Published in final edited form as:

J Immigr Minor Health. 2019 April ; 21(2): 356–363. doi:10.1007/s10903-018-0740-7.

Smoking Among Chinese Livery Drivers

Jennifer C. Leng^{1,2,3}, Lei Lei¹, Shu Fang Lei¹, Zhiying Zhu¹, Nancy Mo¹, Brian Sou¹, Imran Mujawar¹, and Francesca Gany^{1,2,3,4}

¹Department of Psychiatry and Behavioral Sciences, Immigrant Health and Cancer Disparities Service, Memorial Sloan Kettering Cancer Center, 485 Lexington Avenue, 2nd Floor, New York, NY 10017, USA

²Department of Medicine, Memorial Sloan Kettering Cancer Center, New York, NY, USA

³Department of Healthcare Policy and Research, Weill Cornell Medical College, New York, NY, USA

⁴Department of Medicine, Weill Cornell Medical College, New York, NY, USA

Abstract

We aimed to assess a key risk factor for lung cancer, smoking, in a vulnerable group, Chinese livery drivers in New York City (NYC). This is a nested cohort study conducted in the summer/fall of 2014 within a larger NIMHD-funded R24 program, the Taxi Network. The Taxi Network Needs Assessment (TNNA) survey was administered to a broad demographic of drivers. This study reports on the TNNA survey smoking-related results among NYC Chinese livery drivers. 97 drivers participated. Mean age was 44.7 years, 2.1% were English proficient, and 23.4% were living below the poverty line. Most were insured (82.5%), had a PCP (82.5%), and had had a routine check-up within the past year (79%). 73% were current or former smokers. Culturally and linguistically tailored smoking cessation interventions, strategies to mitigate exposure to air pollution, and programs to facilitate lung cancer screening should be developed and implemented for high-risk Chinese livery drivers.

Keywords

Lung cancer; Smoking; Air pollution; Chinese; Livery drivers

Introduction

The Chinese population in New York City (NYC) grew by 34% in the last decade, if this growth rate is maintained, Chinese immigrants are anticipated to become the largest immigrant group in the City in the next few years [1]. Nationwide, immigrants from China constitute the second largest foreign-born group, after those from Mexico [1]. Chinese immigrants work in a number of occupations that put them at higher risk for lung cancer, including taxi driving, which increases their environmental exposure to fine particulate

Compliance with Ethical Standards

Conflict of interest None of the authors have any conflicts of interests or financial disclosures to report.

matter (PM_{2.5}) and black carbon air pollution [2, 3]. They are a sedentary population with high rates of stress, limited knowledge about health care resources, long work hours that often interfere with their ability to access health care, and cultural and linguistic barriers to care [4–6].

Drivers work long hours (10–12 h/day shifts, ~6 day/week) [7], most often in heavy traffic, where exposure to environmental contaminants increases health risk [8–10]. Compared to outdoor/indoor microenvironments, in-vehicle PM levels are often very high, originate from external sources, including road traffic [2], and can be 3–5 times that of outdoor PM values [3]. Fine PM (PM < 2.5 micrometers [PM_{2.5}]), sulfate particles, and sulfur dioxide (SO₂) increase all-cause, cardiopulmonary, and lung cancer mortality [11, 12], and PM exposure has been specifically linked to lung cancer [13–15]. Many studies have demonstrated a high prevalence of lung cancer among taxi drivers, suggesting a possible association with PM [16, 17].

Chinese drivers in NYC who smoke now or who smoked in the past may be at exceptionally high risk for lung cancer due to the combined impact of tobacco use and air pollution exposure. In a national study among Asian Americans in the U.S., lifetime smoking prevalence among Chinese men was 42.5% [18].

Worldwide, lung cancer is the most common cancer, with 1.8 million new diagnoses and 1.6 million deaths in 2012 [19]. In the U.S., lung cancer is the leading cancer killer of both men and women [20]. Lung cancer causes more deaths than the three next most common cancers combined (colon, breast, and pancreas); an estimated 158,080 individuals were expected to die from lung cancer in the U.S. in 2016 representing approximately 1 in 4 cancer deaths [21]. The U.S. Preventive Services Task Force (USPSTF) recommends annual screening for lung cancer with low-dose computed tomography (LDCT) in adults age 55–80 years with a 30 pack year history, who currently smoke or have quit within the past 15 years [22]. The stage at which lung cancer is detected is an important factor in survival [23–25]. 85% of patients diagnosed at clinical stage IA have a 10-year survival rate of 88–92%, whereas those diagnosed at clinical stage II to IV have a 5-year survival rate that ranges from 40 to < 5% [23, 24]. No published data are available, however, on lung cancer screening rates among taxi drivers, or among Asian Americans, though previous research describes lower rates of screening for other cancers among foreign-born Asian Americans and Pacific Islanders (APIs) compared to U.S. born APIs [26]. Even when adjusting for insurance-related access to care, large differences in cancer screening completion between U.S. born and foreign-born APIs were not explained [26]. A substantial body of research suggests that immigrants face unique barriers to care, including language and cultural factors [27–31].

Given the literature describing the high prevalence of smoking and low rates of cancer screening among Asian Americans, as well as increased exposure to harmful air pollution, and language and cultural barriers to care, Chinese livery drivers are likely to be at particularly high risk for lung cancer and poor cancer outcomes. This study therefore sought to assess a key risk factor, smoking, in this vulnerable group. This is a nested cohort study conducted within a larger NIMHD-funded R24 program, the Taxi Network. The Taxi Network Needs Assessment (TNNA) survey was administered to a broad demographic of

taxi drivers. The current study reports on the TNNA survey smoking-related results among an extremely high-risk population, NYC Chinese livery drivers. Future studies will describe TNNA smoking results among other groups of high risk, as well as lower risk, drivers.

Methods

This study was determined to be exempt by the Institutional Review Board/Privacy Board of Memorial Sloan Kettering Cancer Center (MSKCC).

Instrument

The TNNA study instrument is a 23-page survey including questions related to demographic information, e.g., age, gender, English language proficiency, birth country; occupational information, e.g., vehicle arrangements, work shifts; health care access information, e.g., health insurance status, whether driver has a primary care provider (PCP), last routine checkup; health behavior information, e.g., past and current smoking habits, pack years, age when first started smoking, drinking habits; comorbid conditions, e.g., noninsulin-dependent diabetes mellitus (NIDDM), hypertension, high cholesterol, stress, anxiety and/or depression, chronic pain. To assess English language proficiency, the U.S. Census question was used, “How well do you speak English?”; response options included “Very well, Well, Not well, and Not at all” [32]. The survey was translated into Chinese and was administered in Mandarin or Cantonese (or in English), at the preference of the participant. Mandarin and Cantonese refer to two commonly spoken dialects of the Chinese language. The written Chinese is the same for all dialects. We also back-translated the survey into English, using well-established guidelines [33]. The survey also includes validated Chinese versions of the Perceived Stress Scale (PSS-10) [34, 35] and the Patient Health Questionnaire (PHQ-9) [36–38]. The PSS-10 is a 10-item measure (selected from the 14 questions in the original PSS) of a patient’s perceived stress during the past month [34, 35]. The PHQ-9 is a 9-item self-reported questionnaire that screens for depression and measures its severity over the past 2 weeks [36–38].

Recruitment

Drivers were recruited from the livery bases for which they drive. To compile a list of livery bases employing Chinese drivers, a database of all registered livery bases and companies was accessed from the NYC Taxi & Limousine Commission (TLC) [39]. All registered livery bases were searched for drivers with ethnic Chinese last names. All livery bases identified as having drivers with ethnic Chinese last names were then contacted to confirm that they indeed employed livery drivers of Chinese descent. A total of 13 bases were confirmed to have Chinese livery drivers. A search of car service advertisements and companies was also conducted using the Google search engine, using key words in English and Chinese including: Chinese livery, New York Chinese livery cars, New York Chinese livery bases, and the Chinese characters for *dian zhao che* (‘livery car’), and *niu yue dian zhao che* (‘New York livery car’). Advertisements for Chinese livery car services were also searched in the Chinese newspaper *World Journal* between June 1st and June 16th, 2014. *World Journal* is a daily Chinese language newspaper serving overseas Chinese in North America, and is the largest Chinese language newspaper in the United States [40, 41]. Field

visits to find prominently located livery bases in the Chinatowns of Manhattan, Flushing (Queens), and Sunset Park (Brooklyn) were also conducted. Through these approaches, an additional ten Chinese livery bases were identified. All 23 Chinese livery bases were contacted to assess interest in participating in our TNNA study, along with preferred times to administer the survey. A total of 17 Chinese livery bases, with a total driver roster of 2496, agreed to participate. The survey was conducted during the summer and fall of 2014.

Data Collection

Study staff contacted livery base managers and owners to schedule times when data collection would be feasible and least disruptive to work flow. Livery drivers returning to the base were approached for potential participation. Study staff explained the purpose of the study and ascertained driver interest. If interested in participating, study staff administered the survey on the spot. Each survey was administered in the language the participant preferred, either English, Mandarin, or Cantonese. If drivers were not willing to complete the survey on the spot, but were willing to complete the survey at another time, study staff made an appointment with the driver to meet him again or to conduct the survey over the phone, at a later date. Each survey took between 30 and 45 min to complete. Each participant who completed the survey received a \$25 gas card in appreciation of his time.

Data Analysis

Data analysis was conducted in 2015/2016. We conducted descriptive analyses of demographics, occupational factors, healthcare access, health behaviors including tobacco and alcohol use, comorbidities, PSS-10 scores, and PHQ-9 scores, by smoking status. The number of smoking pack-years was estimated for each individual, keeping it at zero for non-smokers. We further analyzed pack years by the presence or absence of reported comorbidities, including NIDDM, hypertension, high cholesterol, stress, anxiety/depression, and chronic pain (the question on stress in the TNNA survey was related to the overall rating of the level of stress the drivers experienced over the last month, this was different from the PSS-10, which provides a composite score assessing self-perceived stress). We used box-plots to map and compare pack-years data by self-reported presence or absence of each comorbidity.

Lastly, the correlated binary outcome of self-reported presence or absence of comorbidities was modeled against pack-years using a generalized linear mixed model (proc GLIMMIX in SAS 9.3), with a logit link. The model was adjusted for age, with access to a primary care physician (PCP) as a covariate. The interaction of comorbidity type (cardiovascular/metabolic—NIDDM, hypertension, high cholesterol vs. psychological/chronic pain—stress, anxiety/depression, chronic pain) and pack-years was also included in the model. The odds ratios were estimated for pack-years and the other covariates in the model to estimate the strength of their association with prevalence of self-reported comorbidities.

All statistical analyses were conducted using SAS statistical software, v.9.3 (SAS Institute Inc, Cary, NC) and IBM SPSS statistics v.20.0 (SPSS Inc, Chicago, IL).

Results

Seventeen Chinese livery bases initially agreed to participate. Ten bases were ultimately willing to work with the research team to provide opportunities to conduct the survey. The remaining seven bases, due to time constraints, were unwilling to facilitate administration of the survey. Of the ten willing bases, only eight had drivers that were interested in participating (drivers refused due to lack of time and/or interest). These eight bases were exceptionally helpful in driver recruitment efforts, and were led by management who encouraged drivers to participate. The other two bases that stated they were willing to participate were less enthusiastic about the study, and asked the study team to approach drivers street side (at the base). Drivers who were approached street side at these bases were unwilling to participate, hence no drivers were recruited from these sites.

One-hundred and thirty drivers were approached, 33 refused due to lack of time or interest, and 97 drivers completed the survey (69 completed the survey in Mandarin and 28 in Cantonese). Table 1 provides an overall description of the characteristics of drivers, including by smoking status. All drivers were male, the mean age was 44.7 years, mean years spent in the US was 11.9, 2.1% were English proficient (reported speaking English “Very well”) [32], and 23.4% were living below the poverty line. Most were insured (82.5%), had a PCP (82.5%), and had had a routine checkup within the past year (79%). Fifty-five percent reported consuming alcohol. Seventy-three percent of Chinese drivers were current or former smokers (49% current, 24% former). Chinese drivers who had ever smoked had a mean of 13 pack years (SD 15.2) of smoking. Thirty percent of Chinese drivers had > 20 pack years; 17% had > 30 pack years. Fifty-four percent of current smokers ($n = 48$) responded that they were interested in receiving tobacco cessation services. Prevalence of self-reported comorbidities was 6.2% with NIDDM, 17.2% with hypertension, 25.5% with high cholesterol, 20% with stress, 1.1% with anxiety/depression, and 29.8% with chronic pain. The only differences between ‘ever smokers’ and ‘never smokers’ was that ‘ever smokers’ worked fewer hours per week than their ‘never’ smoking counterparts ($p < 0.05$), and had a higher proportion of alcohol consumers ($p < 0.001$).

The distribution of pack-years by the presence or absence of self-reported comorbidities, including NIDDM, hypertension, high cholesterol, stress, anxiety/depression, and chronic pain among the 97 Chinese drivers is shown in Fig. 1. The mean pack-years was higher in drivers with cardiovascular/metabolic comorbidities, including NIDDM, hypertension, and high cholesterol, compared to those without. This difference in pack-years was significantly higher for hypertension ($p < 0.05$).

The results of the generalized linear mixed model are summarized in Table 2. Drivers were less likely to report cardiovascular/metabolic comorbidities than psychological/chronic pain ones (OR 0.4 [0.16, 0.96]). Older drivers were more likely to report a comorbidity (OR 1.05, [1.01, 1.1]). Having a PCP was not associated with the overall probability of reporting a comorbidity (p -value = 0.440). Pack-years was not significantly associated with the probability of reporting a comorbidity overall (p -value = 0.229). However, the interaction between comorbidity type and pack-years was statistically significant (p -value = 0.004), indicating that pack-years have a stronger association with the probability of reporting

cardiovascular/metabolic comorbidities than psychological/chronic pain ones (OR 1.07 [1.02, 1.13]).

Discussion

To the best of our knowledge, this is the first study assessing tobacco use in a uniquely vulnerable group, Chinese immigrant livery drivers. A limitation of this study was the relatively small number of bases ($n = 8$) from which we were able to recruit drivers. Non-participating bases cited lack of time as the reason for not participating, and a broader sample of bases may have provided a more representative sample of drivers. Still, our findings are important in that they highlight the extremely high rates of smoking in this group. We found a much higher prevalence of lifetime smoking, 73%, compared to Chinese men in a national study of Asian Americans (42.5%) [18]. In the U.S., smoking remains the leading cause of preventable death, and in addition to lung cancer and cardiovascular disease, is causally linked to numerous other cancers (i.e. head and neck, colorectal, liver, stomach, pancreatic, kidney and ureter, cervical and bladder) and chronic diseases (e.g. diabetes, respiratory diseases such as chronic obstructive pulmonary disease and asthma, blindness, cataracts, reduced fertility in women, male sexual dys-function, rheumatoid arthritis, impaired immune function) [42]. Overall mortality of smokers is three times higher than that of never-smokers [43]. Next steps should include the development and testing of smoking cessation programs adapted for the culture and language of Chinese drivers as well as for their unique occupational context, strategies to mitigate exposure to air pollution, and interventions to facilitate lung cancer screening for this high risk population.

Smoking is the number one risk factor for lung cancer, and in the U.S. is linked to 80–90% of lung cancers [44]. Culturally responsive and language specific smoking cessation programs are needed for the Chinese driver community to address the very high lung cancer risk faced by Chinese livery drivers. There is a paucity of culturally tailored smoking cessation programs for Chinese Americans and Chinese immigrants [45]. Only 2.1% of drivers in our study were English proficient, underscoring the language barriers drivers may face, in addition to cultural factors, which may limit their access to smoking cessation programs. Wu et al. showed promising results in a pilot study among Chinese smokers of a culturally and linguistically sensitive cessation program [45]. In a study by Spigner et al. among Chinese and Vietnamese male current and former smokers, family encouragement and physician recommendation were found to be the main facilitators of cessation behavior among former smokers, and “will power” or “self-determination” were frequently (60%) described as helpful methods to quit smoking [46]. Among Chinese former smokers, the majority did not believe nicotine patches or gum to be helpful [46]. This is concerning given the availability and effectiveness of nicotine replacement therapy (NRT); indeed NRT has not been thoroughly assessed in Asian communities [46]. Further, some respondents described using other gum but not NRT gum, or traditional medicine, to help them quit smoking [46]. Future cessation interventions should take into account these culturally embedded factors, as well as further explore the use of traditional treatments in this population. For Chinese livery drivers, cessation interventions should be additionally tailored to their occupational context to encourage participation (in our study approximately half of current smokers were interested in smoking cessation services). Cessation

interventions should be adapted for drivers' shift work and long work hours, and should consider offering counseling and services during the evening and weekends, as well as innovative approaches such as communicating through messaging apps popular in the Chinese community (i.e. WeChat).

In addition to the increased risk of lung cancer from smoking, Chinese livery drivers experience further risk due to exposure to harmful environmental contaminants, including PM, which has also been linked to lung cancer [13–15]. Consistent with previous studies [5, 47], livery drivers in this study reported working long hours, during which they are confined to the vehicle's cabin and where PM levels are high [2, 3]. Limited research on potential interventions to mitigate these risks has emerged in recent years. A study by Pui et al. showed that while built-in recirculation air filtration in vehicles can reduce exposure to large particle pollutants ($> 3 \mu\text{m}$) to acceptable levels; most vehicles do not filter ultrafine particles [48, 49]. Other interventions, such as portable air filtration systems that remove ultrafine particles, may be promising. The link between recirculating air filtration and improved health outcomes, however, has never been studied among taxi drivers and is an important intervention to explore, especially given the high rates of smoking in this population.

In addition to smoking cessation efforts and strategies to mitigate exposure to air pollution, programs should be developed to facilitate lung cancer screening for high risk Chinese livery drivers. Screening rates for other cancers are lower among Asian Americans than any other ethnic group [50]. In 2012, the Centers for Disease Control and Prevention (CDC) called for the need to increase cancer screening rates among Asian Americans by identifying eligible individuals, facilitating completion of screening tests, and tracking participation to monitor screening rates [51]. In this study, the majority of drivers had both health insurance and a PCP, and had had a routine check-up within the year prior to the survey. Drivers eligible for lung cancer screening according to the USPSTF guidelines [22] are thus well positioned to avail themselves of this potentially life-saving test. Community health worker (CHW) efforts address language and cultural factors that often act as barriers to optimal care in immigrant communities, and have been successful in significantly increasing cancer screening rates [52–55]. Future interventions should explore the use of CHWs to facilitate lung cancer screening in the Chinese driver population.

Conclusions

Chinese livery drivers represent an understudied, high-risk, hard-to-reach group who could potentially benefit greatly from culturally and linguistically responsive efforts to facilitate smoking cessation, mitigate air pollution exposure, and encourage lung cancer screening. Interventions could also potentially be modified in the future for similarly at-risk groups, such as other populations of livery and yellow taxi drivers in NYC and throughout the U.S., other high risk occupations (e.g. restaurant and construction work), and with potential adaptability to include other cancer screening tests as well, e.g. colorectal cancer. For example, for other populations of drivers, much of the information related to the occupational context of driving, i.e. how a program can best fit within the time (long work hours, shift work) and space (limited space to meet with outreach staff at livery bases) constraints of the occupation, may apply. For Chinese workers in other occupations such as

restaurant or construction work, much of the information related to community, culture and language may be relevant (i.e. what characteristics are preferred in interventionists or CHWs, strategies to address cultural barriers to cessation and screening, role of language barriers, etc.).

Acknowledgements

This publication was supported by the National Institutes of Health under Award Numbers R24MD008058, U01MD010648, and P30CA008748. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. J. Leng conceived and supervised the study, and led the writing; L. Lei, S.F. Lei, Z. Zhu, N. Mo, and B. Sou conducted the data collection; I. Mujawar conducted the statistical analysis, and F. Gany supervised the study. The article contents have not been previously presented elsewhere. The authors have no conflicts of interest or financial disclosures to report.

References

1. Lobo AP, Salvo JJ. Population Division of the New York City Department of City Planning. The Newest New Yorkers—Characteristics of the City's Foreign-born Population. 2013 https://www1.nyc.gov/assets/planning/download/pdf/data-maps/nycpopulation/nnny2013/nnny_2013.pdf Accessed 1 Sept 2017.
2. Geiss O, Barrero-Moreno J, Tirendi S, Kotzias D. Exposure to particulate matter in vehicle cabins of private cars. *Aerosol Air Qual Res*. 2010;10(6):581.
3. 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):209–14. [PubMed: 10787137]
4. Apantaku-Onayemi F, Baldyga W, Amuwo S, Adefuye A, Mason T, Mitchell R, Blumenthal DS. Driving to better health: cancer and cardiovascular risk assessment among taxi cab operators in Chicago. *J Health Care Poor Underserved*. 2012;23(2):768–80. [PubMed: 22643623]
5. Gany F, Gill P, Leng J, Silberstein J, Baser R. Supporting South Asian taxi drivers to exercise through pedometers (SSTEP) to decrease cardiovascular disease risk. *J Urban Health*. 2014;91(3):463–76. [PubMed: 24500026]
6. Gany FM, Gill PP, Ahmed A, Acharya S, Leng J. “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):986–92. [PubMed: 22843321]
7. Schaller Consulting. 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>. Accessed 1 Sept 2017.
8. Sacks JD, Stanek LW, Luben TJ, Johns DO, Buckley BJ, Brown JS, Ross M. Particulate matter-induced health effects: who is susceptible? *Environ Health Perspect*. 2011;119(4):446–54. [PubMed: 20961824]
9. Schwartz J, Laden F, Zanobetti A. The concentration-response relation between PM(2.5) and daily deaths. *Environ Health Perspect*. 2002;110(10):1025–9.
10. Tsang H, Kwok R, Miguel AH. Pedestrian exposure to ultrafine particles in Hong Kong under heavy traffic conditions. *Aerosol Air Qual Res*. 2008;8(1):19–27.
11. Pope CA, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, GD T. Lung cancer cardiopulmonary mortality and long-term exposure to fine particulate air pollution. *J Am Med Assoc*. 2002;287:1132–41.
12. Pope CA, Thun MJ, Namboodiri MM, Dockery DW, Evans JS, Speizer FE, Heath CW, Jr. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. *Am J Respir Crit Care Med*. 1995;151(3 Pt 1):669–74. [PubMed: 7881654]
13. Gallus S, Negri E, Boffetta P, McLaughlin JK, Bosetti C, La Vecchia C. European studies on long-term exposure to ambient particulate matter and lung cancer. *Eu J Cancer Prev*. 2008;17(3):191–4.

14. Lepeule J, Laden F, Dockery D, Schwartz J. Chronic exposure to fine particles and mortality: an extended follow-up of the Harvard six cities study from 1974 to 2009. *Environ Health Perspect.* 2012;120(7):965–70. [PubMed: 22456598]
15. Turner MC, Krewski D, Pope CA, 3rd, Chen Y, Gapstur SM, Thun MJ. Long-term ambient fine particulate matter air pollution and lung cancer in a large cohort of never-smokers. *Am J Respir Crit Care Med.* 2011;184(12):1374–81. [PubMed: 21980033]
16. Hansen J, Raaschou-Nielsen O, Olsen JH. Increased risk of lung cancer among different types of professional drivers in Denmark. *Occup Environ Med.* 1998;55(2):115–8. [PubMed: 9614396]
17. Jakobsson R, Gustavsson P, Lundberg I. Increased risk of lung cancer among male professional drivers in urban but not rural areas of Sweden. *Occup Environ Med.* 1997;54(3):189–93. [PubMed: 9155780]
18. Chae DH, Gavin AR, Takeuchi DT. Smoking prevalence among asian americans: findings from the National Latino and Asian American Study (NLAAS). *Public Health Rep.* 2006;121(6):755–63. [PubMed: 17278411]
19. World Health Organization, International Agency for Research on Cancer. GLOBOCAN 2012: estimated cancer incidence, mortality, and prevalence worldwide in 2012. http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx?cancer=lung. Accessed 1 Sept 2017.
20. Centers for Disease Control and Prevention. CDC WONDER Online database, compiled from compressed mortality file 1999–2012. Series 20 No. 2R 2014 <http://wonder.cdc.gov/cmfi10.html>. Accessed 1 Sept 2017.
21. American Cancer Society. Cancer facts and figures. 2016 <http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-047079.pdf>. Accessed 1 Sept 2017.
22. US Preventive Services Task Force. Recommendation summary. 2014 <http://www.uspreventiveservicestaskforce.org/Page/Topic/recommendation-summary/lung-cancer-screening>. Accessed 1 Sept 2017.
23. Crino L, Weder W, Van Meerbeeck J, Felip E. Early stage and locally advanced (non-metastatic) non-small-cell lung cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol.* 2010;21(suppl_5):v103–v115. [PubMed: 20555058]
24. Henschke CI, Yankelevitz DF, Libby DM, Pasmantier MW, Smith JP, Miettinen OS. Survival of patients with stage I lung cancer detected on CT screening. *N Engl J Med.* 2006;355(17):1763–71. [PubMed: 17065637]
25. Johnson DH, Schiller JH, Bunn PA, Jr. Recent clinical advances in lung cancer management. *J Clin Oncol.* 2014;32(10):973–82. [PubMed: 24567433]
26. Goel MS, Wee CC, McCarthy EP, Davis RB, Ngo-Metzger Q, Phillips RS. Racial and ethnic disparities in cancer screening: the importance of foreign birth as a barrier to care. *J Gen Intern Med.* 2003;18(12):1028–35. [PubMed: 14687262]
27. Hwang H Colorectal cancer screening among Asian Americans. *Asian Pac J Cancer Prev.* 2013;14(7):4025–32. [PubMed: 23991947]
28. Jacobs EA, Karavolos K, Rathouz PJ, Ferris TG, Powell LH. Limited English proficiency and breast and cervical cancer screening in a multiethnic population. *Am J Public Health.* 2005;95(8):1410–6. [PubMed: 16043670]
29. Kandula NR, Wen M, Jacobs EA, Lauderdale DS. Low rates of colorectal, cervical, and breast cancer screening in Asian Americans compared with non-Hispanic whites: cultural influences or access to care? *Cancer* 2006;107(1):184–92. [PubMed: 16721803]
30. Schleicher E. Immigrant women and cervical cancer prevention in the United States. Baltimore: Women's and Children's Health Policy Center, Johns Hopkins Bloomberg School of Public Health 2007 <https://www.jhsph.edu/research/centers-and-institutes/womens-and-childrens-health-policy-center/publications/ImmigrantWomenCervCancerPrevUS.pdf>. Accessed 1 Sept 2017.
31. Ward E, Jemal A, Cokkinides V, Singh GK, Cardinez C, Ghafoor A, Thun M. Cancer disparities by race/ethnicity and socioeconomic status. *CA: Cancer J Clin.* 2004;54(2):78–93. [PubMed: 15061598]
32. Karliner LS, Napoles-Springer AM, Schillinger D, Bibbins-Domingo K, Perez-Stable EJ. Identification of limited English proficient patients in clinical care. *J Gen Intern Med.* 2008;23(10):1555–60. [PubMed: 18618200]

33. Gany F, Diamond L, Meslin R, Gonzalez J. Ensuring access to research for non-dominant language speakers In: Castañeda X, Rodriguez-Lainz A, Schenker MB, editors. Migration and health research methodologies: a handbook for the study of migrant populations. Oakland: University of California Press; 2012.
34. Cohen S, Williamson G. Perceived stress in a probability sample of the United States In: Spacapan S, Oskamp S, editors. The social psychology of health: Claremont Symposium on applied social psychology. Newbury Park: SAGE; 1988.
35. Wang Z, Chen J, Boyd JE, Zhang H, Jia X, Qiu J, Xiao Z. Psycho-metric properties of the Chinese version of the Perceived Stress Scale in policewomen. PLoS ONE. 2011;6(12):e28610. [PubMed: 22164311]
36. Kroenke K, Spitzer R, Williams J. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001;16(9):606–13 (Electronic version). [PubMed: 11556941]
37. Spitzer RL, Kroenke K, Williams JB, Group PHQPCS. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. J Am Med Assoc. 1999;282(18):1737–44.
38. Yeung A, Fung F, Yu S-C, Vorono S, Ly M, Wu S, Fava M. Validation of the Patient Health Questionnaire-9 for depression screening among Chinese Americans. Compr Psychiatry. 2008;49(2):211–7. [PubMed: 18243896]
39. NYC Taxi & Limousine Commission. NYC Taxi & Limousine Commission - Current Licensees. 2014 http://www.nyc.gov/html/tlc/html/industry/current_licensees.shtml. Accessed 1 Sept 2017.
40. Chinese Advertising Agencies. About world journal. <http://www.chineseadvertisingagencies.com/mediaguide/World-Journal.html>. Accessed 1 Sept 2017.
41. World Journal. World journal - about us. http://www.worldjournal.com/page-about_us-e/. Accessed 1 Sept 2017.
42. U.S. Department of Health and Human Services. The health consequences of smoking-50 years of progress. A report of the surgeon general executive summary. 2014 <https://www.surgeongeneral.gov/library/reports/50-years-of-progress/index.html>. Accessed 1 Sept 2017.
43. Center for Disease Control and Prevention. Tobacco-related mortality. 2016 https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/tobacco_related_mortality/. Accessed 1 Sept 2017.
44. Centers for Disease Control and Prevention. What are the risk factors for lung cancer? 2016 https://www.cdc.gov/cancer/lung/basic_info/risk_factors.htm. Accessed 1 Sept 2017.
45. Wu D, Ma GX, Zhou K, Zhou D, Liu A, Poon AN. The effect of a culturally tailored smoking cessation for Chinese American smokers. Nicotine Tob Res. 2009;11(12):1448–57. [PubMed: 19915080]
46. Spigner C, Yip M-P, Huang B, Tu SP. Chinese and Vietnamese adult male smokers' perspectives regarding facilitators of tobacco cessation behavior. Asian Pac J Cancer Prev. 2007;8(3):429. [PubMed: 18159982]
47. New York City Taxi and Limousine Commission. Taxicab factbook 2014 http://www.nyc.gov/html/tlc/downloads/pdf/2014_taxicab_fact_book.pdf. Accessed May 2017.
48. Pui DY, Qi C, Stanley N, Oberdörster G, Maynard A. Recirculating air filtration significantly reduces exposure to airborne nano-particles. Environ Health Perspect. 2008;116(7):863. [PubMed: 18629306]
49. World Health Organization, International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Carbon black, titanium dioxide, and talc 2010, vol 93 <http://monographs.iarc.fr/ENG/Monographs/vol93/index.php>. Accessed 1 Sept 2017.
50. Centers for Disease Control and Prevention. Cancer screening in the United States. 2014 https://www.cdc.gov/cancer/dcpc/research/articles/screening_us.htm. Accessed 1 Sept 2017.
51. Centers for Disease Control and Prevention. Study finds racial and ethnic disparities in US cancer screening rates. 2012 https://www.cdc.gov/media/releases/2012/p0126_cancer_screening.html. Accessed 1 Sept 2017.
52. Fernandez ME, Gonzales A, Tortolero-Luna G, Williams J, Saavedra-Embesi M, Chan W, Vernon SW. Effectiveness of Cultivando la Salud: a breast and cervical cancer screening promotion program for low-income Hispanic women. Am J Public Health. 2009;99(5):936–43. [PubMed: 19299678]

53. Lam TK, McPhee SJ, Mock J, Wong C, Doan HT, Nguyen T, Lai KQ, Ha-Iaconis T, Luong TN. Encouraging Vietnamese-American women to obtain Pap tests through lay health worker outreach and media education. *J Gen Intern Med*. 2003;18(7):516–24. [PubMed: 12848834]
54. The Association of State and Territorial Health Officials (ASTHO). Improving cancer prevention and control: how state health agencies can support patient navigators and community health workers. 2012 <http://www.astho.org/ImprovingCancerPreventionandControl/>. Accessed 15 Feb 2018.
55. Wells KJ, Luque JS, Miladinovic B, Vargas N, Asvat Y, Roetzheim RG, Kumar A. Do community health worker interventions improve rates of screening mammography in the United States? a systematic review. *Cancer Epidemiol Biomark Prev*. 2011;20(8):1580–98.

Fig. 1.
Pack years by comorbidities among Chinese drivers (n = 97)

Table 1

Characteristics of Chinese drivers by smoking status

	Overall (N = 97)	Never smoker (N = 26)	Ever smoker (N = 71)
Age, μ (SD)	44.7 (10.0)	45.3 (8.8)	44.4 (10.5)
Years in US, μ (SD)	11.9 (7.5)	10.8 (6.4)	12.3 (7.9)
Education, n (%)			
Below high school	14 (14.6)	3 (12.0)	11 (15.5)
Completed high school	45 (46.9)	14 (56.0)	31 (43.7)
Some college	12 (12.5)	1 (4.0)	11 (15.5)
Graduate or higher	25 (26.0)	7 (28.0)	18 (25.4)
English proficiency, n (%)			
Not English proficient	95 (97.9)	26 (100)	69 (97.2)
English proficient	2 (2.1)	-	2 (2.8)
Marital living situation, n (%)			
Spouse/partner at home	66 (68.8)	18 (69.2)	48 (68.6)
Spouse/partner not at home	8 (8.3)	2 (7.7)	6 (8.6)
No spouse/partner	22 (22.9)	6 (23.1)	16 (22.9)
Below poverty line, n (%)	18 (23.4)	4 (21.1)	14 (24.1)
Years driving Taxi, μ (SD)	2.1 (1.1)	2.3 (1.0)	2.1 (1.1)
Work hours per week [*] , μ (SD)	57.6 (15.2)	63.9 (16.8)	55.5 (14.2)
Shift worked, n (%)			
Day	68 (70.8)	20 (76.9)	48 (68.6)
Night	5 (5.2)	1 (3.9)	4 (5.7)
Varies	23 (24.0)	5 (19.2)	18 (25.7)
Health insurance, n (%)	80 (82.5)	21 (80.8)	59 (83.1)
PCP, n (%)	80 (82.5)	21 (80.8)	59 (83.1)
Alcohol consumption ^{**} , n (%)	53 (54.6)	8 (30.8)	45 (63.4)
Comorbidities (prevalence)			
NIDDM, n (%)	6 (6.2)	-	6 (8.5)
Hypertension, n (%)	16 (17.2)	3 (12.5)	13 (18.8)
High cholesterol, n (%)	24 (25.5)	6 (24.0)	18 (26.1)

	Overall (N = 97)	Never smoker (N = 26)	Ever smoker (N = 71)
Stress, n (%)	19 (20.0)	5 (19.2)	14 (20.3)
Anxiety/depression, n (%)	1 (1.1)	-	1 (1.5)
Chronic pain, n (%)	28 (29.8)	7 (26.9)	21 (30.9)
PHQ-9 score, μ (SD)	2.8 (3.4)	1.9 (2.3)	3.1 (3.7)
PSS-10 score, μ (SD)	9.4 (5.5)	7.7 (5.6)	10.1 (5.4)
Pack years, μ (SD)	13 (15.2)	-	13 (15.2)

*
p-value < 0.05;
**
p-value < 0.001

Results of generalized mixed model assessing association between pack years and comorbidities (n = 97)

Table 2

Variable	Coefficient	SE	p-value	OR (95% CI)
Pack years	−0.055	0.022	0.229	0.98 (0.95, 1.01)
CVD/met [‡] versus psych/chr pain [£]	−0.927	0.450	0.041	0.4 (0.16, 0.96)
Comorbidities (CVD/met vs. psych/chr pain) × pack years [*]	0.072	0.025	0.004	1.07 (1.02, 1.13)
Age	0.053	0.021	0.012	1.05 (1.01, 1.1)
No PCP versus having a PCP	−0.510	0.659	0.440	0.6 (0.16, 2.2)

PCP primary care physician

^{*} Interaction between comorbidity type and pack years

[‡] CVD/met: cardiovascular/metabolic comorbidities, including NIDDM, hypertension, and high cholesterol

[£] Psych/chr pain: psychological/chronic pain comorbidities, including stress, anxiety/depression, and chronic pain