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Step On It! - Workplace cardiovascular risk assessment of New York City yellow taxi drivers

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Abstract

Background—Multiple factors associated with taxi driving can increase the risk of cardiovascular disease (CVD) in taxi drivers.

Methods—This paper describes the results of Step On It!, which assessed CVD risk factors among New York City taxi drivers at John F. Kennedy International Airport. Drivers completed an intake questionnaire and free screenings for blood pressure, glucose and body mass index (BMI).

Results—466 drivers participated. 9% had random plasma glucose values >200 mg/dl. 77% had elevated BMIs. Immigrants who lived in the U.S. for >10 years had 2.5 times the odds (CI: 1.1–5.9) of having high blood pressure compared to newer immigrants.

Discussion—Abnormalities documented in this study were significant, especially for immigrants with greater duration of residence in the U.S., and underscore the potential for elevated CVD risk in this vulnerable population, and the need to address this risk through frameworks that utilize multiple levels of intervention.

Keywords

taxi drivers; occupational health; immigrant health; cardiovascular disease risk

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BACKGROUND

Multiple factors associated with taxi driving can increase the risk of cardiovascular disease (CVD) in this high-risk occupational group.^{1,2} In a Japanese study, the prevalence of myocardial infarction and multi-vessel disease was higher among male taxi drivers than non-drivers.³ In a Swedish study, drivers had higher rates of smoking, overweight, low physical activity, and job strain compared to men in the general population.⁴ Elevated myocardial infarction risk remained after adjusting for these factors and for diabetes, hypertension, and socioeconomic group.⁴

A major risk factor for drivers is their occupation-induced sedentary lifestyle.^{1,2} Several recent studies show a significant association between being sedentary and high rates of CVD, hypertension, and diabetes.^{5–9} Men with sedentary occupations are more likely to have coronary heart disease and sudden heart failure.¹⁰ A survey of Chicago drivers found 40% never exercise.¹¹

Taxi drivers also face chronic environmental exposures that potentially increase their CVD risk. Associations have been observed between elevations in fine airborne particulate matter (PM), systolic blood pressure increases,¹² reduced heart rate variability,^{13–19} accelerated atherosclerosis, and inflammation.^{20–23} Further, in a study by Peters et al., an association was found between traffic exposure and the onset of myocardial infarction within one hour after exposure.²⁴ PM is commonly used as an indicator of exposure to air pollutants, though black carbon (BC), a component of fine PM, is often used as another metric for evaluation of PM exposure, especially to diesel exhaust PM.²⁵ Westerdahl et al. demonstrated that BC and ultrafine particle (UFP) concentrations on freeways in Los Angeles were up to 20 times those measured in residential locations.²⁶ In New York City, Zwack et al. demonstrated that UFP concentrations decreased by 15–20% within the first 100 m of two major roadways.²⁷ Contributions of different microenvironments to overall exposure to air pollutants is also dependent on the time spent in each microenvironment²⁸, thus drivers working long shifts are likely subject to greater exposure. Variations in in-vehicle UFP exposure depend on the vehicle (age, mileage, etc.) and ventilation settings.²⁹ In-vehicle BC concentration is also dependent upon several other conditions like the type of vehicle being followed (diesel vs. gasoline-powered), road types, and congestion levels.^{30,31} In several studies, in-vehicle PM levels have been found to be very high, come from external sources such as other vehicles on the road,³² and can be greater than ambient PM₁₀ values by 1.7 to 4 times.³³ A study by Adams et al. in London showed that PM_{2.5} concentrations inside motor vehicles was on average two times the urban background concentration.³⁴

Along with physical inactivity and environmental exposures, taxi drivers have high stress, poor diets, unstable income, and poor health care access, all of which can exacerbate health risks.^{2,4,35,36} Stress adversely influences adverse behaviors^{37–39} and is correlated with increases in systemic inflammatory markers, cholesterol, and blood pressure, thereby increasing rates of myocardial infarction, stroke, and CVD-related mortality.^{38–41} In a study of Japanese taxi drivers, blood pressure during workdays was significantly higher than during non-work days.⁴² Poor diet further increases CVD risk. A survey of Chicago drivers found only 5% met recommended levels of fruit and vegetable intake.¹¹ Sixty percent also

reported that they were uninsured,¹¹ much higher than the national average of 17%.⁴³ In a study conducted in New York City (NYC) among South Asian taxi drivers, 40% of drivers had no usual source of healthcare.⁴⁴

In Fall 2011, the Immigrant Health and Cancer Disparities Service (IHCD) at Memorial Sloan-Kettering Cancer Center (MSKCC) conducted Step On It!, a workplace initiative to assess and address CVD risk among NYC taxi drivers, a diverse, hard-to-reach population who likely share needs with other U.S. taxi drivers. Of the 42,000 NYC yellow taxi drivers, 84% are foreign-born, largely hailing from South Asia, Central America, the Caribbean, Eastern Europe, and West Africa.⁴⁵ Step On It!, a workplace initiative delivered at a frequently visited site, the John F. Kennedy (JFK) International Airport holding lot, was an expansion of IHCD's previously developed health fair model developed for the South Asian community in NYC.⁴⁶ This model was developed by IHCD's community-based participatory research program, the South Asian Health Initiative, which uses an established protocol and methodology to deliver health screening, counseling, and follow-up, with health insurance education and navigation into care. Step On It! also addressed needs described in a recent IHCD taxi driver focus group study: healthcare access, nutrition education, stress relief, and exercise promotion.¹ This paper describes CVD risk factors assessed during Step On It!. The negative impact on health status with increasing duration of residence in the U.S. is a well described phenomenon.⁴⁷ We aimed to assess the effect of greater length of stay in the U.S. on CVD risk in this unique population, and how this risk may be exacerbated by barriers to care specific to the taxi driver occupation.

METHODS

The Step On It! health event was held for five consecutive days in late September/early October 2011, when the weather in NYC is mild and optimally suited to conduct an outdoor initiative, and drivers are not likely to be deterred from participation due to weather extremes. IHCD obtained permission from the Port Authority of New York and New Jersey to host Step On It! in an empty lot adjacent to the yellow cab holding lot of the JFK Airport. Thousands of cab drivers await dispatch in the holding lot each day. Given that there are 485,000 taxi trips made per day in NYC, and 3.5% of pick-ups occur at airports, we can estimate that nearly 17,000 cabs await dispatch at the airports each day.⁴⁸ Several free services were offered: blood pressure, glucose, body mass index, and oral health screenings; health counseling; health insurance enrollment; nutrition, exercise, stress reduction, yoga, tobacco cessation workshops; and free cancer screening appointments. On the days of the event, two outreach staff members were permitted to enter the holding lot to distribute Step On It! flyers which outlined the schedule of services. Interested drivers were directed to the event.

Intake Questionnaire and Health Screening

Written informed consent was obtained from each participating driver in his/her preferred language. Multi-lingual outreach staff surveyed participants using an intake questionnaire that had been used by the researchers in prior health fair events.⁴⁶ Questions regarding demographics, employment, healthcare access, medical history, tobacco use, physical

activity (derived from the National Health and Nutrition Examination Survey Questionnaire⁴⁹) and migration were included. Height (using a measuring tape affixed to a fence), weight (using a Taylor 7009 Lithium Electronic Scale), and waist circumference (measured by placing a tape measure snugly and parallel to the floor on the participant's abdomen just above the hip bone) were recorded. Participants were then directed to have their blood pressure and glucose measured using an ADC 9002 E-Sphyg 2 Digital LCD Desk Unit Sphygmomanometer, and a TRUEtrack glucometer, respectively.

Approval was obtained from the MSKCC Institutional Review Board.

Sample

A total of 466 taxi drivers self-selected to participate in Step On It!, out of an estimated total of 3500 drivers who would have been in the lots at that time. Approximately 25% of the estimated 3500 drivers were approached, approximately 53% of those approached agreed to participate. Of these 466, 413 completed at least one health screening (blood pressure, glucose, anthropometric measurements) and were included in our analysis.

Health screening measures

Health screening measures included blood pressure (mmHg) categorized according to the American Heart Association standard hypertension range: 1) systolic ≥ 140 and diastolic ≥ 90 , and 2) systolic >140 and/or diastolic >90 ; random glucose levels (mg/dL) categorized according to the American Diabetes Association guidelines: 1) <200 (not indicative of a diagnosis of diabetes); 2) ≥ 200 (along with symptoms of hyperglycemia, indicative of a diagnosis of diabetes); body mass index (BMI) categorized by American Heart Association standard guidelines: 1) ≤ 25 [normal], and 2) >25 [overweight/obese]; high risk waist circumference categorized according to the National Heart, Lung, and Blood Institute guidelines: >102 cm for men, >88 cm for women.^{50–53}

Independent variables

Independent variables of interest included years driving a taxi, whether the taxi was rented or owned, days per week worked, monthly income, age, region of birth, years residing in the U.S., marital status, educational level, English language ability, having/not having a primary care provider, health insurance status, tobacco use status, exercise, and histories (yes/no) of high blood pressure, diabetes, and high cholesterol. Inclusion of these variables for assessment was informed by the authors' prior work addressing the health concerns of drivers.^{1,46}

Analysis

We first described the characteristics of the 413 participants who completed at least one health screening (blood pressure, glucose, anthropometric measurements) and were included in our analysis. We then described the observed prevalence of abnormal screening results among the participants. We assessed the prevalence of abnormal results for each screening measure, first for the full sample, and then across strata of each sociodemographic and health history variable.

Bivariate and multiple logistic regression analyses were conducted to determine risk factors for each abnormal health screening result, from among the sociodemographic and health history predictors. Unadjusted odds ratios (ORs) and 95% confidence intervals were calculated to assess the risk for each predictor variable alone. Adjusted ORs and their 95% confidence intervals were calculated using multiple logistic regression to determine the relationship of each predictor variable to abnormal screening results, controlling for the other variables in the model. We used a two-sided significance level of $\alpha=0.05$. All analyses were restricted to available cases.

Analyses were conducted with the SPSS Statistics software package, version 21.0.

RESULTS

All results described are among available cases; missing data were excluded. We conducted a parallel analysis with imputed data, using multiple imputation, which demonstrated results similar to the ones presented in our manuscript. However, we found one exception, where the multiple logistic regression model in our paper (Table III) predicting being overweight (BMI > 25) did not show “years driving taxi” as a significant covariate (OR for 10 years driving vs. <10 years = 2.0, CI=0.9–4.5), while the imputed model did (OR=1.4, CI=1.1–2.0).

Characteristics of the Sample (Tables Ia, Ib)

Among the 466 self-selected participants in Step-on-it!, no differences were found in demographic and driver characteristics between individuals eligible for the analysis (completed at least one health screening) and those ineligible (Fisher's exact tests, all $p>0.05$). Due to restrictions on drivers' time at Step-on-it!, questionnaires had varying levels of completeness.

Sociodemographics—All participants except one were male (99.7%) and almost half (47%) were originally from South Asian countries. Only 2% of participants were born in the U.S. 83% of the foreign-born had been living in the U.S. for over 10 years. The majority were married (74%) and had completed some college or more (55%). Only 42% reported speaking English “very well”, indicating that a majority were limited English proficient (LEP).⁵⁴

Driving History and Income—Forty-seven percent of taxi drivers had been driving for 10 years or longer. Three hundred and forty-six drivers responded to the question about their average monthly incomes, among whom 21% reported monthly incomes of more than \$2,256, 37% reported incomes between \$1,355–\$2,256, and 34% reported incomes less than \$1,355 (27 drivers responded “Don't know” to this question).

Healthcare Access—Only 46% of participants had health insurance. Forty-nine percent did not have a primary care provider (PCP).

Health Behaviors—Approximately 30% of drivers reported ever using tobacco (including cigarettes, cigars, hookahs, and smokeless tobacco), over half of whom were current users.

Medical History—Twenty-eight percent of drivers reported a history of hypertension, among whom only 64% reported taking blood pressure medication. Most common reasons for not taking blood pressure medication included “I feel it is unnecessary” (43%), “I do not have a prescription” (14%), and “Cannot afford it” (11%). Fourteen percent of taxi drivers had been previously diagnosed with diabetes, among whom 77% were taking diabetes medication. Three hundred sixty-three participants responded to the question on a previous history of problems with cholesterol; of these, 28% reported high cholesterol, among whom 52% described taking medications.

Health Screening Results

A total of 368 participants had their blood pressure and 326 their blood glucose levels measured at Step On It!. Half (52%) of all drivers screened had blood pressure values >140 systolic and/or >90 diastolic (mmHg). 46% of drivers with no prior diagnosis of hypertension had a high blood pressure reading. Random plasma glucose values were >200 mg/dl for 9% of screened participants. Among participants with a prior diagnosis of diabetes, 36% had random glucose results >200 mg/dL at the screening. Among those without a prior diabetes diagnosis, 4% had a random glucose value >200 mg/dL. BMI was calculated for 332 drivers; 77% were either overweight or obese ($\text{BMI}>25$). Among the 317 participants who had their waist circumference measured, 111 (35%) had measurements considered high risk (Table IIa).

Predictors of Abnormal Screening Results

Blood Pressure—Participants were more likely to screen positive for blood pressure >140 systolic and/or >90 diastolic if they had spent 10 years or more driving a taxi ($\text{OR}=2.4$, $\text{CI}=1.5\text{--}3.7$), or were between the ages of 40–59 (vs. 18–39 years old, $\text{OR}=2.0$, $\text{CI}=1.2\text{--}3.3$). Immigrant participants were over twice as likely to have high blood pressure values if they had resided in the U.S. for over 10 years ($\text{OR}=2.4$, $\text{CI}=1.3\text{--}4.4$), compared to those in the U.S. for ten years or less. Participants had 2.3 times the odds of presenting with high blood pressure values at the screening if they had a personal history of hypertension ($\text{CI}=1.4\text{--}3.8$). Among those with a prior history, those who were taking medication for hypertension were much less likely to have high blood pressure values than those who were not on medication for their hypertension ($\text{OR}=0.2$, $\text{CI}=0.1\text{--}0.7$) (Table IIa). Among the 59 drivers who had a prior history of hypertension and who had high blood pressure readings at the health fair, 31 (53%) reported currently taking medication for hypertension.

Glucose—Participants between the ages of 40 and 59 were significantly more likely to have high random glucose (>200 mg/dl) than those between ages 18 and 39 ($\text{OR}=8.5$, $\text{CI}=1.1\text{--}65.3$). Participants also had 12.2 times the odds of having high random glucose values if they had a history of diabetes ($\text{CI}=5.0\text{--}29.8$) than if they did not (Table IIa).

BMI and waist circumference—The odds of being overweight or obese ($\text{BMI}>25$) were greater among drivers who had driven for at least 10 years ($\text{OR}=1.9$, $\text{CI}=1.1\text{--}3.3$). Caribbean drivers had 3.0 times the odds ($\text{CI}=1.5\text{--}6.1$) of having a high risk waist circumference than South Asian drivers. Immigrant drivers who had resided in the U.S. for more than 10 years

were over twice as likely (OR=2.5, CI=1.2–5.0) to have high risk waist circumferences than immigrant drivers who had lived in the U.S. for 10 or fewer years (Table IIa).

No other significant bivariate analysis results were found between health screening results and driver characteristics (Table IIa).

Predictors of Healthcare Access

Drivers born in Africa (OR=1.7, CI=1.0–2.8) and the Caribbean (OR=2.4, CI=1.3–4.6) were more likely to be uninsured than those born in South Asia. Married or partnered drivers were less likely to be uninsured (OR=0.3, CI=0.2–0.5) and less likely to be without a PCP (OR=0.5, CI=0.3–0.7) than single, widowed, or divorced drivers. Participants who were unaware of their hypertension diagnosis status (responded “don't know” to the question of whether they had a history of hypertension) were more likely to be uninsured (OR=3.1, CI=1.4–6.9) and more likely to have no PCP (OR=2.6, CI=1.3–5.3), than those who stated they did not have a history of hypertension (Table IIb).

Multivariable Analysis of Risk

Multiple logistic regression models were run to assess the associations between potential sociodemographic and health history predictors and abnormal health screening results. There was significant overlap between the variables years driving taxi, age, and years in the United States, with p-values <0.001 for Chi-square tests/Fisher's exact tests, and with Cramer's V values ranging from 0.39 to 0.44. Twelve percent of drivers were younger than 40 years, had been living in the US less than 10 years, and had been driving a taxi for less than 10 years, while 43% of drivers were older than 40 years, had been living in the US more than 10 years, and had been driving a taxi for more than 10 years. Because of this, we checked for multicollinearity in the logistic regression models. Multicollinearity occurs when variables are highly correlated and leads to inflated variance estimates. One crude but practical way to check for multicollinearity among categorical variables in a logistic regression model is to run a series of models in which you add or drop one variable at a time, looking for large shifts in the coefficient and variance estimates. In our models, coefficient and standard error estimates remained stable through sequential models, suggesting that multicollinearity is not a threat to the accuracy of our results.

Years in the U.S. was the sole significant predictor of high blood pressure after adjusting for years driving taxi, age, region of birth, and marital, health insurance, primary care provider, and exercise status. Immigrant participants who had lived in the US for more than ten years had over twice the odds of screening positive for high blood pressure compared to immigrants who had lived in the US for 10 or fewer years (adjusted OR=2.5, CI=1.1–5.9).

Fewer variables were entered into the model predicting high glucose due to small numbers of participants in response categories for high glucose, age, years in the U.S., and region of birth. We entered age into the model because it was significantly associated with glucose in the bivariate model, along with the potential confounders of years driving taxi and years in the U.S. None of the three predictors was significantly associated with high glucose after adjusting for the other variables in the model (LRT=4.13, df=3, p>0.05).

No risk factors were significantly associated with high BMI when the model included years driving taxi, age, region of birth, and marital, health insurance, primary care provider, and exercise status.

High risk waist circumference was predicted by region of birth after controlling for years driving taxi, age, years in the U.S., and marital, health insurance, primary care provider, and exercise status. This association was evident through type 3 analysis of effects (Wald $\chi^2 = 10.24$, $df=2$, $p<0.05$). This was driven by the higher waist circumference of Caribbean-born (OR=4.4) and Middle Eastern-born (OR=4.7) drivers compared to African-born drivers. Table 1c does not show any significant ORs for region of birth because no group differed from the South Asian reference group, which was chosen because it is the most prevalent region of birth among participants in our sample (Table III).

DISCUSSION

Step On It! found CVD risk factors among the majority of participating drivers. Importantly, only 46% of drivers had health insurance. Drivers are generally considered independent contractors and thus not 'employees'. The vast majority are therefore not entitled to employer-sponsored health insurance options through taxi companies.⁵⁵ Additionally, drivers work hours that coincide with clinic hours of operation. These barriers to care may have contributed to the high prevalence of unaddressed CVD risk factors observed in this study. More than half of screened drivers had blood pressure values over 140/90 mmHg. As a comparison, NYC hypertension rates are approximately 26%.⁵⁶ As further comparison, in urban India (the majority of drivers in this study were originally from South Asia), rates of hypertension among men varied from 36% in Jaipur, 44% in Mumbai, and 31% in Thiruvananthapuram.⁵⁷ Seventy seven percent of drivers had a BMI in the overweight or obese range; in comparison 56% of NYC residents are overweight or obese.⁵⁸ The prevalence of overweight and obesity among men in India aged 40–49 is 13.4% and 2.6%, respectively; and among ages 50–59, 11.5% and 2.3%, respectively.⁵⁹ Nine percent of drivers had abnormal random glucose values. The National Urban Diabetes Survey in India showed an age standardized prevalence of diabetes and impaired glucose tolerance of 12.1% and 14%, respectively, with no significant differences between genders.⁶⁰

Living in the U.S. for over 10 years is likely to increase drivers' CVD risk. The impact of increased duration of residence in the U.S. on worsening health status has been well described in the literature,⁴⁷ and our hypothesis that this would be evidenced in this study was supported. Newer immigrants were significantly less likely to have high blood pressure readings compared to drivers residing in the U.S. for 10 years or more. This is an important and novel finding, as this is the first study to examine duration of residence as a predictor variable for CVD risk factors among U.S. taxi drivers. In addition, drivers who already had a diagnosis of hypertension were more likely to have high blood pressure values, indicating that their conditions were not being adequately managed. One of the Healthy People 2020 objectives is to "increase the proportion of adults with hypertension whose blood pressure is under control", with a target of 61.2%.⁶¹ Almost half of the drivers who had a prior history of hypertension were not on any medications for their condition. Reasons for poor blood pressure control among drivers previously diagnosed with hypertension in this study should

be further investigated and addressed. Poor management of chronic conditions such as hypertension, impaired glucose tolerance, diabetes, overweight/obesity leads to long-term complications, negative health outcomes and decreased productivity.^{62–68}

The extent of abnormalities documented in this study was profound, and underscores the potential for significantly elevated CVD risk in this vulnerable population, and the need to address this risk through models or frameworks that utilize multiple levels of intervention. For example, the Healthy People 2020 Framework incorporates an ecological and determinants approach to health promotion and disease prevention, where health and health behaviors are determined by multiple levels of influence, including personal (biological, psychological), institutional/organizational, environmental (physical, social), and at the policy level.⁶⁹ In a literature review of comprehensive worksite health promotion programs, Sorensen et al. demonstrated that program effectiveness was enhanced when based on social ecological approaches, including the integration of workers' broader social contexts, addressing multiple risk factors for change, and including workers in program planning and implementation.⁷⁰

Potential interventions for taxi drivers, to have the greatest impact, should be multi-level, addressing individual risk (i.e. screening and prevention, counseling, linkages to primary care and facilitated insurance enrollment, and treatment/management of chronic conditions associated with CVD risk), and organizational/institutional/environmental factors (i.e. facilitated access to health care, exercise facilities, healthy food), and policy issues (i.e. working hours, pay). Results from our study suggest that multiple CVD risk factors should be targeted, prioritizing intervention in the early years of immigration and long-term management of blood pressure for drivers with already elevated blood pressure. For example, potential interventions focused on blood pressure screening and navigation into primary care could be implemented at points of entry into the taxi driver workforce, such as upon completion of Defensive Driving and Taxi Training courses (both are required in NYC to obtain a hack license).⁷¹

This study has limitations. The sampling method may have introduced bias. Participation in Step On It! was completely voluntary. Individuals who are more interested in their health may have been more likely to participate in this free health program, which could underestimate the health disparities experienced by this population. Conversely, those who knew of a pre-existing health condition and/or were not feeling well may have been more likely to participate, which would overestimate the extent of abnormal values in taxi drivers. Despite this, this study has good potential for generalizability to other NYC drivers and for relevance to other driver communities across the country. Taxi drivers across diverse metropolitan areas spend time awaiting dispatch in holding lots. In NYC, thousands of taxi drivers wait in the John F. Kennedy (JFK) International Airport holding lot on a daily basis (for up to 2 hours at a time), and drivers may go to the holding lot multiple times a day or week. However, drivers who spend more time at airport holding lots may have higher exposures than their counterparts who spend less time in the lots, as airport operations are associated with elevated levels of air pollutants, including ultrafine particles, black carbon, and nitrogen oxides.^{72–74}

Many drivers had to leave abruptly during the event once their spot on the queue reached dispatch. Given these time constraints, intake data was partially incomplete for a subset of drivers; another subset of drivers was unable to complete all screenings offered. Due to logistical constraints, including lack of lighting in the designated lot at night, Step On It! took place during daytime hours (11 a.m. to 5 p.m.) and did not capture data on the health status of taxi drivers working evening and overnight shifts. Shift workers, especially night shift workers, have been shown to be at increased risk for cardiovascular events.⁷⁵ Future interventions should be inclusive of night shift drivers. Such studies should also be held at different times throughout the year, as risks and responses to survey questions may be dependent on season and weather, i.e. drivers may be more sedentary in colder weather,⁷⁶ and the effects of air pollution may also vary depending on season, if drivers' windows are open or closed, and if air conditioning is used.⁷⁷

Further, exposure to particulate matter and secondary exposure to tobacco smoke were not assessed as part of this study. Future studies should include these assessments; differentiating drivers' risk from chronic environmental exposure vs. other risk factors (i.e. stress, sedentary lifestyle) is an important but yet unaddressed gap in the literature.

Available data were still valuable in providing CVD risk information for an occupational group that is largely understudied. This study demonstrates the feasibility of a work-based intervention that overcomes drivers' time constraints. Future studies should include long term cohort studies following changes in CVD risks and documenting CVD outcomes longitudinally after the implementation of multilevel interventions targeting the unique barriers and needs of NYC immigrant taxi drivers. Such studies should also monitor variations in drivers' environmental exposures, and the impact of these exposures on health risks, and should also include questions related to diet, stress, and physical activity. Studies should also consider developing partnerships with clinics and hospitals where drivers can reliably and conveniently seek care (at low or no cost, with flexible hours), to accurately document relevant data from medical charts as well as to build stronger linkages between community and occupationally-based outreach and education efforts and the health care system.

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References

1. Gany FM, Gill PP, Ahmed A, et al. "Every disease...man can get can start in this cab": focus groups to identify south Asian taxi drivers' knowledge, attitudes and beliefs about cardiovascular disease and its risks. *J Immigr Minor Health*. 2013; 15(5):986–992. [PubMed: 22843321]
2. Burgel BJ, Gillen M, White MC. Health and Safety Strategies of Urban Taxi Drivers. *J Urban Health*. 2012; 89(4):717–722. [PubMed: 22669644]
3. Kurosaka K, Daida H, Muto T, et al. Characteristics of coronary heart disease in Japanese taxi drivers as determined by coronary angiographic analyses. *Ind Health*. 2000; 38(1):15–23. [PubMed: 10680306]
4. Bigert C, Gustavsson P, Hallqvist J, et al. Myocardial infarction among professional drivers. *Epidemiology*. 2003; 14(3):333–339. [PubMed: 12859035]
5. Katzmarzyk PT, Church TS, Craig CL, et al. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc*. 2009; 41(5):998–1005. [PubMed: 19346988]
6. Healy GN, Matthews CE, Dunstan DW, et al. Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003–06. *Eur Heart J*. 2011; 32(5):590–597. [PubMed: 21224291]
7. Barnes AS. Obesity and sedentary lifestyles: risk for cardiovascular disease in women. *Tex Heart Inst J*. 2012; 39(2):224–227. [PubMed: 22740737]
8. Hu FB. Sedentary lifestyle and risk of obesity and type 2 diabetes. *Lipids*. 2003; 38(2):103–108. [PubMed: 12733740]
9. Beilin LJ. Lifestyle and hypertension--an overview. *Clin Exp Hypertens*. 1999; 21(5–6):749–762. [PubMed: 10423098]
10. Kagan AR. Atherosclerosis and myocardial disease in relation to physical activity of occupation. *Bull World Health Organ*. 1976; 53(5–6):615–622. [PubMed: 1087204]
11. Apantaku-Onayemi F, Baldyga W, Amuwo S, et al. Driving to Better Health: Cancer and Cardiovascular Risk Assessment among Taxi Cab Operators in Chicago. *J Health Care Poor Underserved*. 2012; 23:768–780. [PubMed: 22643623]
12. Brook RD, Rajagopalan S, Pope CA 3rd, et al. Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation*. 2010; 121(21):2331–2378. [PubMed: 20458016]
13. Cavallari JM, Fang SC, Eisen EA, et al. Time course of heart rate variability decline following particulate matter exposures in an occupational cohort. *Inhal Toxicol*. 2008; 20(4):415–422. [PubMed: 18302049]
14. Chuang KJ, Chan CC, Su TC, et al. The effect of urban air pollution on inflammation, oxidative stress, coagulation, and autonomic dysfunction in young adults. *Am J Respir Crit Care Med*. 2007; 176(4):370–376. [PubMed: 17463411]
15. Fang SC, Cassidy A, Christiani DC. A Systematic Review of Occupational Exposure to Particulate Matter and Cardiovascular Disease. *Int J Environ Res Public Health*. 2010; 7(4):1773–1806. [PubMed: 20617059]
16. Magari SR, Hauser R, Schwartz J, et al. Association of heart rate variability with occupational and environmental exposure to particulate air pollution. *Circulation*. 2001; 104(9):986–991. [PubMed: 11524390]
17. Pieters N, Plusquin M, Cox B, et al. An epidemiological appraisal of the association between heart rate variability and particulate air pollution: a meta-analysis. *Heart*. 2012; 98(15):1127–1135. [PubMed: 22628541]
18. Wu S, Deng F, Niu J, et al. Association of heart rate variability in taxi drivers with marked changes in particulate air pollution in Beijing in 2008. *Environ Health Perspect*. 2010; 118(1):87–91. [PubMed: 20056565]
19. Wu SW, Deng FR, Niu J, et al. The relationship between traffic-related air pollutants and cardiac autonomic function in a panel of healthy adults: a further analysis with existing data. *Inhal Toxicol*. 2011; 23(5):289–303. [PubMed: 21506879]

20. Brook RD, Franklin B, Cascio W, et al. Air pollution and cardiovascular disease: a statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. *Circulation*. 2004; 109(21):2655–2671. [PubMed: 15173049]
21. Min KB, Min JY, Cho SI, et al. The relationship between air pollutants and heart-rate variability among community residents in Korea. *Inhal Toxicol*. 2008; 20(4):435–444. [PubMed: 18302051]
22. Riediker M, Devlin RB, Griggs TR, et al. Cardiovascular effects in patrol officers are associated with fine particulate matter from brake wear and engine emissions. *Part Fibre Toxicol*. 2004; 1(1): 2. [PubMed: 15813985]
23. Weichenthal S, Kulka R, Dubeau A, et al. Traffic-related air pollution and acute changes in heart rate variability and respiratory function in urban cyclists. *Environ Health Perspect*. 2011; 119(10): 1373–1378. [PubMed: 21672679]
24. Peters A, von Klot S, Heier M, et al. Exposure to traffic and the onset of myocardial infarction. *N Engl J Med*. 2004; 351(17):1721–1730. [PubMed: 15496621]
25. World Health Organization. World Health Organization Report: Health Effects of Black Carbon. 2012.
26. Westerdaal D, Fruin S, Sax T, Fine PM, Sioutas C. Mobile platform measurements of ultrafine particles and associated pollutant concentrations on freeways and residential streets in Los Angeles. *Atmos Environ*. 2005; 39(20):3597–3610.
27. Zwack L, Paciorek C, Spengler J, Levy J. Modeling Spatial Patterns of Traffic-Related Air Pollutants in Complex Urban Terrain. *Environ Health Perspect*. 2011; 119:852–59. [PubMed: 21262596]
28. Leung PL, Harrison RM. Evaluation of personal exposure to monoaromatic hydrocarbons. *Occup Environ Med*. 1998; 55(4):249–257. [PubMed: 9624279]
29. Hudda N, Eckel SP, Knibbs LD, Sioutas C, Delfino RJ, Fruin SA. Linking In-Vehicle Ultrafine Particle Exposures to On-Road Concentrations. *Atmos Environ*. 2012; 59:578–586.
30. Fruin SA, Winer AM, Rodes CE. Black carbon concentrations in California vehicles and estimation of in-vehicle diesel exhaust particulate matter exposures. *Atmos Environ*. 2004; 38(25): 4123–4133.
31. Schneider, CG.; Hill, B. Clean Air Task Force. No Escape From Diesel Exhaust: How to Reduce Commuter Exposure. Boston, MA: 2007.
32. Geiss O, Barrero-Moreno J, Tirendi S. D. K. Exposure to Particulate Matter in Vehicle Cabins of Private Cars. *Aerosol and Air Quality Research*. 2010; 10(6):581–588.
33. Praml G, Schierl R. Dust exposure in Munich public transportation: a comprehensive 4-year survey in buses and trams. *Int Arch Occup Environ Health*. 2000; 73(3):209–214. [PubMed: 10787137]
34. Adams HS, Nieuwenhuijsen MJ, Colville RN, McMullen MA, Khandelwal P. Fine particle (PM_{2.5}) personal exposure levels in transport microenvironments, London, UK. *Sci Total Environ*. 2001; 279(1–3):29–44. [PubMed: 11712603]
35. Blasi, G.; Leavitt, J. Driving Poor: Taxi Drivers and the Regulation of the Taxi Industry in Los Angeles. UCLA Institute of Industrial Relations; Los Angeles, U.S.: 2006.
36. Community Development Project of the Urban Justice Center. [Accessed March 1, 2014] UNFARE Taxi Drivers and the Cost of Moving the City. 2003. <http://www.urbanjustice.org/pdf/publications/Unfare.pdf>
37. Bradley EH, McGraw SA, Curry L, et al. Expanding the Andersen Model: The Role of Psychosocial Factors in Long-Term Care Use. *Health Serv Res*. 2002; 37(5):1221–1242. [PubMed: 12479494]
38. Hamer M, Molloy GJ, Stamatakis E. Psychological distress as a risk factor for cardiovascular events: pathophysiological and behavioral mechanisms. *J Am Coll Cardiol*. 2008; 52(25):2156–2162. [PubMed: 19095133]
39. Hamer M, Malan L. Psychophysiological risk markers of cardiovascular disease. *Neurosci Biobehav Rev*. 2010; 35(1):76–83. [PubMed: 19909773]
40. Bairey Merz CN, Dwyer J, Nordstrom CK, Walton KG, Salerno JW, Schneider RH. Psychosocial stress and cardiovascular disease: pathophysiological links. *Behav Med*. 2002; 27(4):141–147. [PubMed: 12165968]

41. Kowata E, Hozawa A, Kakizaki M, et al. Perceived stress and cardiovascular disease mortality. The Ohsaki Cohort Study. *Nihon Koshu Eisei Zasshi*. 2012; 59(2):82–91. [PubMed: 22642183]
42. Kobayashi F, Watanabe T, Watanabe M, et al. Blood pressure and heart rate variability in taxi drivers on long duty schedules. *J Occup Health*. 2002; 44:214–220.
43. O'Hara, B.; Caswell, K. [Accessed April 1, 2013] Health Status, Health Insurance, and Medical Services Utilization: 2010. 2013. <http://www.census.gov/prod/2012pubs/p70-133.pdf>
44. Islam N, Kwon SC, Ahsan H, et al. New York AANCART Using Participatory Research to Address the Health Needs of South Asian and Korean Americans in New York City. *Cancer*. 2005; 104(12(Suppl)):2931–2936. [PubMed: 16247777]
45. Schaller Consulting. [Accessed May 2, 2012] The changing face of taxi and limousine drivers, U.S., large states and metro areas and New York City. 2004. <http://www.schallerconsult.com/taxi/taxidriver.pdf>
46. Gany F, Levy A, Basu P, et al. Culturally Tailored Health Camps and Cardiovascular Risk among South Asian Immigrants. *J Health Care Poor Underserved*. 2012; 23(2):615–625. [PubMed: 22643611]
47. Antecol H, Bedard K. Unhealthy assimilation: why do immigrants converge to American health status levels? *Demography*. 2006; 43(2):337–360. [PubMed: 16889132]
48. [Accessed March 1, 2014] New York City Taxi and Limousine Commission. 2014. Taxicab Factbook. http://www.nyc.gov/html/tlc/downloads/pdf/2014_taxicab_fact_book.pdf
49. CDC National Center for Health Statistics. National Health and Nutrition Examination Survey Questionnaire (or Examination Protocol, or Laboratory Protocol). USHHS; Hyattsville, MD: 2010.
50. Anand SS, Yusuf S, Vuksan V, et al. Differences in risk factors, atherosclerosis, and cardiovascular disease between ethnic groups in Canada: the Study of Health Assessment and Risk in Ethnic groups (SHARE). *Lancet*. Jul 22; 2000 356(9226):279–284. [PubMed: 11071182]
51. American Diabetes Association. Standards of Medical Care in Diabetes - 2013. 2013.
52. American Heart Association. [Accessed October 1, 2013] Understanding Blood Pressure Readings. 2012. http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/AboutHighBloodPressure/Understanding-Blood-Pressure-Readings_UCM_301764_Article.jsp
53. American Heart Association. [Accessed March 1, 2013] Body Mass Index (BMI Calculator). 2013. http://www.heart.org/HEARTORG/GettingHealthy/WeightManagement/BodyMassIndex/Body-Mass-Index-BMI-Calculator_UCM_307849_Article.jsp
54. Agency for Healthcare Research and Quality. [Accessed October 1, 2013] Chapter 4: Defining Language Need and Categories for Collection. 2010. <http://www.ahrq.gov/research/findings/final-reports/iomracereport/reldata4a.html>
55. United Workers Congress. [Accessed March 1, 2014] Taxi Drivers. 2014. <http://www.unitedworkerscongress.org/taxi-drivers.html>
56. Angell SY, Garg RK, Gwynn RC, Bash L, Thorpe LE, Frieden TR. Prevalence, awareness, treatment, and predictors of control of hypertension in New York City. *Circ Cardiovasc Qual Outcomes*. 2008; 1(1):46–53. [PubMed: 20031787]
57. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertens*. 2004; 18(2):73–78. [PubMed: 14730320]
58. New York City Department of Health and Mental Hygiene. [Accessed October 1, 2013] Obesity. <http://www.nyc.gov/html/doh/html/living/obesity.shtml>
59. Kelly T, Yang W, Chen CS, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes (Lond)*. 2008; 32(9):1431–1437. [PubMed: 18607383]
60. Ramachandran A, Snehalatha C, Kapur A, et al. High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia*. 2001; 44(9):1094–1101. [PubMed: 11596662]
61. United States Department of Health and Human Services. [Accessed August 1, 2013] [HealthyPeople.gov](http://www.healthypeople.gov). Heart Disease and Stroke: Objectives. 2013. [HealthyPeople.gov](http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=21)<http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=21>

62. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group. *N Engl J Med.* 1993; 329(14):977–986. [PubMed: 8366922]
63. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. *Lancet.* 1998; 352(9131):837–853. [PubMed: 9742976]
64. Gu Q, Dillon CF, Burt VL, et al. Association of hypertension treatment and control with all-cause and cardiovascular disease mortality among US adults with hypertension. *Am J Hypertens.* 2010; 23(1):38–45. [PubMed: 19851295]
65. Harris MI. Diabetes in America: epidemiology and scope of the problem. *Diabetes Care.* 1998; 21(Suppl 3):C11–14. [PubMed: 9850480]
66. Ng YC, Jacobs P, Johnson JA. Productivity losses associated with diabetes in the US. *Diabetes Care.* 2001; 24(2):257–261. [PubMed: 11213875]
67. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics--2012 update: a report from the American Heart Association. *Circulation.* 2012; 125(1):e2–e220. [PubMed: 22179539]
68. Valdiman V, Smith DW, Page MR. Productivity and economic burden associated with diabetes. *Am J Public Health.* 2001; 91(1):129–130. [PubMed: 11189805]
69. United States Department of Health and Human Services. Healthy People 2020 Framework. Washington, DC: 2012. Office of Disease Prevention and Health Promotion.
70. Sorensen G, Linnan L, Hunt MK. Worksite-based research and initiatives to increase fruit and vegetable consumption. *Prev Med.* 2004; 39(Suppl 2):S94–100. [PubMed: 15313078]
71. LaGuardia Community College. [Accessed March 1, 2014] How to get a New York city Hack License. <http://ace.laguardia.edu/taxi/documents/How%20to%20get%20a%20New%20York%20city%20Hack%20License.pdf>
72. Westerdaal D, Fruin S, Fine P. C. S. The Los Angeles International Airport as a source of ultrafine particles and other pollutants to nearby communities. *Atmos Environ.* 2008; 42(13):3143–3155.
73. Carslaw DC, Beevers SD, Ropkins K, Bell MC. Detecting and quantifying the contribution made by aircraft emissions to ambient concentrations of nitrogen oxides in the vicinity of a large international airport. *Atmos Environ.* 2006; 40(28):5424–5434.
74. Dodson RE, Houseman EA, Morind B, Levy JI. An analysis of continuous black carbon concentrations in proximity to an airport and major roadways. *Atmos Environ.* 2009; 43(24):3764–3773.
75. Vyas MV, Garg AX, Iansavichus AV, et al. Shift work and vascular events: systematic review and meta-analysis. *BMJ.* 2012; 345:e4800. [PubMed: 22835925]
76. Gany F, Gill P, Baser R, Leng J. Supporting South Asian Taxi Drivers to Exercise through Pedometers (SSTEP) to decrease cardiovascular disease risk. *J Urban Health.* Jun; 2014 91(3): 463–476. [PubMed: 24500026]
77. Lee K, Sohn H, Putti K. In-vehicle exposures to particulate matter and black carbon. *J Air Waste Manag Assoc.* 2010; 60(2):130–136. [PubMed: 20222524]

Table 1a

Percentage of Taxi Drivers with Abnormal Health Screening Results, by Health Screening Results *

		Row Percentage			
		Health Screening Results			
<i>Variable</i>	<i>No.</i>	<i>High BP (>140/90)</i>	<i>High glucose (>200)</i>	<i>Overweight (BMI > 25)</i>	<i>High risk waist circumference</i>
Total Sample	413	51.6(n=190)	8.9 (n=29)	77.4 (n=257)	35.0 (n=111)
Years Driving Taxi					
<10 years	207	42.2	6.2	72.4	31.6
10 years	182	63.4	11.7	83.2	39.1
Taxi Rented or Owned					
Rented	119	55.7	5.4	83.3	40.4
Owned	267	49.8	10.4	74.6	32.7
"Don't know"	3	66.7	0.0	100.0	50.0
Days per week worked					
5	123	48.2	5.1	72.2	37.5
6	185	57.5	11.6	80.6	31.1
7	80	45.3	8.2	76.4	39.7
"Don't know"	1	100.0	0.0	0.0	0.0
Monthly Income					
<\$1355	118	52.8	7.6	76.0	37.4
\$1355–2256	128	52.3	7.8	75.7	31.1
> \$2256	73	47.8	10.5	80.6	33.9
"Don't know"	27	48.0	23.8	76.0	29.2
Age					
18–39	100	39.3	1.3	76.4	25.8
40–59	209	55.9	9.9	77.8	37.4
60	33	57.7	11.5	72.7	42.9
Region of birth					
South Asia	181	50.9	9.9	78.4	32.7
Africa	92	54.8	7.9	70.0	20.3
Caribbean	57	58.3	7.3	83.7	59.5
Latin America	13	38.5	0.0	77.8	44.4
Europe	11	37.5	0.0	75.0	28.6
Middle East	23	52.4	10.0	90.5	55.0
East Asia	4	25.0	0.0	25.0	25.0
United States	7	50.0	33.3	100.0	57.1
Years in the US					
0–10	64	34.5	2.0	67.2	19.6
>10	318	56.0	9.6	78.8	37.7

		Row Percentage			
		Health Screening Results			
<i>Variable</i>	<i>No.</i>	<i>High BP (>140/90)</i>	<i>High glucose (>200)</i>	<i>Overweight (BMI > 25)</i>	<i>High risk waist circumference</i>
US Born	7	50.0	33.3	100.0	57.1
Marital Status					
Married or partnered	288	53.5	9.0	77.0	33.9
Single, widowed, divorced	98	48.3	8.4	78.4	39.2
“Don't know”	2	50.0	0.0	50.0	0.0
Education					
HS grad or lower	173	49.7	9.8	74.5	33.3
Some college or higher	210	53.5	7.7	79.8	35.4
“Don't know”	1	100	0.0	100.0	100.0
Speaks English					
Very well	163	58.4	9.7	80.7	36.8
Limited English Proficient	228	47.2	8.0	74.9	33.7
Has a primary care doctor					
Yes	190	52.7	8.5	78.2	34.9
No	183	49.7	9.2	76.1	33.8
“Don't know”	2	50	0.0	0.0	0.0
Has health insurance					
Yes	161	51.0	10.3	79.0	35.6
No	188	50.3	7.5	75.8	34.2
“Don't know”	13	44.4	10.0	80.0	44.4
Tobacco use					
Never	225	51.0	8.7	80.0	35.0
Current	58	47.2	12.2	74.5	36.5
Former	40	55.9	7.4	75.0	39.4
“Don't know”	6	100.0	0.0	80.0	0.0
Exercise (10 mins activity at a time)					
Yes	257	51.3	9.1	76.5	34.0
No	70	46.8	7.1	81.4	37.9
Hypertension history					
Hx of HTN					
Yes	105	65.6	14.1	81.6	35.7
No	222	45.6	6.9	74.0	33.7
“Don't know”	45	44.7	6.1	82.9	35.3
Takes med for HTN					
Yes	61	57.4	17.4	87.8	38.3
No	34	84.8	12.5	72.4	28.6

		Row Percentage			
		Health Screening Results			
<i>Variable</i>	<i>No.</i>	<i>High BP (>140/90)</i>	<i>High glucose (>200)</i>	<i>Overweight (BMI > 25)</i>	<i>High risk waist circumference</i>
N/A	308	46.7	7.1	75.9	34.8
Family hx of HTN					
Yes	82	50.7	7.1	88.0	39.7
No	99	45.8	7.9	72.5	32.2
"Don't know"	11	85.7	11.1	90.0	22.2
Diabetes history					
Hx of DM					
Yes	52	64.4	35.7	79.1	58.5
No	294	48.9	4.4	75.8	29.5
"Don't know"	29	46.2	4.2	84.0	44.0
Takes med for DM					
Yes	37	56.3	39.3	82.8	65.5
No	11	80.0	30.0	80.0	40.0
N/A	361	49.8	4.9	77.2	31.5
Family hx of DM					
Yes	75	44.6	9.5	83.6	33.8
No	111	52.1	4.6	76.9	34.3
"Don't know"	10	71.4	22.2	88.9	50.0
Cholesterol History					
Hx of chol					
Yes	103	57.8	10.7	79.1	38.8
No	206	48.6	8.0	75.0	32.1
"Don't know"	54	47.9	8.9	81.6	32.6
Takes med for chol					
Yes	48	53.7	14.7	74.4	46.2
No	44	61.0	9.1	81.1	29.7
"Don't know"	1	N/A	N/A	100.0	0.0
N/A	310	49.6	8.4	76.8	33.6
Family hx of chol					
Yes	40	44.1	8.8	84.6	42.1
No	113	48.5	6.5	76.2	31.7
"Don't know"	33	52.2	12.0	88.9	38.5

* All percentages are among available cases.

Table 1b

Percentage of Taxi Drivers with Abnormal Health Screening Results, by Tobacco Use and Health Care Access*

		Row Percentage		
		Tobacco Use and Healthcare Access		
<i>Variable</i>	<i>No.</i>	<i>Tobacco use</i>	<i>Uninsured</i>	<i>No PCP</i>
Total Sample	413	29.8 (n=98)	51.9 (n=188)	48.8 (N=183)
Years Driving Taxi				
<10 years	207	31.0	50.8	49.7
10 years	182	28.4	53.3	48.0
Taxi Rented or Owned				
Rented	119	22.2	47.8	43.0
Owned	267	32.7	53.5	52.3
"Don't know"	3	33.3	66.7	0.0
Days per week worked				
5	123	31.1	55.0	49.1
6	185	29.7	48.9	45.8
7	80	28.6	53.9	56.4
"Don't know"	1	0.0	100.0	0.0
Monthly Income				
<\$1355	118	34.3	58.4	50.9
\$1355–2256	128	28.4	47.2	49.6
> \$2256	73	28.8	51.4	43.8
"Don't know"	27	20.8	50.0	48.1
Age				
18–39	100	27.3	53.8	60.0
40–59	209	27.8	51.1	43.4
60	33	43.5	48.3	43.3
Region of birth				
South Asia	181	28.4	42.8	42.5
Africa	92	21.1	59.1	52.2
Caribbean	57	28.9	63.5	54.7
Latin America	13	30.0	63.6	54.5
Europe	11	50.0	72.7	72.7
Middle East	23	52.2	39.1	43.5
East Asia	4	75.0	75.0	50.0
United States	7	33.3	83.3	100.0
Years in the US				
0–10	64	26.8	54.2	58.3
>10	318	30.5	50.7	45.8

		Row Percentage		
		Tobacco Use and Healthcare Access		
<i>Variable</i>	<i>No.</i>	<i>Tobacco use</i>	<i>Uninsured</i>	<i>No PCP</i>
US Born	7	33.3	83.3	100.0
Marital Status				
Married or partnered	288	30.3	45.5	44.0
Single, widowed, divorced	98	28.2	68.8	63.2
Don't know	2	0.0	100.0	50.0
Education				
HS grad or lower	173	30.1	51.9	49.4
Some college or higher	210	29.5	51.5	48.8
"Don't know"	1	N/A	100.0	N/A
Speaks English				
Very well	163	26.1	51.6	48.4
Limited English Proficient	228	32.3	52.2	49.1
Has a primary care doctor				
Yes	190	27.2	20.1	N/A
No	183	32.3	85.2	N/A
"Don't know"	2	50.0	0.0	N/A
Has health insurance				
Yes	161	28.6	N/A	10.6
No	188	30.3	N/A	80.2
"Don't know"	13	45.5	N/A	69.2
Tobacco use				
Never	225	N/A	51.6	48.2
Current	58	N/A	53.6	60.3
Former	40	N/A	51.3	45.0
"Don't know"	6	N/A	66.7	50.0
Exercise (10 mins activity at a time)				
Yes	257	29.9	53.8	48.2
No	70	25.0	44.9	49.3
Hypertension history				
Hx of HTN				
Yes	105	28.9	42.3	36.9
No	222	29.2	51.9	50.5
"Don't know"	45	36.4	75.6	71.1
Takes med for HTN				
Yes	61	27.8	36.2	35.0
No	34	30.3	54.8	41.2
N/A	308	30.2	55.5	53.3

		Row Percentage		
		Tobacco Use and Healthcare Access		
Variable	No.	Tobacco use	Uninsured	No PCP
Family hx of HTN				
Yes	82	32.5	47.5	42.7
No	99	27.0	63.4	63.9
"Don't know"	11	28.6	50.0	72.7
Diabetes history				
Hx of DM				
Yes	52	28.9	25.0	23.5
No	294	29.0	54.2	49.7
"Don't know"	29	39.1	78.6	82.8
Takes med for DM				
Yes	37	16.1	22.9	22.2
No	11	50.0	44.4	36.4
N/A	361	29.9	56.1	52.8
Family hx of DM				
Yes	75	37.7	50.7	47.3
No	111	25.3	60.4	60.0
"Don't know"	10	42.9	44.4	60.0
Cholesterol History				
Hx of chol				
Yes	103	40.0	35.7	31.7
No	206	24.2	56.0	51.9
"Don't know"	54	32.6	64.7	67.9
Takes med for chol				
Yes	48	30.0	19.6	19.1
No	44	46.2	53.7	44.2
"Don't know"	1	100.0	0.0	0.0
N/A	310	25.9	58.0	55.1
Family hx of chol				
Yes	40	42.1	48.7	47.5
No	113	23.0	57.1	56.8
"Don't know"	33	35.7	53.1	54.5

* All percentages are among available cases.

Table IIa

Odds Ratios of Abnormal Health Screening Results, by Health Screening Results

		Odds Ratio (95% Confidence Interval)			
		Health Screening Results			
<i>Variable</i>	<i>No.</i>	<i>High BP (>140/90)</i>	<i>High glucose (>200)</i>	<i>Overweight (BMI > 25)</i>	<i>High risk waist circumference</i>
Years Driving Taxi					
<10 years	207	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
10 years	182	2.4 (1.5–3.7)	2.0 (0.9–4.6)	1.9 (1.1–3.3)	1.4 (0.9–2.2)
Monthly Income					
<\$1355	118	1.0 (0.6–1.7)	1.0 (0.3–2.8)	1.0 (0.5–1.9)	1.3 (0.7–2.4)
\$1355–2256	128	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
> \$2256	73	0.8 (0.5–1.5)	1.4 (0.5–4.2)	1.3 (0.6–2.9)	1.1 (0.6–2.2)
“Don’t know”	27	0.8 (0.4–2.0)	3.7 (1.1–12.6)	1.0 (0.4–2.8)	0.9 (0.3–2.4)
Age					
18–39	100	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
40–59	209	2.0 (1.2–3.3)	8.5 (1.1–65.3)	1.1 (0.6–2.0)	1.7 (1.0–3.0)
60	33	2.1 (0.9–5.1)	10.0 (1.0–101.2)	0.8 (0.3–2.4)	2.2 (0.8–5.8)
Region of birth					
South Asia	181	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Africa	92	1.2 (0.7–2.0)	0.8 (0.3–2.1)	0.6 (0.3–1.2)	0.5 (0.3–1.0)
Caribbean	57	1.3 (0.7–2.6)	0.7 (0.2–2.6)	1.4 (0.6–3.5)	3.0 (1.5, 6.1)
Middle East	23	1.1 (0.4–2.6)	1.0 (0.2–4.8)	2.6 (0.6–11.8)	2.5 (1.0–6.5)
Other	35	0.6 (0.3–1.3)	0.7 (0.2–3.4)	0.8 (0.3–2.0)	1.4 (0.6–3.3)
Years in the US					
10	64	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
>10	318	2.4 (1.3–4.4)	5.2 (0.7–39.2)	1.8 (1.0–3.4)	2.5 (1.2–5.0)
US born	7	1.9 (0.4–10.3)	24.5 (1.8–332.5)	N/A	5.5 (1.1–28.0)
Marital Status					
Married or partnered	288	1.2 (0.8–2.0)	1.1 (0.4–2.6)	0.9 (0.5–1.7)	0.8 (0.5–1.4)
Single, widowed, divorced	98	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don’t know”	2	1.1 (0.1–17.7)	N/A	0.3 (0.02–4.7)	N/A
Has a primary doctor					
Yes	190	1.1 (0.7–1.7)	0.9 (0.4–2.0)	1.1 (0.7–1.9)	1.1 (0.7–1.7)
No	183	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don’t know”	2	1.0 (0.1–16.5)	N/A	N/A	N/A
Has health insurance					
Yes	161	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
No	188	1.0 (0.6–1.5)	0.7 (0.3–1.6)	0.8 (0.5–1.4)	0.9 (0.6–1.5)
“Don’t know”	13	0.8 (0.2–3.0)	1.0 (0.1–8.4)	1.1 (0.2–5.3)	1.4 (0.4–5.6)

		Odds Ratio (95% Confidence Interval)			
		Health Screening Results			
<i>Variable</i>	<i>No.</i>	<i>High BP (>140/90)</i>	<i>High glucose (>200)</i>	<i>Overweight (BMI > 25)</i>	<i>High risk waist circumference</i>
Exercise (10 mins activity at a time)					
Yes	257	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
No	70	0.8 (0.5–1.5)	0.8 (0.2–2.4)	1.3 (0.7–2.8)	1.2 (0.7–2.2)
Hypertension history					
Hx of HTN					
Yes	105	2.3 (1.4–3.8)	2.2 (0.9–5.1)	1.6 (0.8–2.9)	1.1 (0.6–1.9)
No	222	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	45	1.0 (0.5–1.9)	0.9 (0.2–4.1)	1.7 (0.7–4.3)	1.1 (0.5–2.3)
Takes med for HTN					
Yes	61	0.2 (0.1–0.7)	1.5 (0.4–5.4)	2.7 (0.8–8.9)	1.6 (0.6–4.3)
No	34	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	0				
N/A	308	0.2 (0.1–0.4)	0.5 (0.2–1.7)	1.2 (0.5–2.9)	1.3 (0.6–3.2)
Family hx of HTN					
Yes	82	1.2 (0.6–2.3)	0.9 (0.3–3.1)	2.8 (1.2–6.4)	1.4 (0.7–2.6)
No	99	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Diabetes history					
History of DM					
Yes	52	1.9 (1.0–3.7)	12.2 (5.0–29.8)	1.2 (0.5–2.7)	3.4 (1.7–6.7)
No	294	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	29	0.9 (0.4–2.0)	1.0 (0.1–7.8)	1.7 (0.6–5.1)	1.9 (0.8–4.3)
Takes med for DM					
Yes	37	0.3 (0.1–1.8)	1.5 (0.3–7.1)	1.2 (0.2–7.4)	2.9 (0.7–12.5)
No	11	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
N/A	361	0.2 (0.1–1.2)	0.1 (0.03–0.5)	0.8 (0.2–4.1)	0.7 (0.2–2.5)
Cholesterol history					
Hx of chol					
Yes	103	1.4 (0.9–2.4)	1.4 (0.5–3.5)	1.3 (0.7–2.4)	1.3 (0.8–2.3)
No	206	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	54	1.0 (0.5–1.8)	1.1 (0.3–3.6)	1.5 (0.7–3.3)	1.0 (0.5–2.0)
Takes med for chol					
Yes	48	0.7 (0.3–1.8)	1.7 (0.4–7.9)	0.7 (0.2–2.0)	2.0 (0.8–5.2)
No	44	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	1	N/A	N/A	N/A	N/A
N/A	310	0.6 (0.3–1.2)	0.9 (0.3–3.2)	0.8 (0.3–1.9)	1.2 (0.6–2.5)

Table IIb

Odds Ratios of Abnormal Health Screening Results, by Tobacco Use and Healthcare Access

		Odds Ratio (95% Confidence Interval)		
		Tobacco Use and Healthcare Access		
<i>Variable</i>	<i>No.</i>	<i>Tobacco use</i>	<i>Uninsured</i>	<i>NoPCP</i>
Years Driving Taxi				
<10 years	207	1.0 (referent)	1.0 (referent)	1.0 (referent)
10 years	182	0.8 (0.5–1.3)	1.1 (0.7–1.7)	0.9 (0.6–1.4)
Monthly Income				
<\$1355	118	1.3 (0.7–2.3)	1.3 (0.8–2.2)	1.1 (0.6–1.7)
\$1355–2256	128	1.0 (referent)	1.0 (referent)	1.0 (referent)
> \$2256	73	1.0 (0.5–2.0)	1.0 (0.5–1.8)	0.8 (0.4–1.4)
“Don’t know”	27	0.6 (0.2–1.9)	1.0 (0.4–2.4)	0.9 (0.4–2.1)
Age				
18–39	100	1.0 (referent)	1.0 (referent)	1.0 (referent)
40–59	209	1.0 (0.6–1.8)	0.8 (0.5–1.3)	0.5 (0.3–0.8)
60	33	2.0 (0.8–5.2)	0.9 (0.4–2.1)	0.5 (0.2–1.3)
Region of birth				
South Asia	181	1.0 (referent)	1.0 (referent)	1.0 (referent)
Africa	92	0.7 (0.4–1.3)	1.7 (1.0–2.8)	1.4 (0.9–2.3)
Caribbean	57	1.0 (0.5–2.0)	2.4 (1.3–4.6)	1.4 (0.8–2.5)
Middle East	23	3.0 (1.3–7.2)	0.8 (0.3–2.1)	0.9 (0.4–2.2)
Other	35	1.9 (0.9–4.1)	3.3 (1.4–7.4)	3.1 (1.4–6.5)
Years in the US				
10	64	1.0 (referent)	1.0 (referent)	1.0 (referent)
>10	318	1.2 (0.6–2.4)	0.9 (0.5–1.6)	0.6 (0.3–1.1)
US born	7	1.4 (0.2–8.2)	4.1 (0.4–37.0)	N/A
Marital Status				
Married or partnered	288	1.1 (0.6–1.9)	0.3 (0.2–0.5)	0.5 (0.3–0.7)
Single, widowed, divorced	98	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don’t know”	2	N/A	N/A	N/A
Has a primary doctor				
Yes	190	0.8 (0.5–1.3)	0.03 (0.02–0.05)	N/A
No	183	1.0 (referent)	1.0 (referent)	N/A
“Don’t know”	2	2.0 (0.1–33.2)	N/A	N/A
Has health insurance				
Yes	161	1.0 (referent)	N/A	1.0 (referent)
No	188	1.1 (0.7–1.8)	N/A	0.03 (0.02–0.05)
“Don’t know”	13	2.0 (0.6–7.1)	N/A	0.7 (0.2–2.9)
Exercise (10 mins activity at a time)				

		Odds Ratio (95% Confidence Interval)		
		Tobacco Use and Healthcare Access		
<i>Variable</i>	<i>No.</i>	<i>Tobacco use</i>	<i>Uninsured</i>	<i>NoPCP</i>
Yes	257	1.0 (referent)	1.0 (referent)	1.0 (referent)
No	70	0.8 (0.4–1.4)	0.7 (0.4–1.3)	1.0 (0.6–1.8)
Hypertension history				
Hx of HTN				
Yes	105	1.0 (0.6–1.7)	0.6 (0.4–1.0)	0.6 (0.4–0.9)
No	222	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	45	1.3 (0.6–2.9)	3.1 (1.4–6.9)	2.6 (1.3–5.3)
Takes med for HTN				
Yes	61	0.8 (0.3–2.1)	0.5 (0.2–1.1)	0.7 (0.3–1.7)
No	34	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	0			
N/A	308	0.9 (0.4–2.1)	1.2 (0.5–2.4)	1.6 (0.8–3.2)
Family hx of HTN				
Yes	82	1.3 (0.7–2.6)	0.4 (0.2–0.8)	0.4 (0.2–0.7)
No	99	1.0 (referent)	1.0 (referent)	1.0 (referent)
Diabetes history				
History of DM				
Yes	52	1.0 (0.5–1.9)	0.3 (0.1–0.5)	0.3 (0.2–0.6)
No	294	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	29	1.5 (0.6–3.7)	3.4 (1.3–9.2)	4.8 (1.8–12.9)
Takes med for DM				
Yes	37	0.2 (0.04–0.9)	0.4 (0.1–1.7)	0.5 (0.1–2.1)
No	11	1.0 (referent)	1.0 (referent)	1.0 (referent)
N/A	361	0.4 (0.1–1.6)	1.8 (0.5–6.7)	2.0 (0.6–6.9)
Cholesterol history				
Hx of chol				
Yes	103	2.1 (1.2–3.5)	0.4 (0.3–0.7)	0.4 (0.3–0.7)
No	206	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	54	1.5 (0.7–3.0)	2.0 (1.0–4.1)	2.1 (1.1–4.0)
Takes med for chol				
Yes	48	0.5 (0.2–1.2)	0.2 (0.1–0.6)	0.3 (0.1–0.8)
No	44	1.0 (referent)	1.0 (referent)	1.0 (referent)
“Don't know”	1	N/A	N/A	N/A
N/A	310	0.4 (0.2–0.8)	1.3 (0.7–2.6)	1.6 (0.8–3.0)

Table III

Multiple Logistic Regression Models Predicting Abnormal Health Screening Results, among all drivers who provided data

	Adjusted Odds Ratio (95% Confidence Interval)			
	<i>High BP (> 140/90)</i>	<i>High Glucose</i>	<i>Overweight (BMI > 25)</i>	<i>High risk waist circumference</i>
Total N included in model	229	253	226	221
Years Driving Taxi				
<10 years	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
10 years	1.5 (0.8–3.1)	1.6 (0.6–4.8)	2.0 (0.9–4.5)	0.8 (0.4–1.7)
Age				
<40	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
40–59	1.3 (0.6–2.6)	6.4 (0.7–56.5)	0.6 (0.3–1.4)	1.4 (0.7–3.2)
60	1.3 (0.4–4.6)	7.1 (0.6–85.7)	0.4 (0.1–1.8)	1.1 (0.3–4.4)
Years in the US				
10	1.0 (referent)	1.0 (referent)	-	1.0 (referent)
>10	2.5 (1.1–5.9)*	1.3 (0.1–12.3)	-	1.9 (0.8–4.9)
US born	1.9 (0.1–26.0)	4.8 (0.2–109.0)	-	4.6 (0.4–48.3)
Region of birth				
South Asia	1.0 (referent)	-	1.0 (referent)	1.0 (referent)
Africa	1.3 (0.7–2.6)	-	1.0 (0.5–2.1)	0.6 (0.3–1.2)
Caribbean	0.7 (0.3–1.8)	-	1.6 (0.5–5.1)	2.4 (1.0–6.1)
Middle East	1.2 (0.4–4.0)	-	1.6 (0.3–8.2)	2.6 (0.8–8.9)
Other	0.4 (0.1–1.2)	-	0.8 (0.2–2.7)	1.3 (0.3–5.0)
Marital Status				
Married or partnered	1.2 (0.6–2.4)	-	0.6 (0.3–1.4)	0.8 (0.4–1.7)
Single, widowed, divorced	1.0 (referent)	-	1.0 (referent)	1.0 (referent)
Has health insurance				
Yes	1.0 (referent)	-	1.0 (referent)	1.0 (referent)
No	1.8 (0.8–3.9)	-	0.9 (0.3–2.2)	1.1 (0.4–2.7)
Has primary care provider				
Yes	1.0 (referent)	-	1.0 (referent)	1.0 (referent)
No	0.8 (0.4–1.7)	-	0.8 (0.3–1.9)	0.8 (0.3–2.0)
Exercise (10 mins activity at a time)				
Yes	1.0 (referent)	-	1.0 (referent)	1.0 (referent)
No	1.3 (0.6–2.7)	-	1.4 (0.6–3.3)	1.2 (0.6–2.6)

*
p < 0.05