) questionnaire and its updated and expanded version, the validated Protocol for the European Community Respiratory Health Survey [82]. A series of nested questions identified asthma-like symptoms experienced, including cough, wheeze, production of phlegm from the chest, shortness of breath, and diagnosis of asthma by a physician. The instrument also takes into account seasonality and the use of medications. For the current analyses, we focused on self-reported asthma (defined by subject reporting a physician's diagnosis with asthma) and wheeze. We explored additional refinement of these definitions, but found that missing data on asthma medication precluded use of these data.

Analysis

We conducted exploratory analyses of the distributional properties of the new contextual variables, summarizing means and standard deviations and visualizing distributions using graphical tools in R [83]. To examine bivariate and multivariate associations between variables (including between covariates), we fit linear and logistic regression models using SAS [84]. We explored analytic models that accounted for correlated errors among subjects recruited from the same worksite in a generalized linear mixed model framework, but found little evidence of within-worksite clustering of outcomes. Accordingly, we present results here based on fixed effects models with no workplace random effects.

Given suggestions of differential patterning of covariate associations by race/ethnicity, we present results overall and stratified by race/ethnicity (White, Black, and Latino). Estimates are based on analysis of completely observed data, with subjects omitted if they were missing data on any of the covariates or outcomes.

To further evaluate the role of residential and workplace contextual and commuting variables as *effect modifiers* of relationships between occupational and social hazards and health, we also fit models with interaction terms between the new contextual variables and predictors that, in previous analyses, had been shown to have significant associations with the outcomes.

RESULTS & DISCUSSION

Area-based socioeconomic characteristics

Overall, we found that subjects in this working class sample lived in relatively deprived census tracts (mean CT % below poverty = 17.9%, mean median household income = $38,062, mean CT % working class=69.8%, mean CT % less than high school =26.5%, mean CT % crowding =7.2%). While this was true of all racial/ethnic groups, we found some differences in area-based socioeconomic measures by race/ethnicity. Black participants lived in CTs with significantly higher % less than high school (mean difference = 2.3%, 0.5-4.0%) and higher % working class (mean difference=2.1%, 0.3-3.8%). In contrast, Latinos in our sample tended to live in CTs with similar socioeconomic characteristics as those of their white counterparts. Boxplots showing distributions of the selected ABSMs and commuting distance by race/ethnicity are presented in Figure 2.

While census tract-level area-based socioeconomic measures (% poverty, median household income, % less than high school education, and % working class) were moderately correlated with individual measures of education and income, we observed significant variation within categories of individual socioeconomic categories, suggesting that the area-based measures may reflect an additional dimension of contextual socioeconomic experience not captured by the individual measures (Figures 3 and 4).

Within racial/ethnic groups, we noted interesting and sometimes counter-intuitive patterns of association with individual education and household income in relation to the poverty line, particularly among Whites. For example, among Whites, household incomes >=200% of the poverty line were associated with residence in CTs with higher % below poverty (mean difference in CT poverty=4.2%, 95% CI 0.1%,0.7%), lower CT median household income (-$6,215, 95% CI -$10,308, -$2,122), and higher % working class (4.2%, 9% CI 0.07%,7.8%). In contrast, associations with individual education tended to go in the expected direction: among Whites, college graduates tended to live in areas with lower % working class (-5.7%, 95% CI -10.4%,-1.1%). However, White subjects with no high school diploma also lived in CTs with slightly less % less than high school (-3.4%, 95% CI -6.7%,-0.1%). These counter-intuitive patterns may be interpreted in light of selection bias, potentially operating differently by race. As the *United For Health* study is restricted to primarily working class subjects, it may be that more affluent Whites who nevertheless work in these particular occupations and at these particular worksites are more likely to live in working class neighborhoods.

We found significant differences in ABSMs across types of worksites represented in the UFH sample. Those working in transportation (bus drivers), compared to those working in retail, tended to live in CTs with lower median household income (-$2,707, 95% CI -$4,644, -770), higher % less than high school (5.4%, 95% CI 3.8%, 7.1%), and higher % working class (8.6%, 95% CI 6.9%, 10.2%), with this pattern holding particularly among Whites and Blacks.

Commuting distance and time

Commute distance and time as calculated using different algorithms were highly correlated (r>0.95), demonstrating that assessment of commuting distance in this sample was robust to the assumptions used determine the street network traversed.

The average commute distance was 7.6 miles (standard deviation 8.2 miles). We observed that Black participants had commutes that were on average 2.5 miles longer than that of White participants (95% CI 1.3-3.6), while Latino participants had commutes of comparable length. We also observed evidence of socioeconomic variation in commute distance among Latinos: more affluent Latinos (with household income

>200% of the poverty line) had longer commutes than poorer Latinos. Commuting distance was longer among those working in transportation (bus drivers), compared with those working in retail, while those working at manufacturing sites (especially Blacks) tended to have shorter commuting distances.

Two countervailing patterns may be driving socioeconomic differences in commute distance. On the one hand, poorer individuals may be constrained in where they can afford to live, and, particularly for Black subjects (given patterns of racial/ethnic residential segregation), may end up having to live farther away from their place of work. On the other hand, the tendency of suburbs to attract more affluent residents may also mean that, for other racial/ethnic groups (particularly Latinos in our sample), greater household income translates into longer commute times because of suburban residence.

While these patterns are complex, they are broadly in keeping with what we have previously termed the "inverse hazard law," by which "the accumulation of health hazards tends to vary inversely with the power and resources of the populations affected" [74, 75]: even in this primarily working class sample, Black participants were observed to live in more deprived CTs and to have longer commutes than White participants.

Associations between ABSMs, commute distance, and selected health outcomes (Specific Aim 2)

Self-rated health

Associations between odds of fair/poor self-rated health and sociodemographic, ABSM, commuting distance, and social and occupational hazard variables are presented in Table 4. Black participants were significantly less likely to report fair or poor health than whites (OR 0.61, 95% CI 0.40, 0.92). In contrast, Latinos were more likely to report fair/poor health (OR 1.75, 95% CI 1.18, 2.62). While overall, women were more likely than men to report fair/poor health, (OR 2.00, 95% CI 1.45, 2.74), this pattern was apparent only among Black and Latino women.

Poor/fair self-rated health was associated with both lower individual educational attainment (OR 1.56, 95% CI 1.10, 2.21) and household income below the poverty line (OR 1.72, 95% CI 1.16, 2.50). The pattern by education was sharpest among blacks and the pattern by household income was sharpest among Latinos.

We did not observe significant associations with ABSMs, although confidence limits on all estimates were quite wide. Point estimates for most associations suggested that more deprived area socioeconomic circumstances were associated with higher odds of poor/fair health, particularly among blacks and Latinos. The exception was that higher CT median household income was associated with significantly lower odds of poor/fair health among Latinos (OR 0.80, 95% CI 0.65, 0.97).

We did not detect a significant association of commuting distance and poor/fair self-rated health in any racial/ethnic group.

Smoking

Associations between odds of being a current vs. non-smoker and sociodemographic, ABSM, commuting distance, and social and occupational hazard variables are presented in Table 5; analogous odds ratios for being an ex- vs. non-smoker are presented in Table 6.

Among whites, women were more likely to report being a current smoker vs. a non-smoker (OR 2.08, 95% CI 1.19, 3.63). Overall, college graduates were less likely to report being a current smoker (especially among blacks) or an ex-smoker. However, those with higher household income in relation to the poverty line had an increased odds of being a current vs. non-smoker, particularly among Latinos. Overall, those with higher household income also had an increased odds of being an ex-smoker vs. a non-smoker.

We did not detect significant socioeconomic gradients in smoking by ABSM, as confidence limits were very wide. Commuting distance did not appear to be associated with smoking either.

Systolic blood pressure

Associations between systolic blood pressure and sociodemographic, ABSM, commuting distance, and social and occupational hazard variables are presented in Table 7, with effect estimates corresponding to estimated slopes from linear regression models. In the UFH cohort, overall systolic blood pressures were quite high compared to the general population (mean SBP=134.8 mmHg). Blacks and whites had similar blood pressures (with SBP among blacks slightly but non-significantly elevated, compared with whites), while Latino subjects had significantly lower blood pressures (mean difference -5.11, 95% CI -8.10, -2.12). Women of all racial/ethnic groups had significantly lower blood pressures than men.

We found that subjects with household incomes >=200% of the poverty line had significantly higher blood pressures than those with household incomes below the poverty line (mean difference=3.19, 95% CI 0.74, 5.65). This was particularly apparent among black participants (mean difference=4.42, 95% CI 0.34, 8.49). In contrast, we did not find socioeconomic differences in systolic blood pressure by individual educational attainment. Differences in the magnitude and direction of socioeconomic gradients by race/ethnicity speak to the importance of considering how selection processes may differ by racial/ethnic group: it may be that Blacks living in the most impoverished census tracts and having higher and possibly uncontrolled blood pressures are not able to work and therefore not represented in our sample of employed workers.

Commuting distance was not associated with systolic blood pressure in the full cohort, but longer commutes were associated with lower systolic blood pressure among Blacks and Latinos (black mean difference= -0.21, 95% CI -0.41,-0.02; Latino mean difference=-0.29, 95% CI -0.57, -0.01).

Asthma and wheeze

Associations between odds physician-diagnosed asthma and sociodemographic, ABSM, commuting distance, and social and occupational hazard variables are presented in Table 8; analogous odds ratios for self-reported wheeze are presented in Table 9. Women were also more likely to report asthma than men (OR 2.14, 95% CI 1.50, 3.04), particularly among blacks. While college graduates were significantly less likely to report asthma in the full cohort, patterns by individual education and household income did not show consistent gradients within racial/ethnic groups. While point estimates for several ABSMs suggested increasing odds of asthma with more deprived ABSM values, these patterns were not significant. Commuting distance was not associated with increased odds of asthma.

Blacks were significantly less likely to report wheeze than whites (OR 0.48, 95% CI 0.34, 0.67). Overall, women were more likely to report wheeze (OR 1.85, 95% CI 1.41, 2.44), particularly among Latinas (OR 2.39, 95% CI 1.40, 4.05). While there was some indication of increasing risk of wheeze with lower individual and household socioeconomic position, patterns were inconsistent and non-significant. There were no significant socioeconomic gradients in wheeze by ABSM. Longer commutes were associated with lower odds of wheeze in the full cohort.

ABSMs and commute distance as modifiers of relationships between social hazards and selected health outcomes (Specific Aim 3)

We evaluated the potential role of ABSMs as confounders of relationships between social hazards and health, as well as possible effect modification of these relationships. Here, we report on patterns in relation to CT % below poverty. We also explored confounding and effect modification by commuting distance.

Self-rated health

The associations we present between self-rated health and social and occupational hazards are previously unreported in the UFH cohort.

We found that workplace abuse was associated with increased odds of reporting poor/fair health (OR 1.08, 95% CI 1.05, 1.12) in the full cohort. This association was significant among blacks (OR 1.11, 95% CI 1.04, 1.19) and Latinos (OR 1.10, 95% CI 1.03, 1.17). In models that additionally adjusted for gender and CT poverty, these associations remained significant and unchanged. In models that included an interaction term between workplace abuse score and CT poverty, the main effect of workplace abuse became slightly stronger, and was significant in all racial/ethnic specific analyses. The point estimate of the workplace abuse X CT poverty interaction suggests that the effect of workplace abuse on self-rated health is strongest among more participants living in more affluent CTs, although the wide confidence limits preclude definitive conclusions.

Increased exposure to occupational hazards was also associated with higher odds of reporting poor/fair health in the full cohort, even after adjusting for gender and CT poverty. Further inclusion of an interaction term between occupational hazards score and CT poverty yielded unstable results.

Adjustment for commuting distance did not substantially change observed relationships between workplace abuse and self-rated health. Inclusion of an interaction term between commuting distance and workplace abuse did not yield evidence of effect modification by commuting distance either.

Smoking

We found indications that smoking was associated with workplace abuse (current vs. non-smoker OR=1.05, 95% CI 1.02, 1.09), racial discrimination (current vs. non-smoker OR for 1-2 exposures of racial discrimination = 1.53, 95% CI 1.09, 2.15), and occupational hazards (current vs. non-smoker OR for 5+ exposures = 1.91, 95% CI 1.19, 3.09), in agreement with our previously published results [73]. In racial/ethnic specific analyses, the effect of racial discrimination was more noticeable among Blacks and Latinos, with the relative odds of current vs. non-smoker among 3+ exposures of racial discrimination 2.3 times that of no exposures. We also detected a significantly increased odds of being an ex- vs. non-smoker among Latinos (OR 1.47, 95% CI 1.02, 2.12).

Controlling for CT % below poverty did little to affect the association between workplace abuse and being a current vs. non-smoker and the interaction term between workplace abuse and CT poverty was not significant.

The excess odds of being a current vs. non-smoker for those reporting 1-2 experiences of racial discrimination was similarly unaffected by controlling for CT poverty. In the model that included interaction terms between categories of racial discrimination and CT poverty, the main effect of 1-2 experiences of racial discrimination was substantially reduced; together with the point estimate of the interaction term, the model suggests that the effect of racial discrimination on smoking is greater among those living in CT with higher poverty, although the interpretation is difficult because of the wide confidence limits.

We also found indications that the effect of occupational hazards was greater among participants living in higher poverty CTs, although once again wide confidence limits preclude definitive conclusions.

Systolic blood pressure

We found that higher systolic blood pressure was associated with experience of sexual harassment, particularly among white women [74]. We found that controlling for CT % below poverty did not affect the observed association, nor did we detect effect modification of the association between sexual harassment and systolic blood pressure by CT poverty. Similarly, we did not observe any effect modification or confounding by commuting distance.

Asthma and Wheeze

We found that experience of workplace abuse was associated with increased odds of physician-diagnosed asthma in the full cohort (OR 1.10, 95% CI 1.06, 1.15) and in racial/ethnic specific analyses (similar magnitude, with the gradient sharpest among Latinos, OR 1.14, 95% CI 1.05, 1.24). Adjustment for CT poverty did not substantially change these estimates. With the inclusion of an interaction term between workplace abuse and CT poverty, the main effect of workplace abuse become slightly stronger, with the point estimate suggesting that the workplace abuse effect is somewhat stronger among participants living in more affluent CTs; however, the wide confidence limits, particularly in the white-specific model, suggest these estimates are unstable.

We also noted an increase odds of asthma among those reporting 3+ experiences of racial discrimination (OR 1.53, 95% CI 1.02, 2.30). After adjustment for gender and CT poverty, the estimated OR was 1.64 (95% CI 1.09, 2.47). The effect was stronger among whites (crude OR 2.81, 95% CI 1.15, 6.85; adjusted OR 3.08, 95% CI 1.24, 7.63). Further adjustment for interactions between categories of racial discrimination and CT poverty yielded unstable models.

In the overall cohort, a greater occupational hazards score was also associated with an increased odds of asthma, after adjustment for gender and CT poverty.

In bivariate models, increased odds of wheeze was associated with sexual harassment in the full cohort and with workplace abuse in the full cohort and racial/ethnic specific analyses. A sizeable effect was also seen for 5+ experiences of occupational hazards (OR 2.89, 95% CI 1.79, 4.67), which was even stronger in white-specific analyses (OR 4.86, 95% CI 1.64, 14.41). However, after adjustment for gender and CT poverty, all associations with social and occupational hazards were no longer significant.

Analyses with commuting distance did not find evidence of confounding of the associations between social or occupational hazard associations and asthma or wheeze. Similarly, there was no evidence of effect modification of these relationships by commuting distance.

Discussion

Associations with ABSMs

Associations between adverse health outcomes and ABSMs were not statistically significant in our study, despite ample evidence from the social epidemiologic literature of socioeconomic gradients in health and neighborhood contextual effects on health [47-50]. While point estimates by several of the ABSMs in our study were in the expected direction, with more adverse health outcomes with increasing neighborhood deprivation, confidence limits for all estimates were wide. The wide confidence limits may suggest non-linearities or effect modification of the socioeconomic gradients, and future analyses will explore these possibilities.

Our use of geocoding and CT ABSMs is informed by awareness of likely strengths and limitations of this methodology. One advantage of using ABSMs is that they can provide important information on social context (e.g., neighborhood poverty rates) that may affect population health, above and beyond individual-level characteristics. One concern often raised about such data, however, pertains to "ecologic fallacy" [85], where by associations between area-level aggregated measures and area-level rates may not accurately reflect individual level associations. Since our study uses individual data characterized in relation to both individual *and* area-based socioeconomic measures, ecologic fallacy is unlikely to affect our results.

A more likely factor influencing the weak socioeconomic gradients by ABSMs that we observed pertains to the composition of the UFH cohort. As we have noted in a previous analysis of systolic blood pressure [74], the UFH cohort was recruited from union members who, by definition, were primarily employed in working class occupations. Thus, the socioeconomic variability of the sample was already restricted, excluding persons in non-working class occupations as well as the unemployed. Restriction to working class persons can also induce selection bias, as was suggested by the observation in some racial/ethnic groups that higher household incomes were associated with residence in more deprived neighborhoods.

Associations with commuting

Our *a priori* hypothesis was that workers who live much farther from where they work would be at greater risk of adverse health outcomes due to the greater time constraints on their lives to get to and from work, and also because of possible physical exposures (such as air pollution) encountered during the commute. What we found, however, was the reverse: where we observed significant associations between commuting time and health outcomes, the data suggest that longer commuting distances are associated with better health outcomes (lower systolic blood pressures among Blacks and Latinos and lower odds of wheeze overall). As with associations between commuting and individual socioeconomic position, we suspect that these patterns are driven by the tendency that those living in suburban areas are more affluent and have better health outcomes. Thus, even if commuting stress does have an adverse effect on health as well, our results suggest that this adverse effect may be offset by the health advantages of those living in more suburban areas.

Our measurement of commuting distance was nevertheless limited by lack of information on car ownership and both mode and time of day of commuting. In effect, the method we are proposing assumes the "best case" scenario of what the commuting distance and time would be, based on the assumptions that: (a) the worker has a car, and (b) she or he take the least time-consuming or shortest distance route via the street network. While it is possible that commuters who live on a direct rail, subway, or ferry line may experience shorter commutes by public transportation, the majority of workers would have to rely on transiting the street network (by car or bus), and most would have to do so during rush hour. Thus, on average, our calculation of the street network transit distances and times would underestimate of the true commute time. We can also anticipate some degree of additional random measurement error, which has the well-known effect of attenuating effect estimates towards the null. The combination of non-differential measurement error and non-differential underestimate implies that any detected impact of commute time on health outcomes would be conservative. Consequently, the associations we observed between commute time and the specified adverse health outcomes are most likely underestimates of the true associations.

Effect modification of social and occupational hazards

CONCLUSIONS

Research on societal determinants of health suggests the existence of an "inverse hazard law," whereby "the accumulation of health hazards tends to vary inversely with the power and resources of the populations affected." These health hazards include economic deprivation, discrimination, and hazardous living and working conditions. They cluster together and are embodied conjointly [36, 50, 74, 75], and harm the health of societal groups exposed to them. For example, research indicates that in the United States, low- compared to high-wage workers are more likely to be exposed to occupational hazards, have less job autonomy, have less or no coverage for health insurance, fewer resources to live a healthy life, and are more likely to be persons of color and women, reflecting past and present patterns of racial/ethnic and gender discrimination [3].

If we are to make real progress in reducing and, ultimately, eliminating occupational health disparities, research must be able to examine how the concentration of hazards and disadvantage among those with the least power and resources in our society contributes to patterns of ill health. Part of this entails consideration of how factors shaping workers' lives outside of the workplace affects their health and susceptibility or resilience to hazards on the job. Our study demonstrates that geocoding and linkage to ABSMs can capture an important dimension of contextual socioeconomic experience, and also begin to pose important questions about how health experiences vary with commuting experience. While the strength of associations between ABSMs and health outcomes in our study were substantially attenuated, likely due to selection bias by restriction to subjects in predominantly working class occupations, results nevertheless suggest that further research using ABSMs and commuting measures should be conducted in more socioeconomically diverse populations of workers. In order to explore in greater detail the impact of commuting experiences on health, we also recommend that studies using GIS methods to determine likely commuting distances and times also collect information on usual mode of transportation, time of day, car ownership, and other factors that can influence the commuting experience.

Policies and interventions to address occupational health disparities should consider how racial/ethnic minorities and socioeconomically disadvantaged workers are doubly or triply disadvantaged by the clustering of adverse socioeconomic circumstances and social and occupational hazards. An individual with few economic resources, from an impoverished neighborhood, and who faces a difficult commute to and from a hazardous job, experiences multiple insults that may interact additively or synergistically in their adverse effects on health. This perspective can encourage and inform occupational health and environmental health practitioners, regulators, and advocates, urban planners, community based groups, and worker organizations, including unions, about ways to create healthier communities and jobs.

Figure 1: Conceptual model of relationships between individual, worksite, neighborhood contextual, and commuting-related variables included in the *United for Health* study (Boston, 2003-2004). Exposures my influence health through direct physiological, stress-mediated, and behavioral pathways.

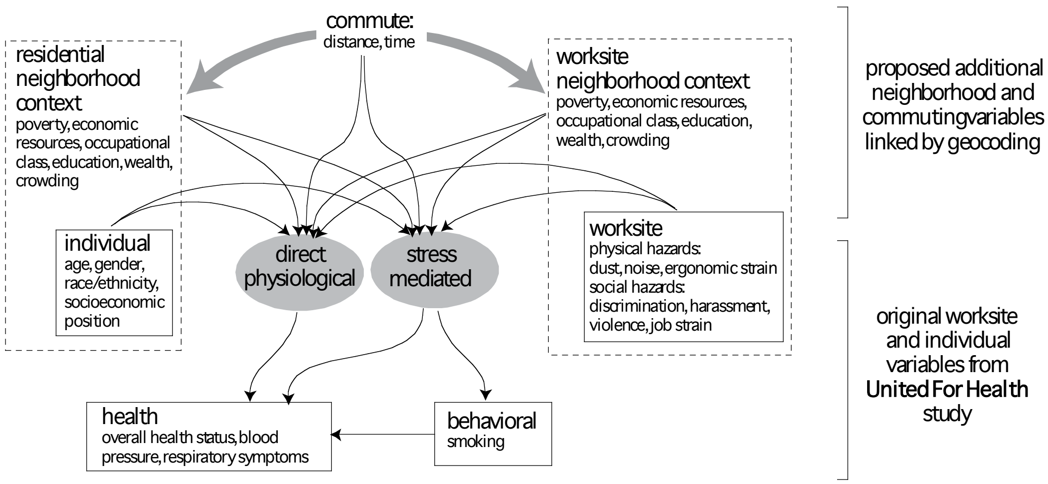

Table 1: Inclusion Enrollment Report for *United For Health* study, Boston, 2003-2004.

Program Director/Principal Investigator (Last, First, Middle): Chen, Jarvis T.

Inclusion Enrollment Report

This report format should NOT be used for data collection from study participants.

Study Title: Work, Neighborhood, Commuting and Occupational Health Disparities

Total Enrollment: 1,202 **Protocol Number:**

Grant Number: R03 OH009338-02

PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race					
	Sex/Gender				
Ethnic Category	**Females**	**Males**	**Unknown or Not Reported**	**Total**	
Hispanic or Latino	106	128	1	235	**
Not Hispanic or Latino	328	611	28	967	
Unknown (individuals not reporting ethnicity)	0	0	0	0	
Ethnic Category: Total of All Subjects*	434	739	29	1,202	*
Racial Categories					
American Indian/Alaska Native	2	0	0	2	
Asian	11	18	0	29	
Native Hawaiian or Other Pacific Islander	1	0	0	1	
Black or African American	308	158	14	480	
White	182	102	5	289	
More Than One Race	25	49	3	77	
Unknown or Not Reported	137	180	7	324	
Racial Categories: Total of All Subjects*	434	739	29	1,202	*

PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)					
Racial Categories	**Females**	**Males**	**Unknown or Not Reported**	**Total**	
American Indian or Alaska Native	0	0	0	0	
Asian	0	0	0	0	
Native Hawaiian or Other Pacific Islander	0	0	0	0	
Black or African American	0	0	0	0	
White	0	0	0	0	
More Than One Race	0	0	0	0	
Unknown or Not Reported	106	128	1	235	
Racial Categories: Total of Hispanics or Latinos**	106	128	1	235	**

* These totals must agree.
** These totals must agree.

Table 2: Selected sociodemographic characteristics and occupational and social hazards in the *United for Health* study, Boston, 2003-2004 (n=1,202).

Demographic characteristics		**Percent**	**Occupational and Social Hazards**		**Percent**
Age	25-44 years	49.3	Exposure to occupational hazards: cumulative	0	18.7
	45-64	50.7		1-2	39.1
Race	White	24.8		3-4	28.3
	Black	41.2		5+	13.9
	Latino	23.6	Occupational hazards: specific exposures (high)		
	Other	10.4	Dust		32.1
Type of worksite	Manufacturing	29	Chemical		22.6
	Retail	32.6	Noise		39.7
	Transportation	38.4	Ergonomic (any high exposure)		67.3
Class position	own or run business	5.1	Workplace abuse:	0	30.3
	self-employed/freelance	6.7	(Number of incidents reported)	1-2	22.3
	Supervisory employee	24.8		3+	47.3
	Non-supervisory employee	63.5	Sexual harassment	0	76.4
Poverty level (household)	<100% poverty	45	(Number of incidents reported)	1-2	19.1
	100-199% poverty	25.1		3+	4.5
	≤200% poverty	29.9	Experiences of racial discrimination:	0	46.8
Education	<12^{th} grade	33.1	(number of situations mentioned)	1-2	23.6
(highest level completed)	High school degree/GED	53.6		3+	29.6
	4 years of college	8.7	Job strain	High	66.4

Table 3: Selected health outcomes in the *United For Health* study, Boston, 2003-2004 (n=1,202).

Outcome Variables		**Percent**
Self-rated health	Poor/fair	15.5
Smoking	Never	60.9
	Ex	23
	Current	16.1
Systolic blood pressure – mean (±std dev)		134.8 (17.8)
Respiratory Symptoms		
% doctor diagnosed asthma		11.8
% wheeze		21.3

Figure 2: Distributions of selected area-based socioeconomic measures (ABSM) and commuting distance by race/ethnicity in the *United For Health* study, Boston, 2003-2004.

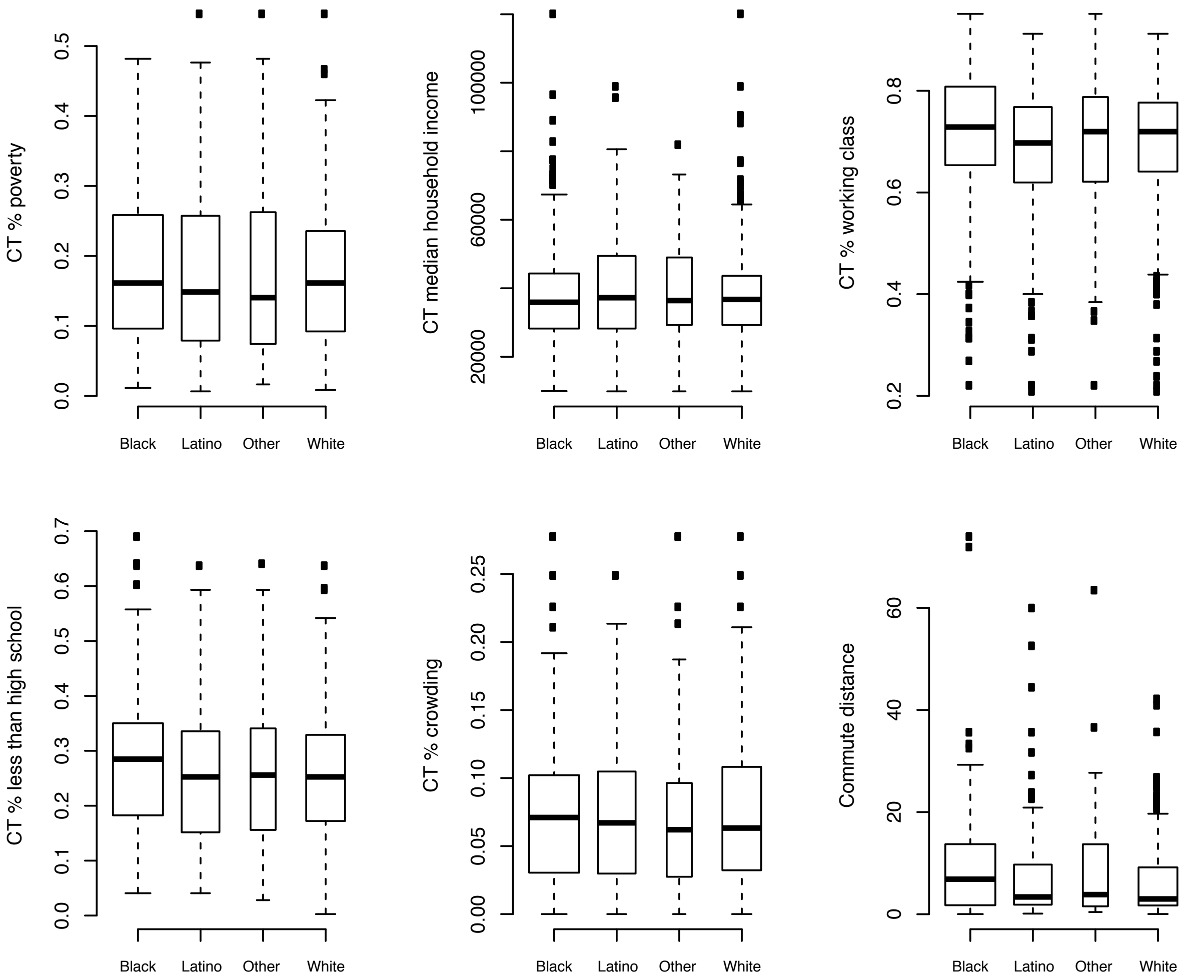

Figure 3: Distributions of selected area-based socioeconomic measures (ABSM) and commuting distance by individual educational attainment in the *United For Health* study, Boston, 2003-2004.

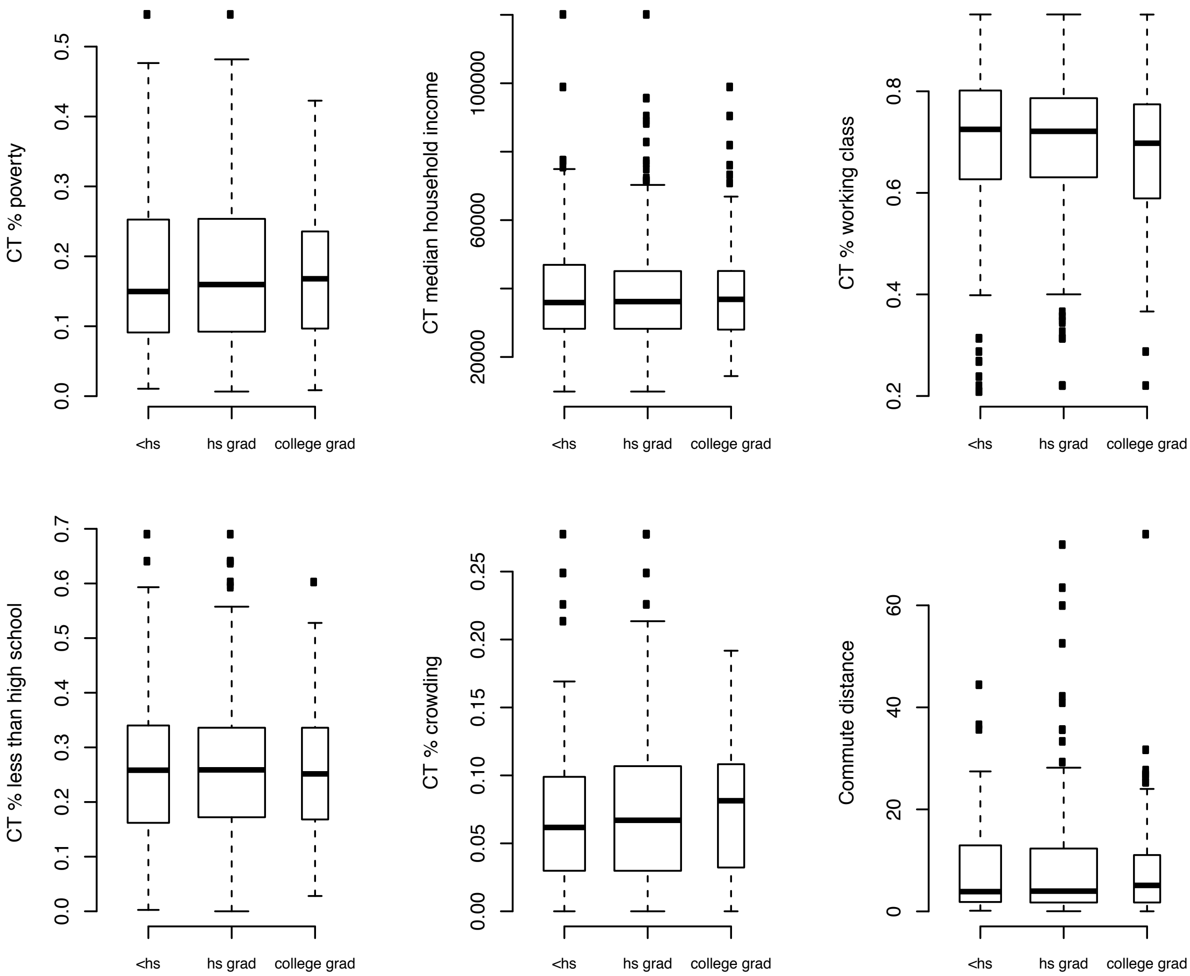

Figure 4: Distributions of selected area-based socioeconomic measures (ABSM) and commuting distance by household income in relation to the poverty line in the *United For Health* study, Boston, 2003-2004.

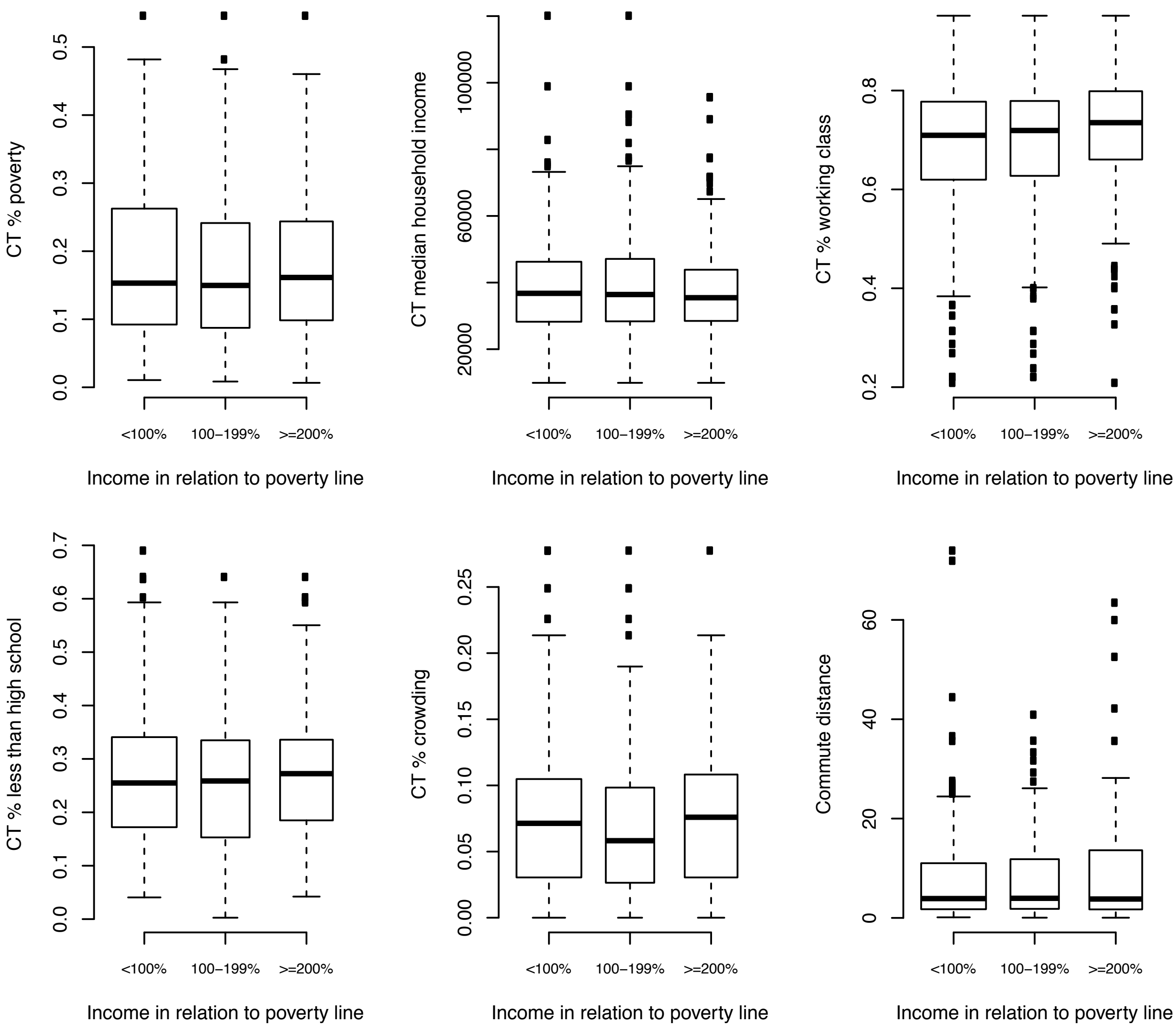

Table 4: Selected bivariate associations (odds ratios from logistic regression models) with odds of fair/poor self-rated health for sociodemographic, area-based socioeconomic, commuting, and social and occupational hazards variables, *United For Health* study, Boston, 2003-2004. Significant associations marked **in bold**.

		All		Whites (N=289)		Blacks (N=476)		Latinos (n=268)	
		OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Demographic variables									
Race/ethnicity	White (reference)								
	Black	**0.61**	**(0.40 ,0.92)**						
	Latino	**1.75**	**(1.18 ,2.62)**						
	Other	0.52	(0.26 ,1.02)						
Gender	female	**2.00**	**(1.45 ,2.74)**	0.84	(0.44 ,1.60)	**2.13**	**(1.19 ,3.84)**	**2.74**	**(1.56 ,4.82)**
	male	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Individual socioeconomic measures									
Individual educational attainment	less than high school	**1.56**	**(1.10 ,2.21)**	1.35	(0.66 ,2.76)	**2.23**	**(1.14 ,4.37)**	0.88	(0.50 ,1.56)
	high school graduate (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	college graduate	0.66	(0.34 ,1.26)	0.46	(0.13 ,1.60)	1.71	(0.67 ,4.39)	<0.001 *	(<0.001 ,>999.9)
Household income in relation to poverty line	<100% poverty (ref)								
	100-199% poverty	**0.47**	**(0.30 ,0.73)**	0.49	(0.22 ,1.10)	0.38	(0.14 ,1.00)	**0.43**	**(0.20 ,0.95)**
	>=200% poverty	**0.58**	**(0.40 ,0.86)**	0.66	(0.33 ,1.33)	1.13	(0.58 ,2.19)	**0.12**	**(0.03 ,0.49)**
Area-based socioeconomic measures									
CT % below poverty		1.38	(0.34 ,5.65)	0.10	(0.01 ,2.25)	8.61	(0.63 ,117.90)	5.47	(0.52 ,57.06)
CT median household income	(per $10,000)	0.98	(0.88 ,1.10)	1.19	(0.98 ,1.44)	0.86	(0.68 ,1.07)	**0.80**	**(0.65 ,0.97)**
CT % less than high school		0.76	(0.21 ,2.75)	0.13	(0.01 ,2.18)	2.19	(0.23 ,20.82)	6.01	(0.56 ,64.88)
CT % working class		1.14	(0.33 ,4.00)	0.59	(0.06 ,5.98)	0.93	(0.09 ,10.18)	9.13	(0.83 ,100.05)
CT % crowding		1.56	(0.07 ,35.12)	0.01	(<0.001 ,7.20)	24.74	(0.10 >999.99)	8.15	(0.03 >999.99)
Commute distance		0.98	(0.96 ,1.00)	1.00	(0.95 ,1.04)	0.98	(0.95 ,1.02)	0.97	(0.92 ,1.01)
Hazards									
Sexual harassment		1.01	(0.85 ,1.20)	0.73	(0.42 ,1.26)	0.99	(0.73 ,1.35)	1.24	(0.94 ,1.64)
Workplace abuse		**1.08**	**(1.05 ,1.12)**	1.06	(0.99 ,1.14)	**1.11**	**(1.04 ,1.19)**	**1.10**	**(1.03 ,1.17)**
Racial discrimination	never (reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.37	(0.94 ,2.01)	1.90	(0.97 ,3.74)	1.31	(0.62 ,2.78)	1.18	(0.60 ,2.32)
	3+ exposures	0.99	(0.67 ,1.44)	1.82	(0.71 ,4.67)	0.92	(0.46 ,1.82)	1.09	(0.55 ,2.15)
Occupational hazards	0 exposures (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	0.85	(0.53 ,1.37)	1.70	(0.46 ,6.25)	0.73	(0.36 ,1.49)	0.52	(0.20 ,1.32)
	3-4 exposures	1.45	(0.90 ,2.32)	2.48	(0.68 ,9.03)	0.73	(0.32 ,1.67)	1.11	(0.45 ,2.70)
	5+ exposures	**1.80**	**(1.06 ,3.07)**	2.58	(0.67 ,9.93)	1.16	(0.42 ,3.20)	0.99	(0.37 ,2.64)
Covariates									
Smoking	Current	**1.58**	**(1.10 ,2.28)**	1.80	(0.90 ,3.58)	**2.30**	**(1.12 ,4.69)**	1.23	(0.61 ,2.47)
	Ex	1.18	(0.76 ,1.83)	0.75	(0.30 ,1.86)	**2.22**	**(1.04 ,4.73)**	1.58	(0.66 ,3.75)
	Never	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Workplace type	Retail	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	Manufacturing	**1.46**	**(1.02 ,2.09)**	1.11	(0.56 ,2.18)	<0.001 *	(<0.001 >999.99)	1.99	(0.94 ,4.23)
	Transportation	**0.37**	**(0.24 ,0.58)**	1.29	(0.55 ,3.05)	0.26	(0.14 ,0.48)	0.20	(0.02 ,1.62)

* Unstable model fit due to no fair/poor self-rated health reported in the college graduate group and manufacturing workplace type.

Table 5: Selected bivariate associations (odds ratios from logistic regression models) with odds of current vs. non-smoking for sociodemographic, area-based socioeconomic, commuting, and social and occupational hazards variables, *United For Health* study, Boston, 2003-2004. Significant associations marked **in bold**.

		All		Whites		Blacks		Latinos	
		OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Demographic variables									
Race/ethnicity	White (reference)	1.00	(reference)						
	Black	**0.24**	**(0.17 ,0.33)**						
	Latino	**0.26**	**(0.18 ,0.39)**						
	Other	**0.29**	**(0.17 ,0.49)**						
Gender	female	1.12	(0.84 ,1.49)	**2.08**	**(1.19 ,3.63)**	1.03	(0.61 ,1.75)	0.69	(0.36 ,1.31)
	male	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Individual socioeconomic measures									
Individual educational attainment	less than high school	1.14	(0.82 ,1.58)	1.50	(0.77 ,2.94)	1.20	(0.64 ,2.24)	1.04	(0.54 ,2.00)
	high school graduate (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	college graduate	**0.58**	**(0.34 ,1.00)**	0.85	(0.37 ,1.93)	**0.22**	**(0.05 ,0.92)**	0.48	(0.10 ,2.18)
Household income in relation to poverty line	<100% poverty (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	100-199% poverty	**1.72**	**(1.22 ,2.42)**	0.93	(0.48 ,1.83)	1.01	(0.53 ,1.94)	**3.28**	**(1.58 ,6.84)**
	>=200% poverty	**1.60**	**(1.14 ,2.24)**	0.62	(0.32 ,1.18)	1.42	(0.79 ,2.55)	1.66	(0.68 ,4.07)
Area-based socioeconomic measures									
CT % below poverty		0.59	(0.16 ,2.10)	0.56	(0.05 ,6.76)	0.56	(0.05 ,5.88)	0.32	(0.02 ,5.37)
CT median household income	(per $10,000)	1.02	(0.92 ,1.17)	0.94	(0.79 ,1.12)	1.10	(0.93 ,1.30)	1.01	(0.82 ,1.24)
CT % less than high school		0.36	(0.11 ,1.13)	0.64	(0.06 ,6.61)	0.22	(0.03 ,1.62)	0.44	(0.03 ,6.44)
CT % working class		0.51	(0.17 ,1.52)	1.56	(0.19 ,12.92)	0.24	(0.03 ,1.71)	0.45	(0.04 ,4.78)
CT % crowding		0.83	(0.05 ,13.56)	3.39	(0.02 ,772.17)	0.18	(0.00 ,29.38)	0.04	<0.001 ,33.78)
Commute distance		0.99	(0.97 ,1.00)	1.01	(0.97 ,1.05)	0.98	(0.95 ,1.01)	0.98	(0.93 ,1.02)
Hazards									
Sexual harassment		0.92	(0.78 ,1.08)	0.67	(0.45 ,1.01)	0.99	(0.77 ,1.27)	1.32	(0.96 ,1.81)
Workplace abuse		**1.05**	**(1.02 ,1.09)**	1.00	(0.94 ,1.07)	1.02	(0.96 ,1.09)	1.02	(0.95 ,1.11)
Racial discrimination	never (reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	**1.53**	**(1.09 ,2.15)**	1.65	(0.88 ,3.07)	**2.14**	**(1.05 ,4.36)**	1.76	(0.82 ,3.76)
	3+ exposures	1.20	(0.86 ,1.67)	0.98	(0.43 ,2.22)	**2.28**	**(1.22 ,4.28)**	**2.30**	**(1.08 ,4.93)**
Occupational hazards	0 exposures (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.17	(0.78 ,1.75)	1.08	(0.44 ,2.68)	0.98	(0.53 ,1.85)	0.99	(0.35 ,2.80)
	3-4 exposures	1.26	(0.82 ,1.93)	1.03	(0.41 ,2.55)	1.04	(0.51 ,2.10)	0.88	(0.31 ,2.53)
	5+ exposures	**1.91**	**(1.19 ,3.09)**	1.28	(0.49 ,3.37)	0.99	(0.38 ,2.58)	1.96	(0.66 ,5.82)
Workplace type	Retail	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	Manufacturing	**0.69**	**(0.50 ,0.97)**	0.83	(0.47 ,1.47)	0.60	(0.12 ,2.93)	0.71	(0.34 ,1.47)
	Transportation	**0.39**	**(0.27 ,0.55)**	1.67	(0.70 ,3.97)	0.38	(0.23 ,0.63)	0.39	(0.10 ,1.52)

Table 6: Selected bivariate associations (odds ratios from logistic regression models) with odds of ex vs. non-smoking for sociodemographic, area-based socioeconomic, commuting, and social and occupational hazards variables, *United For Health* study, Boston, 2003-2004. Significant associations marked **in bold**.

		All		Whites		Blacks		Latinos	
		OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Demographic variables									
Race/ethnicity	White (reference)	1.00	(reference)						
	Black	**0.33**	**(0.23 ,0.49)**						
	Latino	**0.24**	**(0.15 ,0.39)**						
	Other	**0.42**	**(0.24 ,0.75)**						
Gender	female	0.74	(0.52 ,1.04)	0.90	(0.46 ,1.75)	0.93	(0.53 ,1.63)	0.58	(0.25 ,1.35)
	male	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Individual socioeconomic measures									
Individual educational attainment	less than high school	1.10	(0.75 ,1.60)	1.03	(0.47 ,2.26)	1.47	(0.78 ,2.79)	1.30	(0.58 ,2.91)
	high school graduate (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	college graduate	**0.45**	**(0.23 ,0.90)**	0.70	(0.27 ,1.84)	0.40	(0.12 ,1.35)	<0.001 *	<0.001 >999.99)
Household income in relation to poverty line	<100% poverty (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	100-199% poverty	**1.58**	**(1.04 ,2.39)**	0.91	(0.38 ,2.17)	1.39	(0.73 ,2.64)	1.53	(0.56 ,4.15)
	>=200% poverty	**2.25**	**(1.56 ,3.25)**	1.74	(0.82 ,3.69)	1.33	(0.70 ,2.53)	0.82	(0.23 ,2.96)
Area-based socioeconomic measures									
CT % below poverty		1.38	(0.34 ,5.67)	0.89	(0.06 ,14.07)	0.91	(0.08 ,10.34)	8.96	(0.36 ,226.40)
CT median household income	(per $10,000)	0.95	(0.85 ,1.06)	0.94	(0.77 ,1.13)	1.03	(0.85 ,1.25)	0.76	(0.56 ,1.03)
CT % less than high school		1.75	(0.49 ,6.27)	3.03	(0.23 ,40.47)	0.44	(0.05 ,3.62)	11.21	(0.38 ,329.20)
CT % working class		1.88	(0.50 ,7.04)	1.96	(0.21 ,18.26)	0.29	(0.03 ,2.64)	278.75*	(3.62 >999.99)
CT % crowding		2.96	(0.13 ,67.30)	5.72*	(0.01 >999.99)	0.29	(0.00 ,55.14)	24.35*	(0.01 >999.99)
Commute distance		1.00	(0.98 ,1.02)	1.02	(0.98 ,1.06)	1.01	(0.98 ,1.04)	0.93	(0.85 ,1.01)
Hazards									
Sexual harassment		0.97	(0.81 ,1.15)	0.78	(0.50 ,1.19)	0.83	(0.60 ,1.14)	**1.47**	**(1.02 ,2.12)**
Workplace abuse		1.01	(0.97 ,1.05)	0.93	(0.86 ,1.00)	0.99	(0.92 ,1.06)	1.06	(0.96 ,1.16)
Racial discrimination	never (reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	0.72	(0.47 ,1.10)	1.07	(0.53 ,2.18)	0.54	(0.24 ,1.22)	0.53	(0.15 ,1.91)
	3+ exposures	0.88	(0.61 ,1.27)	0.29	(0.08 ,1.04)	1.05	(0.59 ,1.85)	2.15	(0.89 ,5.20)
Occupational hazards	0 exposures (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.28	(0.82 ,2.03)	1.66	(0.59 ,4.65)	0.86	(0.45 ,1.64)	1.49	(0.30 ,7.46)
	3-4 exposures	1.26	(0.78 ,2.04)	1.05	(0.36 ,3.05)	0.87	(0.42 ,1.82)	2.07	(0.43 ,9.99)
	5+ exposures	1.16	(0.64 ,2.11)	0.76	(0.23 ,2.53)	0.56	(0.18 ,1.79)	2.94	(0.56 ,15.37)
Workplace type	Retail	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	Manufacturing	0.83	(0.55 ,1.26)	0.85	(0.43 ,1.67)	0.58	(0.07 ,4.91)	1.19	(0.42 ,3.35)
	Transportation	0.87	(0.60 ,1.27)	**3.19**	**(1.31 ,7.77)**	0.91	(0.51 ,1.63)	0.34	(0.04 ,3.07)

* Unstable model estimate.

Table 7: Selected bivariate associations (mean difference from linear regression models) with systolic blood pressure for sociodemographic, area-based socioeconomic, commuting, and social and occupational hazards variables, *United For Health* study, Boston, 2003-2004. Significant associations marked **in bold**.

		All (n=1144)			**White (n=287)**			**Black (n=474)**			**Latino (n=231)**		
		Estimate	**(95% CI)**		**Estimate**	**(95% CI)**		**Estimate**	**(95% CI)**		**Estimate**	**(95% CI)**	
Demographic variables													
Race/ethnicity	White (reference)	0.00	(reference)										
	Black	2.44	-0.06	4.94									
	Latino	**-5.11**	**-8.10**	**-2.12**									
	Other	0.63	-3.11	4.37									
Gender	female	**-6.32**	**-8.45**	**-4.20**	**-8.98**	**-12.99**	**-4.97**	**-3.84**	**-7.35**	**-0.32**	**-6.84**	**-11.35**	**-2.32**
	male	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
Individual socioeconomic measures													
Individual educational attainment	less than high school	1.52	-0.97	4.01	4.79	-0.15	9.73	3.21	-1.11	7.53	1.92	-2.87	6.72
	high school graduate	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
	college graduate	-0.43	-4.02	3.15	-3.14	-9.32	3.04	-0.03	-5.85	5.78	0.34	-8.59	9.27
Household income in relation to poverty line	<100% poverty (ref)	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
	100-199% poverty	-0.91	-3.51	1.69	1.24	-3.96	6.44	-1.36	-5.53	2.81	0.47	-5.26	6.19
	>=200% poverty	**3.19**	**0.74**	**5.65**	2.87	-1.95	7.70	**4.42**	**0.34**	**8.49**	4.63	-1.78	11.03
Area-based socioeconomic measures													
CT % below poverty		-2.61	-11.96	6.73	4.06	-14.57	22.69	**-15.75**	**-31.07**	**-0.43**	11.78	-7.40	30.95
CT median household income	(per $10,000)	0.25	-0.47	0.96	0.49	-0.83	1.80	-0.98	-0.19	2.16	-1.21	-0.27	0.28
CT % less than high school		-1.37	-9.82	7.08	2.86	-14.71	20.42	-12.66	-25.55	0.23	9.34	-9.94	28.61
CT % working class		4.40	-3.76	12.57	5.63	-9.79	21.04	-1.10	-14.79	12.59	6.04	-11.30	23.38
CT % crowding		-5.27	-25.78	15.25	8.26	-31.99	48.51	-31.58	-64.27	1.10	16.12	-29.25	61.48
Commute distance		-0.07	-0.19	0.06	0.11	-0.17	0.39	**-0.21**	**-0.41**	**-0.02**	**-0.29**	**-0.57**	**-0.01**
Hazards													
Sexual harassment		0.19	-0.97	1.35	-2.71	-5.50	0.08	-0.05	-1.82	1.72	2.14	-0.41	4.69
Workplace abuse		-0.15	-0.41	0.11	0.07	-0.42	0.55	-0.18	-0.61	0.25	-0.41	-0.99	0.18
Racial discrimination	never (reference)	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
	1-2 exposures	1.39	-1.22	4.00	-0.56	-5.14	4.01	3.28	-1.23	7.80	-0.21	-5.83	5.40
	3+ exposures	-0.15	-2.58	2.27	-0.47	-6.99	6.06	1.21	-2.55	4.96	-4.36	-9.98	1.26
Occupational hazards	0 exposures (ref)	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
	1-2 exposures	-1.43	-4.32	1.46	1.58	-5.37	8.52	-1.90	-6.06	2.26	-1.71	-8.92	5.51
	3-4 exposures	-2.29	-5.38	0.80	0.56	-6.49	7.62	-1.25	-5.99	3.48	-2.30	-9.68	5.08
	5+ exposures	-2.52	-6.18	1.14	1.45	-6.13	9.03	0.08	-6.44	6.60	-7.45	-15.51	0.60
Covariates													
Smoking	Current	-0.58	-3.10	1.94	-3.65	-8.16	0.86	2.28	-2.27	6.84	-4.49	-10.25	1.27
	Ex	**3.05**	**0.15**	**5.95**	2.59	-2.51	7.69	2.74	-2.08	7.56	5.13	-2.64	12.91
	Never	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
Workplace type	Retail	0.00	(reference)		0.00	(reference)		0.00	(reference)		0.00	(reference)	
	Manufacturing	-1.24	-3.91	1.43	4.51	0.24	8.79	-2.94	-14.74	8.85	1.09	-4.42	6.60
	Transportation	**4.10**	**1.70**	**6.50**	**9.96**	**4.34**	**15.58**	-0.17	-3.81	3.46	3.94	-4.33	12.21

Table 8: Selected bivariate associations (odds ratios from logistic regression models) with odds of physician-diagnosed asthma for sociodemographic, area-based socioeconomic, commuting, and social and occupational hazards variables, *United For Health* study, Boston, 2003-2004. Significant associations marked **in bold**.

		All OR	All (95% CI)	Whites (N=289) OR	Whites (95% CI)	Blacks (N=476) OR	Blacks (95% CI)	Latinos (n=268) OR	Latinos (95% CI)
Demographic variables									
Race/ethnicity	White (reference)	1.00	(reference)						
	Black	0.70	(0.46 ,1.06)						
	Latino	0.65	(0.40 ,1.08)						
	Other	0.83	(0.45 ,1.55)						
Gender	female	**2.14**	**(1.50 ,3.04)**	1.83	(0.95 ,3.54)	**2.14**	**(1.19 ,3.85)**	1.78	(0.80 ,3.97)
	male	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Individual socioeconomic measures									
Individual educational attainment	less than high school	1.16	(0.78 ,1.73)	0.62	(0.26 ,1.48)	1.18	(0.58 ,2.41)	2.05	(0.90 ,4.63)
	high school gradua	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	college graduate	**0.27**	**(0.10 ,0.75)**	<0.001 *	<0.001 >999.99)	0.40	(0.09 ,1.71)	0.70	(0.09 ,5.69)
Household income in relation to poverty line	<100% poverty (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	100-199% poverty	0.59	(0.35 ,1.00)	**0.26**	**(0.08 ,0.83)**	0.80	(0.36 ,1.76)	1.46	(0.57 ,3.75)
	>=200% poverty	1.37	(0.93 ,2.03)	1.38	(0.66 ,2.89)	1.19	(0.60 ,2.37)	0.81	(0.22 ,2.90)
Area-based socioeconomic measures									
CT % below poverty		1.68	(0.35 ,8.06)	9.45	(0.49 ,181.61)	2.43	(0.17 ,34.77)	0.50	(0.02 ,17.14)
CT median household income	(per $10,000)	0.89	(0.78 ,1.01)	0.82	(0.63 ,1.06)	0.86	(0.69 ,1.08)	0.95	(0.73 ,1.25)
CT % less than high school		1.56	(0.38 ,6.52)	3.93	(0.22 ,70.06)	2.02	(0.21 ,19.19)	1.46	(0.05 ,45.06)
CT % working class		2.67	(0.62 ,11.59)	6.51	(0.37 ,114.43)	2.93	(0.24 ,36.41)	2.09	(0.08 ,55.07)
CT % crowding		13.68	(0.47 ,395.60)	20.40*	(0.03 >999.99)	34.48*	(0.15 >999.99)	234.97*	(0.12 >999.99)
Commute distance		0.99	(0.96 ,1.01)	0.98	(0.93 ,1.03)	1.00	(0.97 ,1.04)	0.98	(0.92 ,1.04)
Hazards									
Sexual harassment		1.14	(0.96 ,1.35)	1.23	(0.82 ,1.85)	1.20	(0.92 ,1.56)	1.07	(0.71 ,1.62)
Workplace abuse		**1.10**	**(1.06 ,1.15)**	**1.09**	**(1.01 ,1.18)**	**1.10**	**(1.03 ,1.17)**	**1.14**	**(1.05 ,1.24)**
Racial discrimination	never (reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.27	(0.81 ,1.99)	1.03	(0.46 ,2.27)	0.93	(0.39 ,2.20)	1.59	(0.59 ,4.32)
	3+ exposures	**1.53**	**(1.02 ,2.30)**	**2.81**	**(1.15 ,6.85)**	1.51	(0.77 ,2.94)	2.17	(0.85 ,5.53)
Occupational hazards	0 exposures (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.13	(0.65 ,1.96)	1.05	(0.32 ,3.46)	0.98	(0.44 ,2.14)	1.40	(0.28 ,6.97)
	3-4 exposures	**1.78**	**(1.03 ,3.08)**	1.68	(0.52 ,5.40)	1.60	(0.71 ,3.62)	1.95	(0.41 ,9.30)
	5+ exposures	1.62	(0.86 ,3.06)	0.82	(0.21 ,3.17)	1.70	(0.59 ,4.93)	1.89	(0.36 ,10.01)
Covariates									
Smoking	Current	**1.77**	**(1.17 ,2.69)**	1.38	(0.62 ,3.06)	1.36	(0.64 ,2.89)	2.20	(0.83 ,5.86)
	Ex	2.17	(1.39 ,3.40)	2.02	(0.87 ,4.67)	1.23	(0.54 ,2.80)	**4.51**	**(1.62 ,12.57)**
	Never	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Workplace type	Retail	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	Manufacturing	**0.61**	**(0.39 ,0.95)**	1.10	(0.52 ,2.32)	1.85	(0.46 ,7.46)	**0.39**	**(0.16 ,0.93)**
	Transportation	**0.52**	**(0.35 ,0.79)**	1.97	(0.83 ,4.65)	0.39	(0.22 ,0.72)	0.41	(0.08 ,2.03)

* Unstable model estimate.

Table 9: Selected bivariate associations (odds ratios from logistic regression models) with odds of self-reported wheeze for sociodemographic, area-based socioeconomic, commuting, and social and occupational hazards variables, *United For Health* study, Boston, 2003-2004. Significant associations marked **in bold**.

		All		Whites (N=289)		Blacks (N=476)		Latinos (n=268)	
		OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Demographic variables									
Race/ethnicity	White (reference)	1.00	(reference)						
	Black	**0.48**	**(0.34 ,0.67)**						
	Latino	1.08	(0.76 ,1.53)						
	Other	**0.59**	**(0.35 ,0.98)**						
Gender	female	**1.85**	**(1.41 ,2.44)**	1.21	(0.72 ,2.04)	1.33	(0.81 ,2.20)	**2.39**	**(1.40 ,4.05)**
	male	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Individual socioeconomic measures									
Individual educational attainment	less than high school	1.35	(0.99 ,1.85)	1.11	(0.60 ,2.06)	1.65	(0.91 ,2.97)	0.81	(0.47 ,1.40)
	high school graduate	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	college graduate	0.58	(0.33 ,1.00)	0.29	(0.10 ,0.85)	1.33	(0.58 ,3.02)	0.25	(0.05 ,1.11)
Household income in relation to poverty line	<100% poverty (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	100-199% poverty	**0.59**	**(0.41 ,0.84)**	0.79	(0.41 ,1.52)	**0.45**	**(0.21 ,0.95)**	0.51	(0.25 ,1.04)
	>=200% poverty	0.76	(0.55 ,1.05)	0.83	(0.45 ,1.52)	1.19	(0.68 ,2.08)	**0.20**	**(0.07 ,0.59)**
Area-based socioeconomic measures									
CT % below poverty		0.83	(0.24 ,2.80)	0.60	(0.05 ,6.65)	3.96	(0.43 ,36.33)	0.87	(0.09 ,8.50)
CT median household income (per $10,000)		0.97	(0.89 ,1.07)	1.00	(0.84 ,1.18)	0.89	(0.74 ,1.07)	0.89	(0.74 ,1.07)
CT % less than high school		0.47	(0.16 ,1.44)	0.48	(0.05 ,4.57)	1.32	(0.20 ,8.80)	1.28	(0.13 ,12.19)
CT % working class		1.17	(0.40 ,3.41)	2.39	(0.31 ,18.30)	1.26	(0.17 ,9.49)	4.80	(0.54 ,42.49)
CT % crowding		0.41	(0.03 ,6.15)	0.01*	(<0.001 ,2.82)	2.67	(0.02 ,315.05)	3.10	(0.02 ,614.40)
Commute distance		**0.98**	**(0.96 ,1.00)**	0.99	(0.96 ,1.03)	1.00	(0.97 ,1.03)	0.97	(0.93 ,1.01)
Hazards									
Sexual harassment		**1.15**	**(1.00 ,1.32)**	1.17	(0.83 ,1.64)	1.09	(0.86 ,1.38)	1.24	(0.94 ,1.63)
Workplace abuse		**1.11**	**(1.07 ,1.14)**	**1.09**	**(1.02 ,1.16)**	**1.12**	**(1.06 ,1.19)**	**1.11**	**(1.04 ,1.19)**
Racial discrimination	never (reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.34	(0.96 ,1.88)	1.33	(0.75 ,2.38)	1.22	(0.62 ,2.43)	1.60	(0.85 ,3.04)
	3+ exposures	1.30	(0.95 ,1.78)	2.00	(0.91 ,4.39)	1.49	(0.84 ,2.63)	1.60	(0.85 ,3.04)
Occupational hazards	0 exposures (ref)	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	1-2 exposures	1.22	(0.79 ,1.88)	1.73	(0.61 ,4.96)	1.01	(0.52 ,1.95)	0.78	(0.32 ,1.89)
	3-4 exposures	**2.12**	**(1.38 ,3.26)**	2.33	(0.81 ,6.66)	1.61	(0.80 ,3.23)	1.10	(0.46 ,2.62)
	5+ exposures	**2.89**	**(1.79 ,4.67)**	**4.86**	**(1.64 ,14.41)**	**2.58**	**(1.10 ,6.04)**	0.85	(0.33 ,2.23)
Covariates									
Smoking	Current	**1.96**	**(1.43 ,2.69)**	**1.88**	**(1.05 ,3.35)**	**2.74**	**(1.50 ,4.99)**	**1.21**	**(0.63 ,2.35)**
	Ex	**1.54**	**(1.06 ,2.23)**	0.97	(0.49 ,1.96)	**2.48**	**(1.31 ,4.72)**	0.99	(0.41 ,2.39)
	Never	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
Workplace type	Retail	1.00	(reference)	1.00	(reference)	1.00	(reference)	1.00	(reference)
	Manufacturing	1.33	(0.97 ,1.84)	1.66	(0.95 ,2.91)	0.27	(0.03 ,2.15)	1.33	(0.69 ,2.60)
	Transportation	**0.50**	**(0.36 ,0.71)**	1.93	(0.94 ,3.94)	**0.36**	**(0.22 ,0.59)**	0.53	(0.16 ,1.82)

* Unstable model estimate.

PUBLICATIONS

Manuscripts detailing the results of our study are currently under preparation.

INCLUSION OF GENDER AND MINORITY STUDY SUBJECTS

We have included the Inclusion Enrollment Table as Table 1 on page 29.

INCLUSION OF CHILDREN

Since *United for Health* is a study of health outcomes among adult workers, no children were included in the study population.

MATERIALS AVAILABLE FOR OTHER INVESTIGATORS

Census tract area-based socioeconomic measures for Massachusetts and for all census tracts in the United States are available for 1990 and 2000 from our Public Health Disparities Geocoding Project website at http://www.hsph.harvard.edu/thegeocodingproject/. We are also planning to post the updated protocol we used to determine commuting distances and times using ArcGIS Network Analyst to our website.

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Yr 2 FSR

FINANCIAL STATUS REPORT

(FOLLOW INSTRUCTIONS ON THE BACK)

Jarvis T. Chen

1. Federal Agency and Organizational Element to which Report is submitted	2 Federal Grant or Other Identifying Number	OMB Approval No. 80-R0180
CDC/NCCDPHP, Public Health Service	5 R03 OH 009338-02 Revised	

3. Recipient Organization	
President and Fellows of Harvard College Office for Sponsored Programs 1350 Massachusetts Ave. Room 620 Cambridge, MA 02138	4. Employer Identification Number: 1-042103580-B1 5. Recipient Account Number or Identifying Number: 275-23600-114833 6. Final Report: x Yes / No 7. Basis: X Cash / Accrual

8. Funding/Grant Period (See Instructions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
09/01/08	08/31/11	09/01/09	08/31/11

a. Net outlays previously reported	72,058.19
b. Total outlays this report period	90,941.81
c. Less Program income credits	0.00
d. Net outlays this report period (Line b minus line c)	90,941.81
e. Net outlays to date (Line a plus line d)	163,000.00
f. Less: Non-Federal share of outlays	0.00
g. Total Federal share of outlays (Line e minus line f)	163,000.00
h. Total unliquidated obligations	0.00
i. Less: Non-Federal share of unliquidated obligations shown on line h	0.00
j Federal share of unliquidated obligations (Line h minus line i)	0.00
k Total Federal share of outlays and unliquidated obligations (Line g plus j)	163,000.00
l Total cumulative amount of Federal funds authorized	163,000.00
i. Unobligated balance of Federal funds (Line l minus line k)	0.00

11. Indirect Expense

a. Type of Rate '(PLACE "x" IN APPROPRIATE BOX: Provisional; X Predetermined; Final; Fixed

b. Rate	c. Base	d. TOTAL AMOUNT	e. FEDERAL SHARE
63.00%	0.00	0.00	0.00
63.00%	55,792.58	35,149.33	35,149.33
Total	55,792.58	35,149.33	35,149.33

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

THIS IS THE FINAL FSR

13. Certification:	Signature of Authorized Certifying Official	Date Report Submitted
I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.	Megan Tran for Typed or Printed Name and Title: Isaac Chery *Senior Financial Analyst*	11/21/2011 Telephone (Area code, number and extension): (617)432-2057

DISTRIBUTION COPY 1 - Official Grant file

STANDARD FORM 269

Form Approved Through 06/30/2012
OMB No. 0925-0001

Department of Health and Human Services **Final Invention Statement and Certification** *(For Grant or Award)*	DHHS Grant or Award No. 5 R03OH009338-02

A. We hereby certify that, to the best of our knowledge and belief, all inventions are listed below which were conceived and/or first actually reduced to practice during the course of work under the above-referenced DHHS grant or award for the period

09/01/2008 through 08/31/2011.

original effective date — *date of termination*

B. Inventions (Note: If no inventions have been made under the grant or award, insert the word *"NONE"* under Title below.)

NAME OF INVENTOR	TITLE OF INVENTION	DATE REPORTED TO DHHS
	NONE	
(Use continuation sheet if necessary)		

C. Signature — This block *must* be signed by an official authorized to sign on behalf of the institution.

Title	Name and Mailing Address of Institution
Acting Asst. Director, Sponsored Programs Admin.	Harvard School of Public Health 677 Huntington Ave. Boston, MA 02115-6028
Typed Name Angie LaTulippe	
Signature: Angie LaTulippe — Date: 8/23/12	

HHS 568 (Rev. 06/09)

CDC Procurement & Grants Office - Branch V
Equipment Inventory Listing

Report Date:	March 2, 2012	Grant Number:	R03 OH009338
Project Title:	Work, Neighborhood, Commuting, and Occupational Health Disparities	Project Period:	09/01/2008 – 08/31/2011
Grantee Name:	Jarvis T. Chen, ScD	Project Officer:	Bernadine Kuchinski
Grants Management Officer:	Angie LaTulippe, 617-432-8146	Grants Specialist:	Maryann P. Monroe

Description of Item: i.e. pH Meter	Mfr.[1] i.e. Fischer	Serial Number	Quantity	Condition[2]	Location[3]	Purchase Cost	Date Received [mm/dd/yyyy]
Macbook 15”	Apple	W89464JE66E	1	Good	Landmark Ctr, 401 Park Drive, Rm 403-N, Boston, MA 02215	$1724	12/01/2009

[1]Mfr. (Manufacturer)
[2]Condition: (Excellent) (Good) (Fair) (Poor) (Inoperable)
[3]Location: complete physical address

For Government Use Only, not to be completed by the Grantee
Property Administrator & PO Disposition Recommendation and Instructions:

Description of Item	Disposition[1]	Address[2]
[Copy from above]	_____Transfer Title	Attn: [Project Officer]
	_____Retain and Compensate Awarding Agency	CDC / NIOSH
	_____ Return to Program Office	1600 Clifton Road, NE MS E-74
	_____Other (explain)	Atlanta, GA 30329-4018
[Copy from above]	_____Transfer Title	
	_____Retain and Compensate Awarding Agency	
	_____ Return to Program Office	
	_____Other (explain)	

[1]Check the appropriate disposition
[2]CDC Warehouse is the central receiving point for delivery of all non-hazardous and non-perishable supplies and equipment, CDC –AM–2004-03, update 2010