Mental Health in Temporary Construction Workers

Qinxue Li

A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Science in Construction Management

University of Washington
2018

Committee:
Ken-Yu Lin
Edmund Seto
Ahmed Abdel-Aziz

Program Authorized to Offer Degree:
Construction Management

University of Washington

Abstract

Mental Health in Temporary Construction Workers

Qinxue Li

Chair of the Supervisory Committee:
Ken-Yu Lin
Department of Construction Management

Construction industry is characterized as not only physically but also mentally demanding with industry specific characteristics such as heavy workload, long working hours, work-family conflicts etc. However, inadequate research has been done to address the mental health aspect of the construction industry, where attention has been dominantly focused on physical health. On the other hand, the variance in terms of labor demands also distinguishes the construction industry from the rest and results in the second highest temporary employment rate based on the report from The Center for Construction Research and Training (CPWR) in 2015. Since the temporary construction workers are reported to have been earning less income, receiving less benefits and experiencing higher job insecurity, this study looks into the mental health of this disadvantaged population.

In the literature review, characteristics of the overall as well as the temporary construction workforce are identified. The measurement of the mental health performance is determined to be the Kessler Index (K6) and the odds of serious mental illness (SMI). Meanwhile, the variables which are considered to be associated with mental health are also teased out from previous studies, which consist of demographics, annual income, housing status, health status and others.

The two data sources identified are the Medical Expenditure Survey (MEPS) and Behavioral Risk Factor Surveillance System-Washington State (BRFSS-WA). Due to the information availability of the variables of interest, two different models are proposed, with one at the national level based on MEPS and one at the Washington State level based on BRFSS-WA.

At the national level, the comparisons are made among the non-construction, permanent construction and temporary construction workforce while at the Washington State level, the comparison is made between non-construction and construction workers. Descriptive analysis is performed on all the variables to create a general profile at the national level and the state level. Linear regression and logistic regression are also performed in order to test the significance of the difference at the two levels.

Based on the analysis, it is found that, at the national level, permanent construction workers have significantly lower mean K6 score than the non-construction workers. Temporary construction workers are found to have lower mean K6 score than non-construction workers and higher mean K6 score than permanent construction workers, but neither of the difference is significant. As for the odds of SMI, permanent construction workers tend to have significantly lower odds than the non-construction workers. Temporary construction workers tend to have higher odds than the other two groups, but neither of the difference is significant. At the Washington State level, construction workers are found to have lower mean K6 score and odds of SMI, but neither of them is significant. In addition, the significance of the covariates are also discussed in the analysis.

Moreover, the lessons learnt from the data handling process are discussed and recommendations are listed out. Limitations of this study and suggestions for future research are also presented at the end.

Table of Contents

List of Figures

List of Tables

1 Introduction

Total worker health is considered a comprehensive approach to improve worker safety and health (CDC, 2016). However, majority of the research mainly focused on physical health as the outcome of interest, and limited attention was paid to mental health, which is an essential element of general health. A positive mental health enables us to realize our potential fully, deal with life stress properly, work productively and contribute to our communities meaningfully (MentalHealth.gov, 2017).

Felter et al. (2016) reviewed studies from 1990 to 2015 in order to evaluate the effectiveness of TWH interventions and out of the 24 eligible studies identified, only six of them considered mental health as the outcome of interest. Among the six, Maes et al. (1998), Eriksen et al. (2002), Palumno et al. (2012), Coffeng et al., 2014, and Hammer et al. (2015) focused on job stress whereas Olson et al. (2015) focused on depression and psychosocial stress. With regard to the populations selected by the six studies, only Hammer et al. (2015) enrolled primarily construction workers while the rest focused on health care and serve, finance, and transportation workers.

On the other hand, construction workers tend to have high work demand, low job control, poor organizational control and work-family conflicts (Todd et al., 2014). These job conditions make the workers more prone to reduced mental health due to the high job stress level (NIOSH, 2014). Additionally, within the construction industry, temporary workers are further disadvantaged with lower earnings, fewer benefits, higher exposure to hazards and lower job insecurity (CPWR, 2015), making them seemingly more vulnerable when being compared with full-time workers.

Temporary workers, whose job lasts for only a limited amount of time or until the completion of a project, enable construction companies to adjust the labor demand with relatively low costs. In 2015, the U.S. construction workforce consisted of 15.5% temporary workers, with a growth more than 40% from 2003. When being compared with the other industries, the percentage of temporary workers employed in construction is 70% and 40% higher in 2015 and 2003 respectively (CPWR, 2015). As the U.S. continues to build its infrastructure, demand for the construction workforce is high and the employment of temporary workers is on the rise. While urban cities offer plentiful employment

opportunities for the construction industry, they also bring forth complicated economic, transportation, housing … etc. challenges to all who work and/or reside in the cities.

In order to better understand the influence of temporary employment on the mental health of construction workers under the emerging U.S. social-economic environment, the mental health performance among non-, permanent and temporary construction workers is investigated in this thesis. Specifically, data were gathered and analyzed both for across the nation and at the Washington State level. The 2016 GDP growth in the Washington State was the highest in the nation, and the state's 2015 employment and wage growth was also the top of the nation, with most hiring in construction, information technology and a couple of other industries.

Since many factors could be at play, adequate measurement of mental health performance and the potential variables (or covariates, in statistical terms) are identified based on the literature review described in Chapter 2. Knowing how employment status influences construction workers' mental health at the juncture of these potential variables enables stakeholders to see how the issue could be multifaceted and cannot be addressed by a unitary method.

The data source for the national level analysis is the Medical Expenditure Survey (MEPS), which is a national wide survey collecting basic household and insurance information of the civilian non-institutional population in the U.S. The data source for the Washington State level analysis is the Behavioral Risk Factor Surveillance System-Washington State (BRFSS-WA), which gathers information of people's health changes in the state. Although data on the employment status (temporary versus permanent) are not available through BREFF-WA for the Washington State, the comparison of non-construction and construction labor force was still conducted in the thesis to provide a point of inference on the mental health for the temporary construction workers within the Washington State. Chapter 3 discusses the overall research methodology, including the data sources.

Chapter 4 explains the data extraction approach, presents the data descriptively, and elucidates how the inferential analysis was conducted statistically. Data extraction essentially involves selecting meaningful data from the sources and preparing the selected data for statistical analysis. The descriptive analysis summarizes the distributions of all the

research covariates. The inferential analysis applies linear and logistic regressions to test the statistical significance of the temporary employment on the mental health performance with all the covariates being adjusted.

Chapter 5 reflects upon the lessons learnt working with the existing data sets. For example, even though a standardized occupation classification system is adopted by the sources from which this thesis drew data, groupings of the data at the sources are quite different, making integrated data analysis impossible if not extremely difficult. Finally in Chapter 6, the findings are concluded along with the research limitation discussion and recommendations for the future work.

2 Literature Review

2.1 Total worker health (TWH)

CDC (2016) described well-being as judging life positively and feeling good, which was built upon social, economic and personal development enabled by a healthy condition. Through promoting health, people gain more access to individual, social as well as environmental resources which may ultimately improve their well-being.

NIOSH launched the TWH Program in June 2011 with a vision to not only protect workers from hazards, but also promote their health and well-being. In this approach, work is considered as a social determinant of health which can exert an important impact on the well-being of workers through work-related factors such as income, work load, stress level, interaction among the coworkers etc.

Under the scope of promoting the TWH, research has been done across all industries, but with limited attention to address the mental health issue. Felter et al. (2016) conducted a literature review on TWH interventions across all industries and out of the 24 eligible studies, only six studies considered mental health as the outcome of interest (Maes et al., 1998; Eriksen et al., 2002; Palumno et al., 2012; Coffeng et al., 2014; Hammer et al., 2015). There were four studies which enrolled primarily construction workers in the 24 eligible studies, but only one considered work-life stress reduction as the outcome of interest (Hammer et al. 2015), while the rest mainly focused on physical health- smoking status (Barbeau et al. 2006, Sorensen et al. 2007) and shoulder pain (Borstad et al. 2009).

2.1.1 Characteristics of the construction industry

Unique characteristics of the labor force distinguish the construction industry from the rest. In order to have a better understanding of the health conditions of those who work in the construction industry, it is crucial to go through the overall profile of this industry.

- *Aging workforce*

The pace of aging in the construction labor force has exceeded that for the general industries. In the sixth edition of The Construction Chart Book (CPWR, 2018), CPWR provided a general overview of the construction industry with data collected up to 2015. It reported that the average age of workers increased by 6.5 years between 1985 and 2015 in the construction industry comparing to 4.9 years in all U.S. workers. The shift in the age distribution was also found within the construction labor force between 1985 and 2015, with 59% increase in the age group of 45 to 64 years and 67%, 49% and 32% decrease in the age groups of 16 to 19 years, 20 to 24 years, and 25 to 34 years respectively.

- *Health insurance coverage*

  The rate of health insurance coverage in construction is lower compared with all industries combined. In 2015, 78.3% wage-and-salary workers in construction had health insurance coverage, compared to 89.9% in the general industries. As for the self-employed workers who constituted 24.5% of the construction workers, only 74% was covered by health insurance (CPWR, 2018).

- *Family income as a percentage of poverty line*

  The income level in construction tends to be more likely below the poverty line. The CPWR reported, from 2012 to 2014, that more than 7% of construction workers lived below the federal poverty level, compared to 6.1% in all industries. Nearly 25% of the constriction workers had a household income less than two times of the federal poverty level, compared with about 20% in all industries (CPWR, 2016). For instance, in 2014, the federal poverty level was $11,670 with two persons in household was $15,730 and $23,850 with, two times less than which were $3,890 and $7950 respectively (ASPE, 2014)

- *Temporary employment*

  From 2003 to 2014, the proportion of temporary employment in construction is higher than that in industries otherwise. In 2014, 15.5% of employees in the construction industry were temporary workers, with 46%

increase compared with 10.6% in 2003, while only 9.1% of the workforce is temporary employment in non-construction industry, with 23% increase compared with 7.4% in 2003. The demographics of the temporary workers were also distinct from the regular employees. In the 2011-2014 average, temporary workers tended to constitute higher percentage at the age group of 16-34 (temporary 35.8% versus regular 29.5%), education lower than high school (temporary 46.6% versus regular 19.3%), Hispanic (temporary 44.3% versus regular 21.0%) and foreign-born (temporary 40.6% versus regular 19.2%) (CPWR, 2018).

2.1.2 Health Status of Construction Workers

- *Body Mass Index (BMI)*

  Caban et al. (2005) reported that the prevalence rate of obesity among male construction and extractive trades and construction labors were 18.45% and 22.32% based on the National Health Interview Surveys from 1997 to 2002. CPWR (2016) reported that, between 2012 and 2014, 74.5% construction workers were either overweight or obese, while 65.2% of the overall workforce were at the same condition. Within construction, rates of an abnormal BMI also increased with age. Workers with unhealthy BIM constituted more than 80% of those at age group 55 years or older and 66% of those at age group 35 years and younger (CPWR, 2016).

- *Diseases and self-related health condition*

  In a ten-year follow up of 14474 male construction workers, Arndt et al., (2005) found that construction workers had significantly higher risk of disability resulting from cancer, respiratory and musculoskeletal diseases. CPWR (2018) reported that 50.1% of construction workers had at least one doctor-diagnosed health conditions, which escalated with age, ranging from 26.4% at age group 16-34 to 87.5% at the age group of 65 and older.

  In a study of construction bricklayers and supervisors, Boschman et al., (2013) found that 18% bricklayers and 20% supervisors rated themselves as depressed, with which high work speed and quantity were associated with. CPWR (2016) reported about 44% of construction workers rated their

mental health to be excellent, compared to 28% in terms of self-related physical health. On the other hand, only 3.3% of construction workers rated their mental health to be fair/poor while 9.8% in terms of physical health. In addition, both self-reported physical and mental health worsened after the age of 45. However, although construction workers tend to rate their mental health more positively, it is plausible that the overestimation is caused by lower level of awareness in terms of mental health issues compared with physical health problems.

2.2 Mental health

2.2.1 Potential covariates

Mental health is found to be associated with general well-being through different studies (CDC, 2016), whose potential covariates are also identified in different studies.

Roberts et al. (2011) adjusted conditioning variables and found that commuting time had a significant negative effect on psychological health by analyzing data from the British Household Panel Survey, 1991-2004. In their study, apart from including commuting time as the key explanatory variable of interest, they also included net household income, housing quality and job satisfaction.

In the study of prevalence of current depression (CD) and frequent mental distress (FMD) in Washington State, Fan et al. (2012) adjusted socio-demographic as well as lifestyle behaviors factors. Depression is defined as a common but serious mood disorder and is a subcategory of distress. People with mental distress can experience problems in the way they think, feel or behave. (National Institute of Mental Health, 2016).

2.2.2 Potential pathway towards negative effect on health

In the study of 383 Spanish workers, Silla et al. (2005) found temporary workers displayed significant lower life satisfaction and well-being compared with permanent workers. In the review of the association between temporary employment and health, Virtanen et al. (2005) identified six potential pathway towards negative effects on health and they were 1) erosion of income, 2) job

insecurity, 3) deficient benefits, 4) on-the-job-training, 5) lack of prospects for promotion, and 6) exposure to hazardous work conditions. Based on the 27 studies they reviewed, they concluded that there was an association between temporary employment and psychological morbidity.

2.3 Mental health in temporary construction workers

Fan et al. (2012) reported the prevalence of FMD was 8.1% in construction workers compared to 7.5% in all workers in Washington State. However, the study did not differentiate the temporary construction workers from permanent construction workers. It is plausible that temporary employment is associated with lower mental health performance in the construction industry, since temporary workers tend to have lower income, less job security, insufficient benefits as well as higher exposure to hazardous work conditions.

Kessler Index (K6) was verified to be valid to assess a person's non-specific psychological distress during the past 30 days and was firstly included in the US National Health Interview Survey in the 1997 (Kessler et al. 2002). The interviewees are asked to rate the level of 1) felt nervous, 2) felt hopeless, 3) felt restless or fidgety, 4) felt so sad that nothing could cheer the person up, 5) felt everything was an effort and 6) felt worthless during the past 30 days. Every question has a scale from none of the time (0 score) to all of the time (4 scores) and the total scores range from 0-24.

An OR is a measure of association between an exposure and an outcome and can be used in case-control as well as cross-section studies (Szumilas, 2010). Having a K6 score $\geqslant$13 is defined as having serious mental illness (SMI) (Kessler et al.1996). The OR of SMI between permanent and temporary construction workers, for example, represents the odds of having SMI when being a permanent construction worker, compared to the odds of having SMI when not being a permanent construction worker, namely being a temporary construction worker.

This study will look into the effect of temporary employment on the K6 score and the odds of SMI with covariates adjusted.

3 Methodology

In order to determine the impact of temporary employment, K6 scores among temporary construction workers will be compared with those among non- and permanent construction workers. Potential covariates of demographics, income, housing, health status, lifestyle behaviors and health insurance coverage will be adjusted in the analysis.

Both Medical Expenditure Panel Survey (MEPS) and Behavioral Risk Factor Surveillance System-Washington State (BRFSS-WA) collect information on K6 score. As for the status of temporary employment, MEPS is the only resource which has information on it. Due to the gaps of information collected in these two major sources, the comparison of K6 scores will be different at the national level as well as the state level. At the national level, the comparisons of K6 scores are conducted among non-construction workers, permanent construction workers and temporary construction workers. At the state level, the comparison is conducted between non-construction workers and construction workers. The adjusted covariates are the same except that housing status and binge drinking are not included in the national level comparisons.

3.1 Available data sources

3.1.1 MEPS

MEPS, initiated in 1996, is a large-scale set of surveys and contains two major components (AHRQ, 2009). One is the household component which gathers information of the civilian non-institutional population of the United States, with annual sample size around 15,000 households. The information of temporary employment is collected in the household component. The other is the insurance component which covers information on the health insurance plans offered by the public and private employers. At the beginning of a year, a new panel of households is selected and all the households will participate in five rounds of interview in the current and subsequence year. As for one full calendar year, information is available from six rounds of interview from two successive panels: the third, the fourth and the fifth rounds from the panel initiated in previous year and the first, the second and the third from the panel initiated in current year. In MEPS, some variables, for instance industry and occupation, are asked in very round of the interview and may change over the period of one full calendar year. Since the information of K6 score is only collected in the fourth round of the

previous panel and the second round of the current panel, information of round specific variables is derived from the same rounds from the previous and current panel in this study. For variables which are collected only in specific round, the information of them is used to represent the whole year.

3.1.2 BRFSS-WA

BRFSS-WA collects information of health changes of people in the Washington State and is conducted by the Washington State Department of Health (WSDOH), partnering with the Center for Disease Control and Prevention (CDC). More than 1000 interviews are conducted with people aged 18 years or older through telephone every month (WSDOH, 2016). Apart from the core questionnaire required by CDC, BRFSS-WA also implements state-specific modules to collect other information. The information of temporary employment is not covered by BRFSS-WA.

3.1.3 Available information and potential gaps

- *Demographics*

  The demographic data of interest are age, gender, race and ethnicity group, marital status and education attainment, which are collected by both MEPS and BRFSS-WA for the overall industries and construction industry. The same information for the temporary construction workers is only covered by MEPS.

- *Income*

  The income data of interest are annual personal wage, annual family income and poverty status. MEPS collects information on these three topics which covers the non-, permanent and temporary construction workers. BRFSS-WA only collects information on annual family income, which covers non-construction and construction workers.

- *Housing status*

  The housing status of interest are whether one owns or rents his/her home and the types of building he/she lives in. BRFSS-WA is the only source for this information which is not covered until 2008.

- *Occupation*

  The occupational data are available in both MEPS and BRFSS-WA for the overall industries and construction industry, but MEPS is the only resource which can distinguish temporary construction workers from the overall construction workers. In addition, occupation variable is round specific in MEPS, thus the information used in this study is derived from the fourth round from previous year's panel and the second round from current year's panel.

- *Health status and other covariates*

  The health status data of interest are the perceived general health, obesity, had coronary heart disease (CHD), had stroke and had asthma. Other covariates of interest are current smoking status, binge drinking, physically inactivity, and health insurance coverage. MEPS collects information on all the factors above except binge drinking for non-, permanent and temporary construction workers. Perceived general health, obesity and physically inactivity variables are round-specific in MEPS, thus the information of them is based on the fourth round from previous year's panel and the second round from current year's panel. BRFSS-WA has available information for all factors for non-construction and construction workers.

- *K6 score*

  K6 score was not collected by MEPS until 2004 and not by BRFSS-WA until 2007. The K6 score information of temporary construction workers is only available in MEPS.

- *Temporary employment*

  The information on temporary employment status is only collected in MEPS and is round-specific. Thus employment status is based on the fourth round from previous year's panel and the second round from current year's panel.

The availability of the information mentioned above is illustrated in Table 1 and Table 2 at national level and Washington State level.

Table 1 Date Availability at National Level

Factors / **Populations**	Demographics	Income Annual Personal Wage/ Family Income/ Poverty Status	Housing	Health Status Perceived General Health/ Obesity/ CHD/ Stroke/ Asthma	Other Covariates (Except Binge Drinking)	K6 Score
Non-construction Workers	MEPS	MEPS	−	MEPS	MEPS	MEPS
Permanent Construction Workers	MEPS	MEPS	−	MEPS	MEPS	MEPS
Temporary Construction Workers	MEPS	MEPS	−	MEPS	MEPS	MEPS

Table 2 Date Availability at WA Level

Factors / **Populations**	Demographics	Income Annual Family Income	Housing Status	Health Status Perceived General Health/ Obesity/ CHD/ Stroke/ Asthma	Other Covariates (Include Binge Drinking)	K6 Score
Non-construction Workers	BRFSS-WA	BRFSS-WA	BRFSS-WA	BRFSS-WA	BRFSS-WA	BRFSS-WA
Permanent Construction Workers	BRFSS-WA	BRFSS-WA	BRFSS-WA	BRFSS-WA	BRFSS-WA	BRFSS-WA
Temporary Construction Workers	–	–	–		–	–

3.2 Proposed models

At national level, the mean K6 score and the odds of SMI will be compared among the non-, permanent and temporary construction labor force with demographics, income, perceived general health, obesity, had CHD, had stroke, had asthma, current smoking status, physically inactivity, and health insurance coverage adjusted.

At Washington State level, the mean K6 score and the odds of SMI will be compared between the non-construction and construction labor force, with demographics, income, housing status, perceived general health, obesity, had CHD, had stroke, had asthma, current smoking status, binge drinking, physically inactivity, and health insurance coverage adjusted.

In order to compare the mean K6 score between two different groups, linear regression is employed. By using linear regression with all the covariates adjusted in the model, the potential confoundings can be teased out in order to identify the association between the temporary employment and the K6 score. In the linear regression, t tests are conducted to test whether the mean K6 scores are significant different between the compared two groups, permanent construction workers vs. temporary construction workers for instance. F-tests are conducted to test whether the exploratory variable and the covariates are significantly associated with the K6 score.

Logistic regression is employed to compare the odds of SMI since the dependent variable (having SMI vs. not having SMI) is dichotomous. Furthermore, in order to control the confoundings, all the covariates are included in the logistic model as independent variables. In the logistic regression, Wald tests are conducted to test whether the odd of SMI are significant different between the compared two groups, permanent construction workers vs. temporary construction workers for instance. F-tests are conducted to test whether the exploratory variable and the covariates are significantly associated with the SMI.

4 Analysis and Results

4.1 At National Level

4.1.1 Data Extraction

At national level, all variable information is extracted from MEPS's yearly consolidated data files from 2008 to 2015 and some variables are computed based on the original information for the purpose of this analysis. A response is treated as having missing value when the answer to the question is "Not Ascertained", "Don't know", "Refused", or "Inapplicable".

A construction worker is defined as the one who reports his/her occupation as "Construction, Extraction and Maintenance". The rest of the workers are considered as non-construction workers and their occupations include: 1) Management, Business and Financial Operations, 2) Professional and Related, 3) Service, 4) Sales and related, 5) Office and Administrative Support, 6) Farming, Fishing, Forestry, 7) Installation, Repair, and Maintenance, 8) Production, 9) Transportation and Material Moving and 10) Military Specific Occupations. The distribution of the occupations is presented in Figure 1 and 2. Within the group of construction workers, a temporary construction worker is defined as the one who reports his/her current main job as either "temporary" or "seasonal". The rest of the group are considered as permanent construction workers.

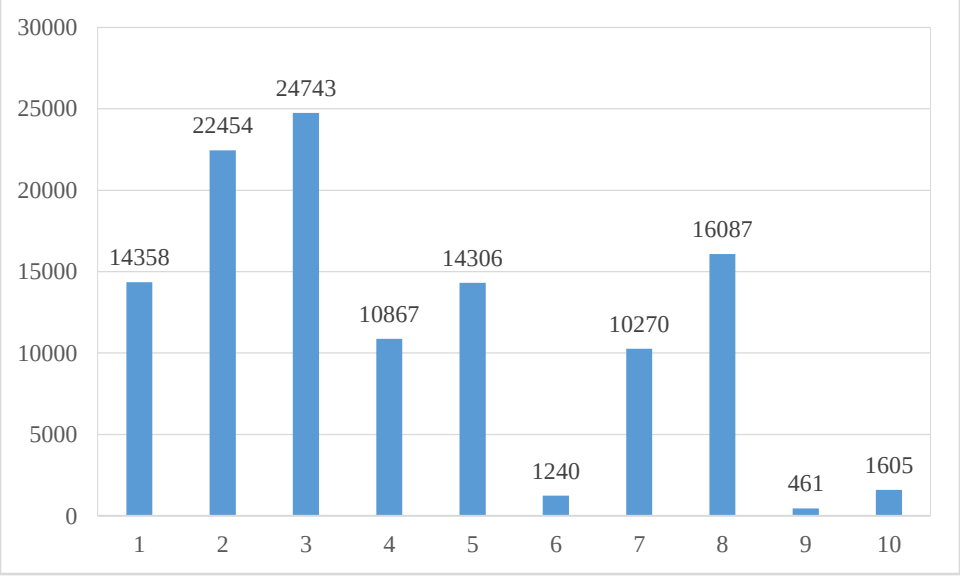

Figure 1 Distribution of all the occupations (At national level, 2008-2015)

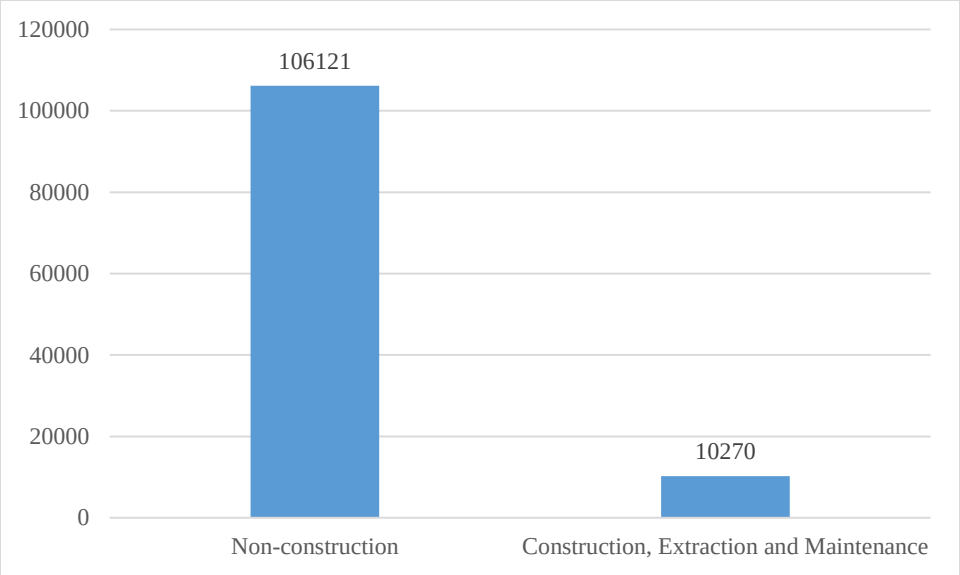

Figure 2 Distribution of Non-construction vs. Construction (At national level, 2008-2015)

The K6 score is collected as integers ranging from 0 to 24 and for the purpose of the analysis, it is categorized into two groups: the group with serious mental illness (SMI) whose K6 score is greater or equal to 13 points and the group without SMI whose K6 score is less than 13.

The mean K6 score and the prevalence of SMI among different occupations are presented in Table 3 and Table 4.

Table 3 Mean K6 Score among Different Occupations (At national level, 2008-2015)

Occupations	N	Mean	Std Dev
1). Management, business, and financial operations	14358	2.43	3.18
2). Professional and related occupations	22454	2.63	3.26
3). Service occupations	24743	2.98	3.95
4). Sales and related occupations	10867	2.98	3.88
5). Office and administrative support	14306	2.83	3.73
6). Farming, fishing and forestry	1240	2.59	3.72
7). Construction, extraction, and maintenance			
• Permanent	8791	2.35	3.45
• Temporary	1411	2.47	3.76
8). Production, transportation, material moving.	16087	2.56	3.71
9). Military specific occupations	461	1.97	3.23
10). Unclassified occupations	1605	2.36	3.74

The mean K6 score among permanent construction workers is only higher than that among military specific occupations while the mean K6 score among temporary construction workers is higher than that among management, business, and financial operations, military specific occupations and unclassified occupations.

Table 4 Prevalence of SMI among Different Occupations (At national level, 2008-2015)

Occupations	Non-SMI	SMI	Prevalence of SMI
1). Management, business, and financial operations	12380	222	1.76%
2). Professional and related occupations	19563	379	1.90%
3). Service occupations	20361	753	3.57%
4). Sales and related occupations	9070	333	3.54%
5). Office and administrative support	12170	374	2.98%
6). Farming, fishing and forestry	1025	27	2.57%
7). Construction, extraction, and maintenance			
• Permanent	7340	168	2.24%
• Temporary	1169	38	3.15%
8). Production, transportation, material moving.	13386	389	2.82%
9). Military specific occupations	116	3	2.52%
10). Unclassified occupations	1100	29	2.57%

As for the prevalence of SMI, permanent construction workers have a higher rate than 1) management, business, and financial operations, and 2) professional and related occupations. Temporary construction workers have a higher rate than all the other occupations except 3) service occupations, and 4) sales and related occupations.

The range of covariate age is from 18 years old to 65 years old and it is categorized into three levels-18 to 24, 25 to 44 and 45 to 65 in this analysis. The covariate race in 2013, 2014 and 2015 is rearranged into six categories in order to be consistent with the information collected from 2008 to 2012, by combing “Asian Indian”, “Chinese” and “Filipino” into one category “Asian”. The marriage status is divided into two categories “Married” and “Not married” which combines the “Widowed”, “Divorced”, “Separated” and “Never married”. The highest education degree is collected from 2008 to 2015, except in 2013 and 2014. So the information for these two years is extracted from a similar variable collected. However, there is still inconsistency in these two years, especially at

the levels of Master's, Doctorate and professional degree, which are collapsed into one level at 2013 and 2014, but separated in other years.

The personal annual wages and family annual income are categorized into five groups-less than 25k, 25k-50k, 50k-75k, 75k-100k and more than 100k.

The information of BMI index is divided into four groups: Underweight (BMI <18.5), Normal weight (18.5≤BMI≤24.9), Overweight (25≤BMI≤29.9) and Obesity (BMI≥30).

The information for gender, ethnicity, poverty status, perceived general health, physical activity, had stroke, had asthma and health insurance coverage is extracted from the source without any other computation. As for physical activity, there is minor difference in terms of the definition of physically active in before and after 2011. It is defined as spending half hour or more in moderate to vigorous physical activity at least three times a week from 2008 to 2010 and is revised into at least five times in a week in 2011 and applied since then.

4.1.2 Descriptive Analysis

At national level, the distributions of all the covariates among non-, permanent and temporary construction workers stay consistent from 2008 to 2015, except annual personal wage and health insurance coverage. Thus, the overall summary of all the variables is presented in Table 5 and the yearly summaries of 2008, 2012 and 2015 are included in the appendix Table 11, Table 12 and Table 13.

As for the distribution of age (Figure 3), people aged from 28 years old to 44 years old contribute to higher percentage of the temporary construction labor force, which is 71%, compared with 60% of permanent construction and 60% of non-construction labor force.

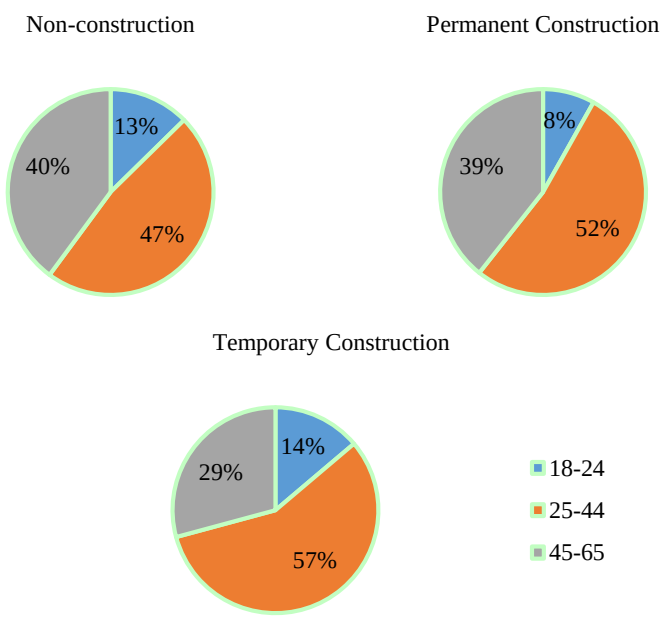

Figure 3 Distribution of age (At national level, 2008-2015)

As for the distribution of gender, it is skewed in construction industry regardless of the status of employment compared with other industries as a whole. Female workers only contribute to 3% of the overall construction labor force.

As for the distribution of race, there is little difference between the permanent and the temporary construction labor force. In non-construction workers, white people contribute a lower proportion while black people and Asians contribute a larger proportion, with 69%, 19% and 7% respectively, compared with 83%, 11% and 1% in permanent construction workers. As for the ethnic group, construction industry has a higher percentage of Hispanic workers compared with the rest industries as a whole. Hispanic workers constitute to 62% of the temporary construction labor force, compared with 40% and 27% of the permanent and non-construction labor force.

As for the marriage status, permanent construction workers have the highest rate of being married (61%), while the non-construction workers go as the second (52%) and the temporary construction workers as the last (45%).

As for the highest education degree obtained (Figure 4), temporary construction workers have the highest percentage of no degree obtained (46%) compared with the permanent construction workers (27%) and non-construction workers (15%). 83% of the permanent and 91% of the temporary construction workers have a highest degree of high school or below.

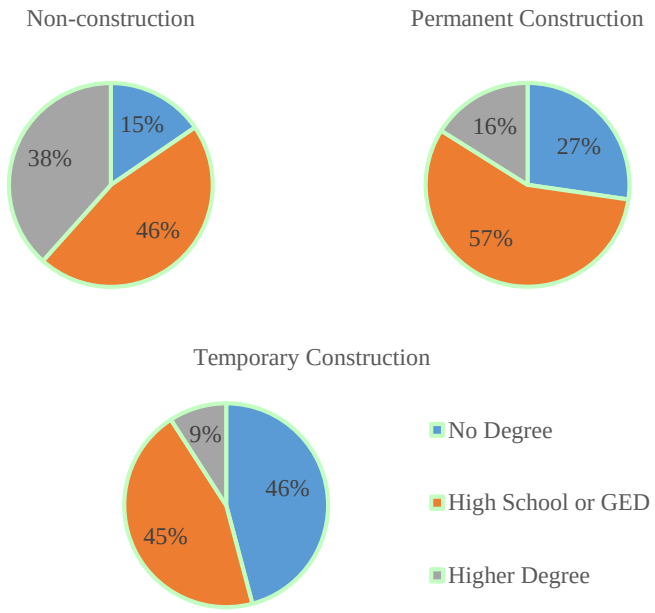

Figure 4 Distribution of education (At national level, 2008-2015)

As for the annual personal wage (Figure 5), temporary construction workers tend to have the highest percentage in the annual personal wage category less than 25k. On average, 63% temporary construction workers fall into this category, compared with 38% in permanent construction workers and 44% non-construction workers. Meanwhile, the percentage of workers in this category decreases over the years, from 63% in 2008 to 54% in 2015 within temporary construction workers, from 41% in 2008 to 31% in 2015 within permanent construction workers, and from 45% in 2008 in to 42% in 2015 within non-construction workers (Figure 6).

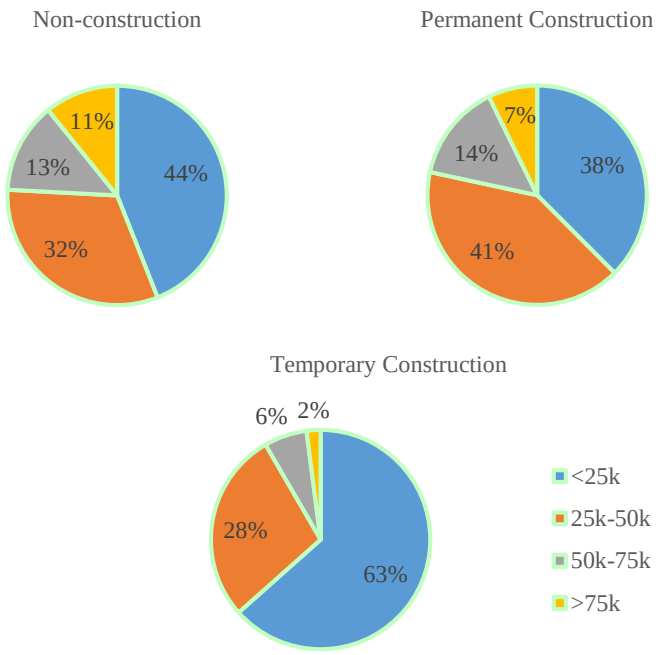

Figure 5 Distribution of annual personal wage (At national level, 2008-2015)

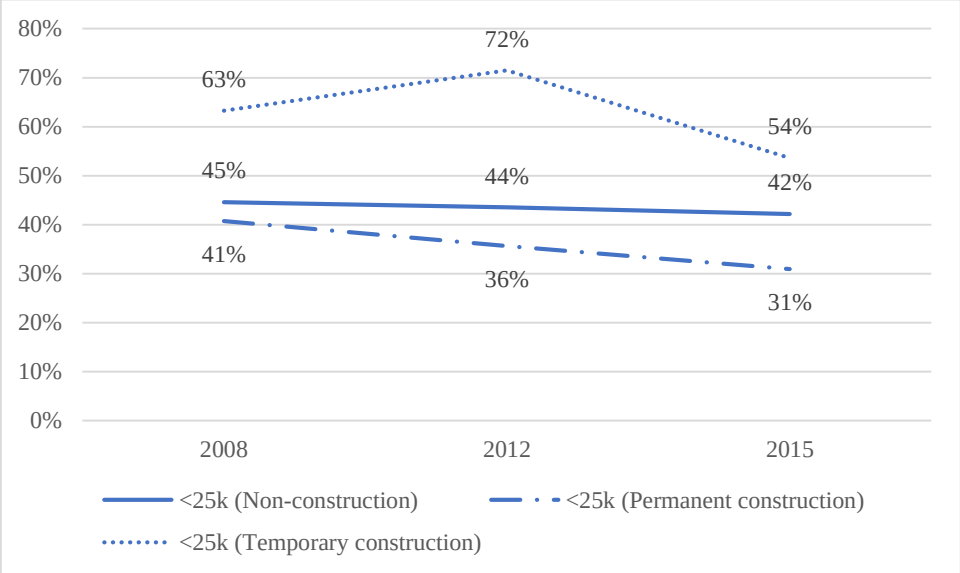

Figure 6 Non- vs. permanent vs. temporary construction workers with <25k annual personal wage (At national level, 2008-2015)

Temporary construction workers also tend to have lower annual family income that 69% of them have a family income less than 50K, compared with 49% in permanent construction workers and 44% in non-construction workers (Figure 7).

The trend of having lower income in temporary construction workers also hold when it comes to the poverty status, which is a relative measurement of the annual family income. 52% of the temporary construction workers are considered as low income or below, compared with 33% and 31% in the permanent construction workers and non-construction workers respectively.

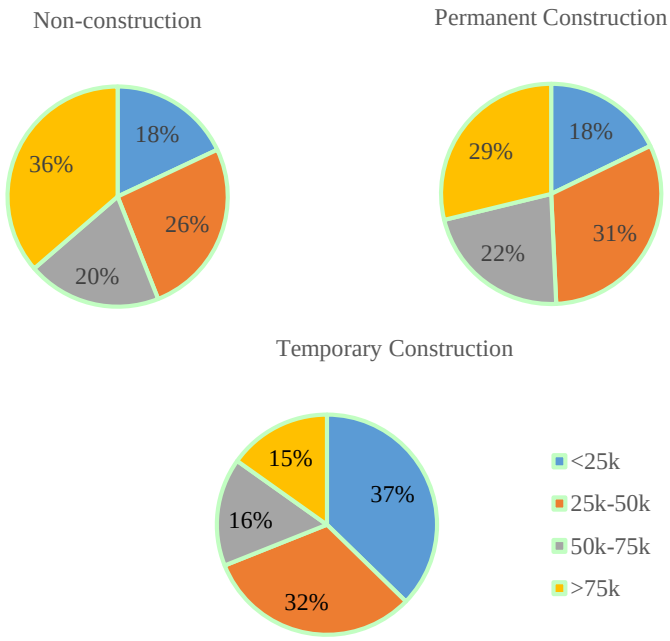

Figure 7 Distribution of annual family income (At national level, 2008-2015)

As for the perceived general health (Figure 8), the ratings of fair or poor consist of a higher proportion in the temporary construction workers (11%) compared with the permanent construction workers (9%) and the non-construction workers (8%). Based on the BMI index, 77% of the temporary and 76% of the permanent construction labor force are overweight or obese, while it is 66% for the rest of the industries. In terms of smoking (Figure 9), 23% temporary construction workers are considered as current smokers, compared with 26% and 16% permanent and non-construction workers. Permanent construction workers are considered to be more physically active (61%) and the rates are very close in the temporary construction workers (53%) and the non-construction workers (55%). As for other health status, distributions are similar within the three groups, except permanent (5%) and temporary (4%) construction workers have lower asthma rate compared with the non-construction workers (8%).

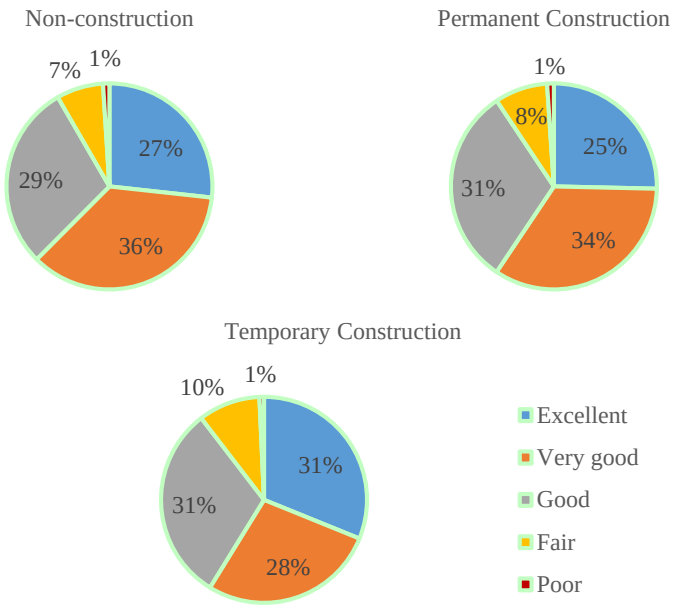

Figure 8 Distribution of perceived general health (At national level, 2008-2015)

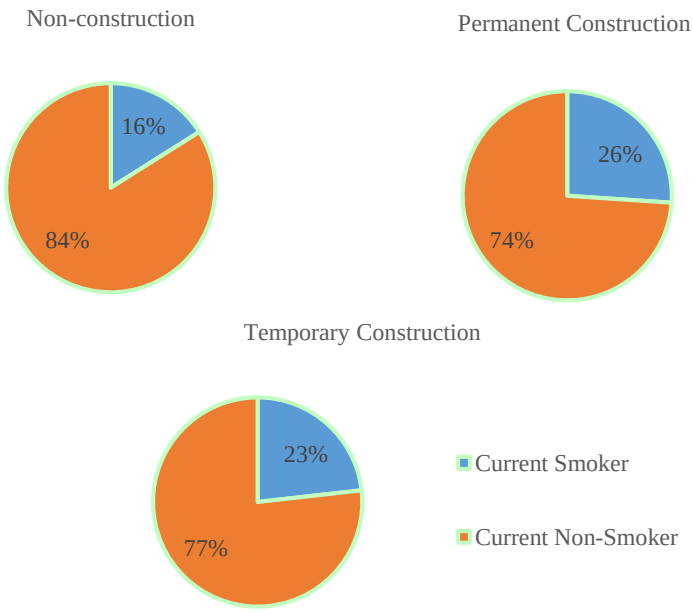

Figure 9 Distribution of current smoking status (At national level, 2008-2015)

As for the health insurance coverage (Figure 10), the uninsured rate is higher in the construction industry, with 36% permanent and 61% temporary construction workers uninsured, while the uninsured rate is only 20% in the non-construction industries. Meanwhile, a significant decrease in terms of uninsured rate is identified among temporary construction workers, which decreases from 70% in 2008 to 50% in 2015. The health insurance coverage rate from 2008 to 2015 is presented in Figure 11.

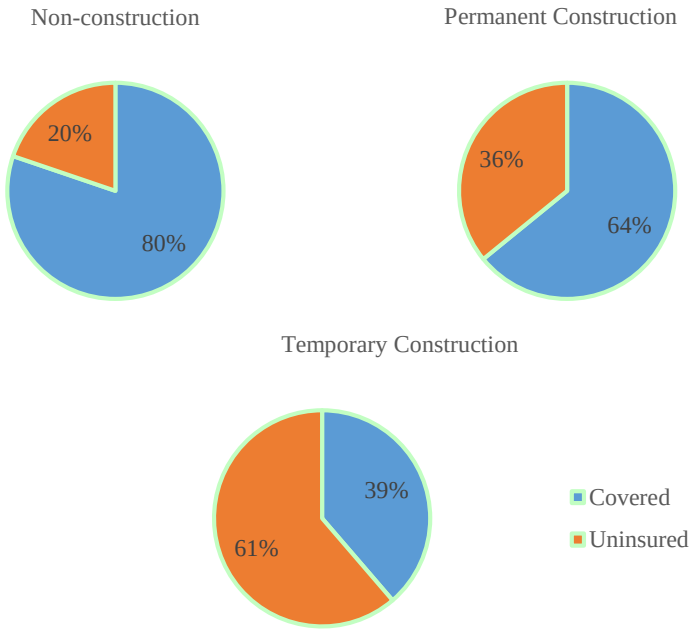

Figure 10 Distribution of health insurance coverage (At national level, 2008-2015)

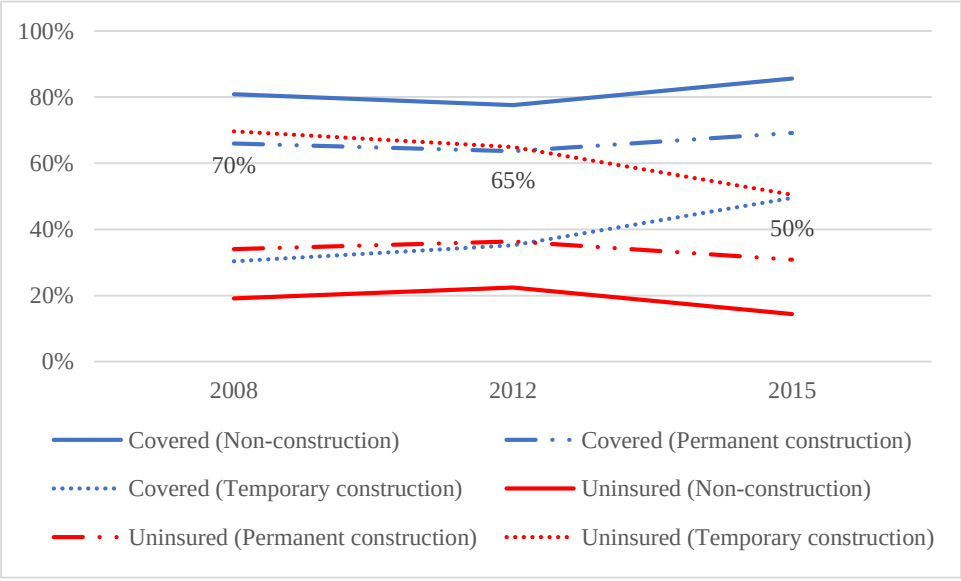

Figure 11 Health insurance coverage in non- vs. permanent vs. temporary construction workers (At national level, 2008-2015)

Table 5 Descriptive Summary of All the Variables (At national level, 2008-2015)

	Non-construction	%	Permanent construction	%	Temporary construction	%
Age						
28-24	13433	13%	717	8%	195	14%
25-44	50363	47%	4614	52%	804	57%
45-65	42325	40%	3460	39%	412	29%
Gender						
Male	49875	47%	8549	97%	1372	97%
Female	56246	53%	242	3%	39	3%
Race						
White	68606	69%	6889	83%	1101	85%
Black	19118	19%	910	11%	128	10%
American Indian/Alaska Native	839	1%	72	1%	15	1%
Asian	7236	7%	203	2%	24	2%
Native Hawaiian/Pacific Islander	1440	1%	55	1%	8	1%
Multiple races reported	2046	2%	123	1%	20	2%
Ethic group						
Hispanic	28858	27%	3509	40%	880	62%
Not Hispanic	77263	73%	5282	60%	531	38%
Marriage status						
Married	55514	52%	5354	61%	633	45%
Not married	50603	48%	3437	39%	778	55%
Highest degree						
No Degree	14161	15%	2078	27%	543	46%
GED	3276	4%	470	6%	59	5%
High School Diploma	39025	43%	3841	50%	474	40%
Bachelor's Degree	17497	19%	402	5%	38	3%
Master's Degree	7684	8%	49	1%	8	1%
Doctorate Degree	1393	2%	7	0%	1	0%
Other Degree	8592	9%	766	10%	61	5%
Annual personal wage						
<25k	46680	44%	3299	38%	895	63%
25k-50k	33798	32%	3592	41%	398	28%
50k-75k	14164	13%	1263	14%	89	6%
75k-100k	5950	6%	437	5%	21	1%
>100k	5529	5%	200	2%	8	1%
Annual family income						
<25k	19106	18%	1567	18%	526	37%

25k-50k	27588	26%	2764	31%	447	32%
50k-75k	20881	20%	1929	22%	224	16%
75k-100k	14236	13%	1250	14%	104	7%
>100k	24310	23%	1281	15%	110	8%
Poverty status						
Poor/Negative	10311	10%	879	10%	301	21%
Near poor	4893	5%	451	5%	123	9%
Low income	16767	16%	1569	18%	313	22%
Middle income	35801	34%	3364	38%	483	34%
High income	38349	36%	2528	29%	191	14%
Perceived general health						
Excellent	28344	27%	2228	25%	439	31%
Very good	37901	36%	2992	34%	390	28%
Good	30920	29%	2746	31%	434	31%
Fair	7795	7%	729	8%	137	10%
Poor	1055	1%	93	1%	10	1%
Obesity						
Under weight	1444	1%	55	1%	9	1%
Normal	33867	33%	2018	24%	310	23%
Overweight	36184	35%	3734	44%	672	50%
Obesity	31767	31%	2719	32%	358	27%
Smoking status						
Current smoker	14894	16%	1985	26%	283	23%
Current non-smoker	77922	84%	5630	74%	936	77%
Physical activity						
Physically active	57173	55%	5300	61%	742	53%
Physically inactive	47502	45%	3402	39%	655	47%
CHD						
Had CHD	1766	2%	199	2%	29	2%
Not had CHD	104270	98%	8589	98%	1381	98%
Stroke						
Had stroke	1170	1%	70	1%	7	0%
Not had stroke	104880	99%	8719	99%	1403	100%
Asthma						
Had asthma	8520	8%	428	5%	63	4%
Not had asthma	97538	92%	8360	95%	1347	96%
Health insurance						
Covered by any private insurance	75981	72%	5180	59%	404	29%
Covered by public insurance only	9136	9%	457	5%	142	10%
Uninsured	21004	20%	3154	36%	865	61%

4.1.3 Inferential Analysis

The linear regression model is used to compare the mean of K6 score among the non-, permanent and temporary construction labor force. The logistic regression model is used to compare the odd of SMI among the three groups mentioned above. In both models, all the covariates are adjusted as factors and the results are presented in Table 6. Since all explanatory variables are treated as categorical variables in the analysis, the first category of these variables is considered as the control group with which the rest categories are compared. Thus results of the linear and logistic regression are not presented for these controls group in the result section.

Table 6 Mean K6 Score and OR of SMI among three groups with covariates adjusted (At national level, 2008-2015).

	K6 Score				OR of Serious Mental Illness			
	Est	95%CI	Pr(>|t|)	Pr(>F)	OR	95%CI	Pr(>|z|)	Pr(>F)
Occupation				**<0.001**				**<0.001**
Non-construction								
Permanent Construction	-0.24	(-0.335, -0.152)	**<0.001**		0.81	(0.662, 0.983)	**0.033**	
Temporary Construction	-0.06	(-0.304, 0.177)	0.604		1.11	(0.718, 1.717)	0.639	
Year				**<0.001**				**<0.001**
2008								
2009	-0.02	(-0.107, 0.069)	0.667		1.00	(0.859, 1.165)	0.992	
2010	-0.18	(-0.270, -0.088)	**<0.001**		0.98	(0.837, 1.151)	0.821	
2011	-0.21	(-0.296, -0.118)	**<0.001**		0.89	(0.764, 1.047)	0.166	
2012	-0.28	(-0.384, -0.176)	**<0.001**		0.99	(0.825, 1.191)	0.928	
2013	-0.37	(-0.479, -0.265)	**<0.001**		0.82	(0.676, 1.005)	0.056	
2014	-0.62	(-0.706, -0.532)	**<0.001**		0.64	(0.539, 0.764)	**<0.001**	
2015	-0.53	(-0.631, -0.422)	**<0.001**		0.66	(0.536, 0.818)	**<0.001**	
Age				**<0.001**				**<0.001**
18-24								
25-44	-0.21	(-0.300, -0.123)	**<0.001**		0.90	(0.777, 1.052)	0.193	
45-65	-0.53	(-0.621, -0.438)	**<0.001**		0.71	(0.604, 0.833)	**<0.001**	
Gender				**<0.001**				**<0.001**
Male								
Female	0.44	(0.393, 0.496)	**<0.001**		1.41	(1.278, 1.564)	**<0.001**	
Race				**<0.001**				**0.002**
White								
Black	-0.64	(-0.710, -0.569)	**<0.001**		0.78	(0.685, 0.883)	**<0.001**	
American Indian/Alaska Native	-0.26	(-0.516, -0.009)	**0.042**		0.79	(0.498, 1.246)	0.308	

Asian	-0.24	(-0.340, -0.147)	**<0.001**		0.84	(0.665, 1.057)	0.136	
Native Hawaiian/Pacific Islander	0.00	(-0.237, 0.227)	0.968		1.46	(0.997, 2.139)	0.052	
Multiple races reported	0.00	(-0.191, 0.183)	0.963		1.00	(0.736, 1.361)	0.996	
Ethic group				**<0.001**				**0.005**
Hispanic								
Not Hispanic	0.48	(0.410, 0.545)	**<0.001**		1.21	(1.072, 1.375)	**0.002**	
Marriage status				**<0.001**				**<0.001**
Married								
Not married	0.25	(0.191, 0.305)	**<0.001**		1.16	(1.045, 1.287)	**0.005**	
Highest degree		(0.000, 0.000)		**<0.001**		(0.000, 0.000)		**<0.001**
No Degree		(0.000, 0.000)				(0.000, 0.000)		
GED	0.30	(0.135, 0.462)	**<0.001**		1.36	(1.108, 1.658)	**0.003**	
High School Diploma	0.08	(0.000, 0.165)	0.051		1.04	(0.911, 1.182)	0.578	
Bachelor's Degree	0.25	(0.155, 0.350)	**<0.001**		0.87	(0.723, 1.050)	0.148	
Master's Degree	0.30	(0.184, 0.408)	**<0.001**		0.73	(0.553, 0.962)	**0.026**	
Doctorate Degree	0.34	(0.161, 0.512)	**<0.001**		1.07	(0.664, 1.732)	0.774	
Other Degree	0.19	(0.076, 0.296)	**<0.001**		1.11	(0.915, 1.340)	0.296	
Annual family income				**<0.001**				**<0.001**
<25k								
25k-50k	-0.32	(-0.405, -0.234)	**<0.001**		0.83	(0.733, 0.936)	**0.002**	
50k-75k	-0.48	(-0.568, -0.385)	**<0.001**		0.76	(0.658, 0.882)	**<0.001**	
75k-100k	-0.59	(-0.685, -0.486)	**<0.001**		0.60	(0.499, 0.731)	**<0.001**	
>100k	-0.76	(-0.851, -0.662)	**<0.001**		0.49	(0.401, 0.589)	**<0.001**	
Perceived general health				**<0.001**				**<0.001**
Excellent								
Very good	0.65	(0.600, 0.704)	**<0.001**		1.61	(1.349, 1.918)	**<0.001**	
Good	1.47	(1.401, 1.529)			3.22	(2.724, 3.810)	**<0.001**	

Fair	3.34	(3.210, 3.479)			9.17	(7.658, 10.990)	**<0.001**	
Poor	6.21	(5.756, 6.671)	**<0.001**		26.65	(21.007, 33.800)	**<0.001**	
Obesity				0.055				**<0.001**
Under weight								
Normal	-0.04	(-0.280, 0.191)	0.712		0.90	(0.622, 1.312)	0.592	
Overweight	-0.08	(-0.322, 0.152)	0.483		0.87	(0.601, 1.271)	0.480	
Obesity	-0.13	(-0.373, 0.105)	0.271		0.95	(0.654, 1.378)	0.785	
Smoke status				**<0.001**				**<0.001**
Current smoker								
Current non-smoker	-0.70	(-0.777, -0.623)	**<0.001**		0.58	(0.518, 0.640)	**<0.001**	
Physical activity				**<0.001**				**<0.001**
Physically active								
Physically inactive	0.22	(0.169, 0.269)	**<0.001**		1.19	(1.083, 1.303)	**<0.001**	
CHD				**0.010**				0.051
Had CHD								
Not had CHD	-0.29	(-0.511, -0.071)	**0.009**		0.78	(0.609, 1.001)	0.051	
Stroke				**<0.001**				**<0.001**
Had stroke								
Not had stroke	-0.54	(-0.842, -0.230)	**<0.001**		0.62	(0.476, 0.820)	**<0.001**	
Asthma				**<0.001**				**<0.001**
Had asthma								
Not had asthma	-0.48	(-0.578, -0.372)	**<0.001**		0.74	(0.649, 0.852)	**<0.001**	
Health insurance				**0.000**				0.520
Covered by any private insurance								
Covered by public insurance only	0.23	(0.121, 0.349)	**<0.001**		1.07	(0.916, 1.250)	0.394	
Uninsured	-0.01	(-0.085, 0.062)	0.753		0.98	(0.860, 1.106)	0.697	

As for the K6 score, permanent construction workers have a significantly lower ($p<0.001$) score than the non-construction workers with other covariates adjusted. The mean K6 score among permanent construction workers is 0.24 point lower than that among the non-construction workers (95% CI: -0.335,-0.152). Temporary construction workers are estimated to have a 0.06-point lower K6 score compared with the non-construction workers with all covariates adjusted, however, the difference is not significant (95%CI: -0.304, 0.177). A comparison between permanent and temporary construction labor force is also performed. The mean K6 score among temporary construction workers is 0.18-point higher than that among permanent construction workers, but the difference is not significant (95% CI: -0.072, 0.431).

As for the covariate age, those among 25-44 or 45-65 tend to have a significantly lower K6 score ($p<0.001$). People from 25-44 have a mean K6 score 0.21-point lower than those from 18-24 (95%CI: -0.300,-0.123) and people from 45-65 have a mean K6 score 0.53-point lower than those from 18-24 (95%CI: -0.621, -0.438).

As for gender, female tend to have a significantly higher K6 score ($p<0.001$), which is 0.44-point higher than that among male (95%CI: 0.393, 0.496). As for the ethic group, the non-Hispanic tend to have a significantly higher K6 score ($p=0.002$), which is 0.48-point higher that that among the Hispanic (95%CI: 0.410, 0.545).

As for the annual family income, the mean K6 score in the group of 25k-50k or higher is significantly lower than that in the group with annual family income less than 25k ($p<0.05$). The difference in the mean K6 score in these groups is 0.32-point (95%CI: -0.405, -0.234), 0.48-point (95%CI: -0.568, -0.385), 0.59-point (95%CI: -0.685,-0.486) and 0.76-point (95%CI: -0.851. -0.662) lower than the lowest category.

As for smoking status, current non-smokers tend to have a significantly lower K6 score compared with the current smokers ($p<0.001$). It is estimated that the mean

K6 score of the former group is 0.70-point lower than that among the latter group (95% CI: -0.777,-0.623).

For other covariates, they are also significantly associated with the mean K6 score, except obesity.

As for the prevalence of SMI, with all covariates adjusted, permanent construction workers have a significantly lower odds of having SMI compared with non-construction workers (p=0.033). The odds of SMI among permanent construction workers is 81% of the odds among non-construction workers (95%CI: 0.662, 0.983). The odds of SMI among temporary construction workers is 1.11 times the odds among non-construction workers, but the difference is not significant (95%CI:0.718,1.717). A companion between permanent and temporary construction labor force is also performed with other covariates adjusted. The odds among temporary construction workers is 1.38 times that among permanent construction workers, however, the difference is not significant (95% CI: 0.865, 2.192). In addition, all the covariates are significant associated with the prevalence of SMI, except had CHD and health insurance coverage status.

As for the covariate age, only those among 45-65 tend to have a significantly lower odds of SMI (p<0.001). The odds among people from 45-65 is 71% of the odds among those from 18-24 (95%CI: 0.604, 0.833).

As for gender, female tend to have a significantly higher odds of having SMI (p<0.001), which is 1.41 times the odds among male (95%CI: 1.278, 1.564). As for the ethic group, the non-Hispanic have a significantly higher odds of having SMI (p=0.002), which is 1.21-times the odds among the Hispanic.

As for the annual family income, the odds of SMI in the group of 25k-50k or higher is significantly lower than that in the group of less than 25k. The odds in these groups is 83% (95%CI: 0.733, 0.936), 76% (95%CI: 0.658, 0.882), 60% (95%CI: 0.499, 0.731) and 49% (95%CI: 0.401, 0.589) of the odds in the lowest category.

As for smoking status, current non-smokers tend to have a significantly lower odds compared with the current smokers ($p<0.001$). It is estimated that odds of SMI in the former group is 58% of the odds in the latter group (95% CI: 0.518, 0.640).

For other covariates, they are also significantly associated with the SMI, except the covariates had CHD and health insurance coverage.

4.2 At Washington State Level

4.2.1 Data Extraction

At Washington State level, all variable information is extracted from BRFSS-WA's data file from 2011 to 2016 and some variables are computed based on the original information for the purpose of this analysis. A response is treated as having missing value when the answer to the question is "Missing", "Don't know", "Refused", or "Not sure".

A construction worker is defined as the one who reports his/her occupation as "Construction, and Extraction". The rest of the workers are considered as non-construction workers and their occupations include: 1) Management, Business and Financial Operations, 2) Professional and Related, 3) Service, 4) Sales and related, 5) Office and Administrative Support, 6) Farming, Fishing, Forestry, 7) Construction and Extraction, 8) Installation, Repair, and Maintenance, 9) Production, 10) Transportation and Material Moving and 11) Military Specific Occupations. The distribution of the occupations is presented in Figure 12 and 13.

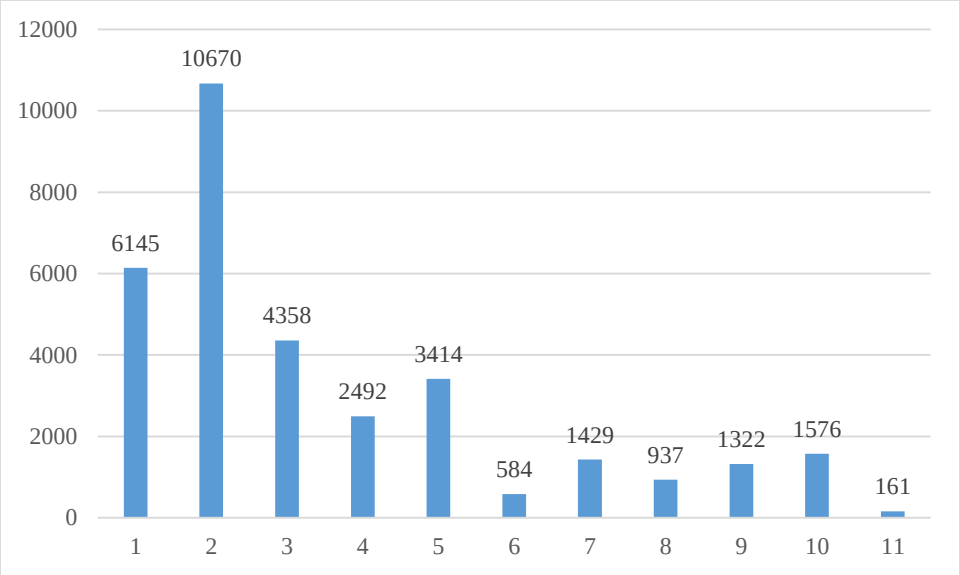

Figure 12 Distribution of all the occupations (At WA level, 2011-2016)

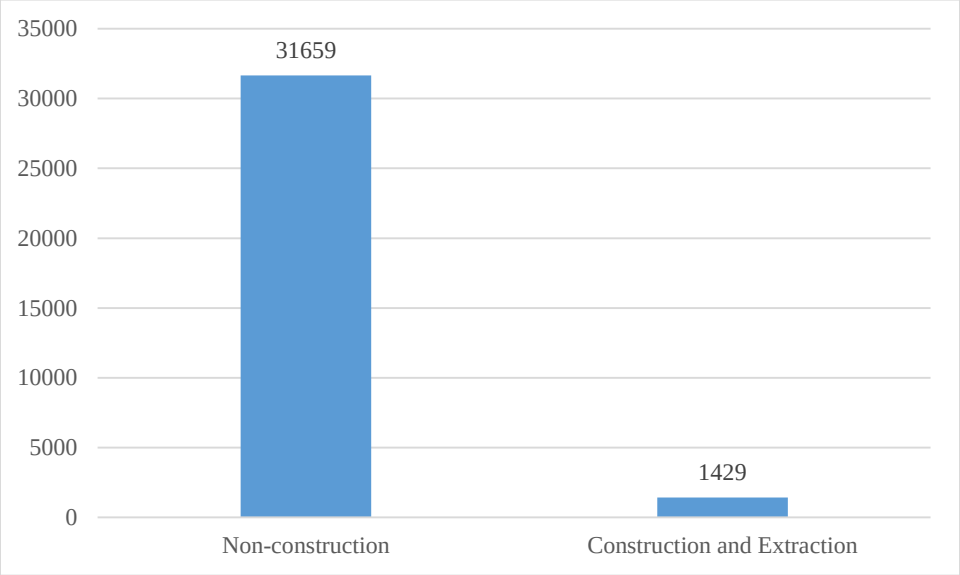

Figure 13 Distribution of Non-construction vs. Construction (At WA level, 2011-2016)

The K6 score is collected as integers ranging from 0 to 24. For the purpose of the analysis, it is transformed in the same way as the MEPS data, which categorizes it into SMI and non-SMI groups. The distribution of K6 score and SMI among different occupations are presented in Table 7 and Table 8.

Table 7 Mean K6 Score among Different Occupations (At WA level, 2011-2016)

Occupation	N	Mean	Std Dev
1). Management, Business & Financial Operations	6145	2.24	2.72
2). Professional and Related	10670	2.45	2.83
3). Service	4358	3.24	3.85
4). Sales and related	2492	2.76	3.38
5). Office and Administrative Support	3414	2.78	3.42
6). Farming, Fishing, Forestry	584	2.58	3.37
7). Construction and Extraction	1429	2.52	3.11
8). Installation, Repair, and Maintenance	937	2.27	2.96
9). Production	1322	2.80	3.52
10). Transportation and Material Moving	1576	2.50	3.33
11). Military Specific Occupations	161	2.61	3.69

The mean K6 score among permanent construction workers is higher than that among 1) management, business and financial operations, 2) professional and related, 8) installation, repair, and maintenance, and 10) transportation and material moving.

Table 8 Prevalence of SMI among Different Occupations (At WA level, 2011-2016)

	Non-SMI	SMI	Prevalence of SMI
1). Management, Business & Financial Operations	5392	55	1.01%
2). Professional and Related	9345	113	1.19%
3). Service	3551	141	3.82%
4). Sales and related	2123	51	2.35%
5). Office and Administrative Support	2927	73	2.43%
6). Farming, Fishing, Forestry	479	7	1.44%
7). Construction and Extraction	1198	21	1.72%
8). Installation, Repair, and Maintenance	779	7	0.89%
9). Production	1108	25	2.21%
10). Transportation and Material Moving	1308	27	2.02%
11). Military Specific Occupations	132	5	3.65%

As for the prevalence of SMI, construction workers have a higher rate than 1) management, business, and financial operations, 2) professional and related occupations, 6) farming, fishing, forestry, and 8) installation, repair, and maintenance.

The range of covariate age is from 18 years old to 65 years old and it is categorized into three levels-18 to 24, 25 to 44 and 45 to 65 in this analysis. The marriage status is divided into two categories “Married” and “Not married”, which combines the “Widowed”, “Divorced”, “Separated”, “Never married” and “Member of unmarried couple”.

The smoking status is categorized into two levels-current smoker and current non-smoker. The former group contains those who report current daily or occasionally smoking and the latter contains those who report no current smoking or never smoked.

The information for gender, race and ethnicity, highest education degree, annual family income, perceived general health, physical activity, binge drinking, had stroke, had asthma, health insurance coverage and housing status is extracted from the source without any other computation.

4.2.2 Descriptive Analysis

At state level, the distributions of all the covariates among non-construction and construction workers stay consistent from 2011 to 2016, except annual family income, health insurance coverage and housing status. Thus, the overall summary of the variables is presented in Table 9. The yearly summaries from 2011 to 2016 are included in the appendix from Table 14 to Table 19.

As for the distribution of age (Figure 14), people aged from 28 to 44 contribute to a higher percentage of the construction labor force, which is 45% compared with 40% of non-construction labor force.

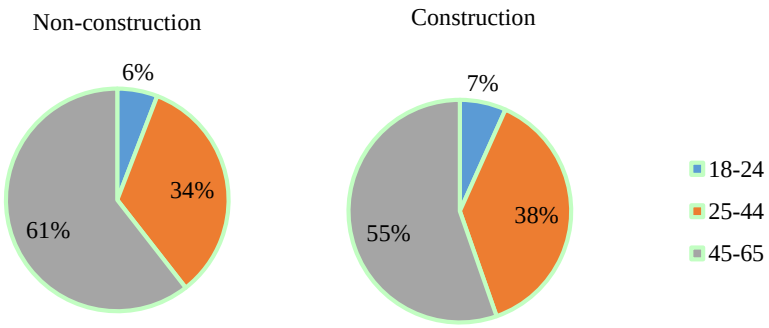

Figure 14 Distribution of age (At WA level, 2011-2016)

As for the distribution of gender, it is skewed in construction industry compared with other industries as a whole. Female workers only contribute to 7% of the overall construction labor force.

As for the distribution of race, there is little difference between the construction and non-construction labor force. As for the ethnic group, construction industry has a higher percentage of Hispanic workers compared with the rest industries as a whole, with 11% Hispanic workers in construction industry compared to 7% in non-construction industries.

As for the marriage status, construction workers have a slightly lower marriage rate of 57%, while the non-construction workers have a marriage rate of 61%.

As for the highest education obtained (Figure 15), majority of the construction workers are high school graduates or have some college or technical school education, which contributes to 76% of the construction labor force, compared with 46% in the non-construction labor force.

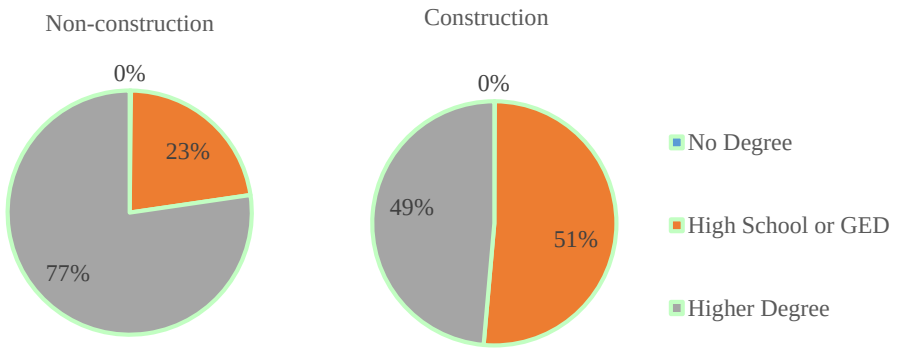

Figure 15 Distribution of education (At WA level, 2011-2016)

As for the annual family income (Figure 16), construction workers have a higher percentage in the annual family income category less than 50k. On average, 41% construction workers fall into this category, compared with 33% in non-construction workers. At the same time, a significant increase in the proportion of the workers who has an annual family income greater than 75k can be identifies

in both groups. 31% construction workers and 42% non-construction workers fall into this category in 2011 while 42% construction workers and 52% non-construction workers in 2016. The annual family income from 2011 to 2016 is presented in Figure 17.

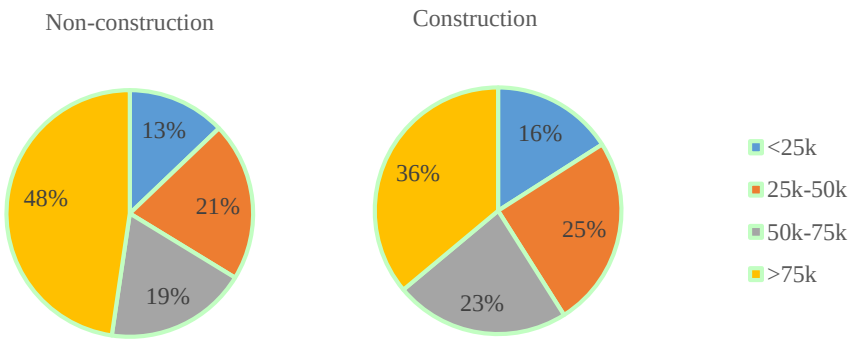

Figure 16 Distribution of annual family income (At WA level, 2011-2016)

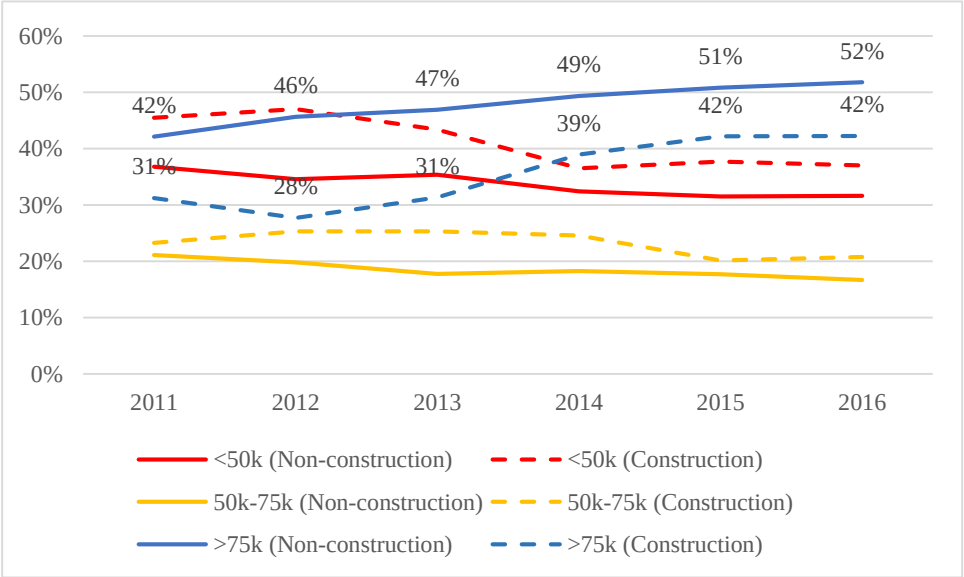

Figure 17 Annual family income non-construction vs. construction (At WA level, 2011-2016)

As for the perceived general health (Figure 18), the ratings of fair or poor consist of a slightly higher proportion in construction workers (12%) compared with non-construction workers (9%). Based on the BMI index, 70% of the construction labor force is overweight or obese, while it is 64% for the rest of the industries. In terms of smoking, construction workers have a higher rate with 23% construction

workers are current smokers, compared with 13% in non-construction workers (Figure 19). Construction workers also have a higher proportion of heavy alcohol consumption, with 11% compared to 7% in non-construction workers. In terms of physical activity, construction workers are considered to be less physically active, with a rate of 80% compared to 85% in the non-construction workers.

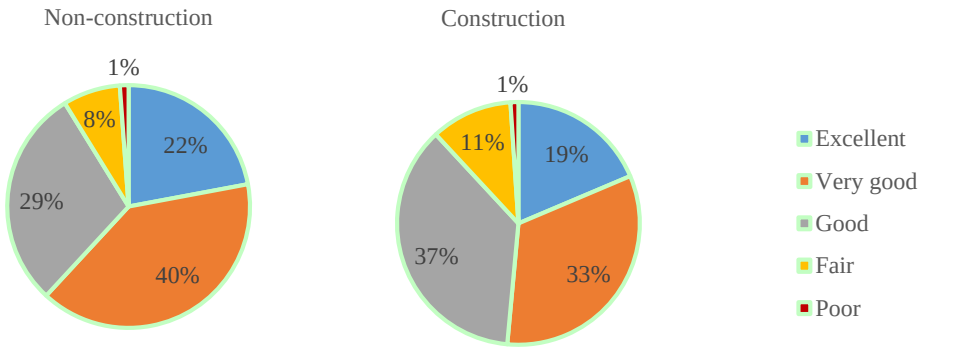

Figure 18 Distribution of perceived general health (At WA level, 2011-2016)

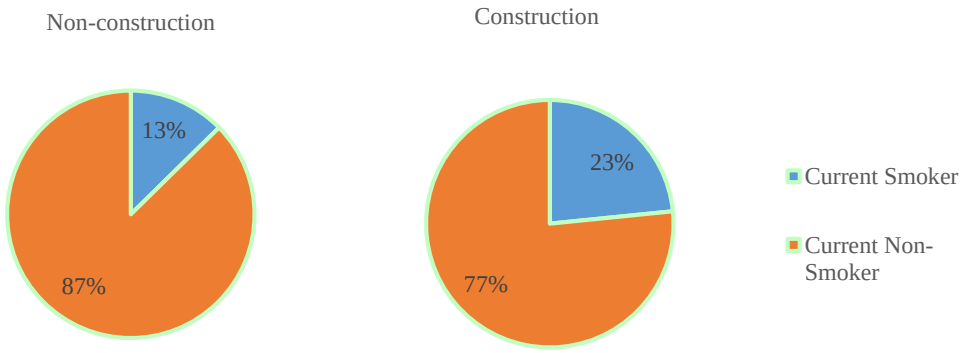

Figure 19 Distribution of current smoking status (At WA level, 2011-2016)

As for other health status, the distributions are similar in the two groups, except construction workers seem to have lower asthma rate (10%) compared with the non-construction workers (14%).

As for the health insurance coverage (Figure 20), the uninsured rate is higher in the construction industry, with 23% construction workers uninsured, while the uninsured rate is only 11% in the non-construction industries. Meanwhile, a significant decrease in the rate of uninsured construction workers can be

identified, which dropped from 27% in 2011 to 16% in 2016. The health insurance coverage rate from 2011 to 2016 is presented in Figure 21.

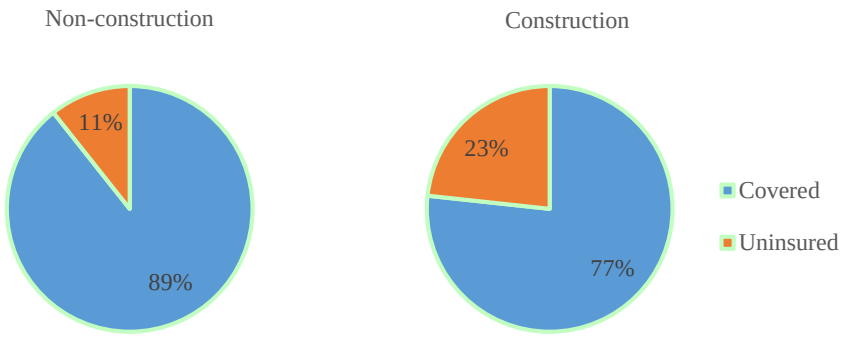

Figure 20 Trend of health insurance coverage (At WA level, 2011-016)

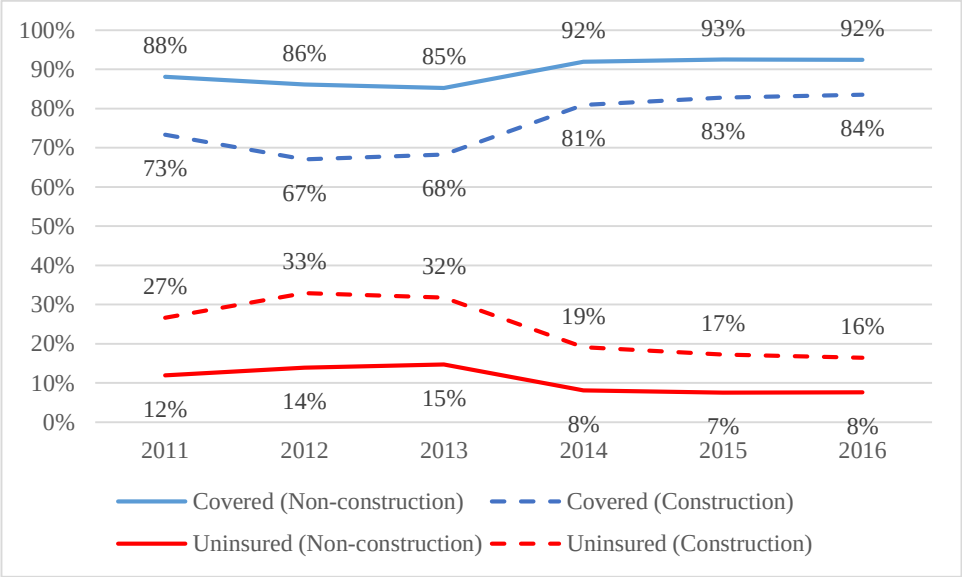

Figure 21 Health insurance coverage rate in non-construction vs. construction (At WA level, 2011-2016)

As for housing status (Figure 22), construction workers tend to have a higher rate of renting their home rather than owning it. 31% construction workers rent their home and 67% own their home, while 24% non-construction workers rent their home and 74% own their home. Meanwhile a significant decrease in the percentage of owning home is identified in both groups. 80% construction workers and 78% non-construction workers own their home in 2011 while 62% of the former group and 69% of the latter group own their home in 2016. The housing status from 2011 to 2016 is presented in Figure 23.

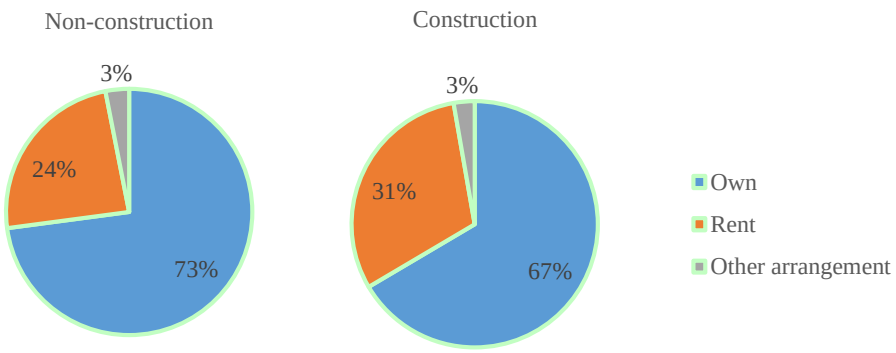

Figure 22 Distribution of housing status (At WA level, 2011-2016)

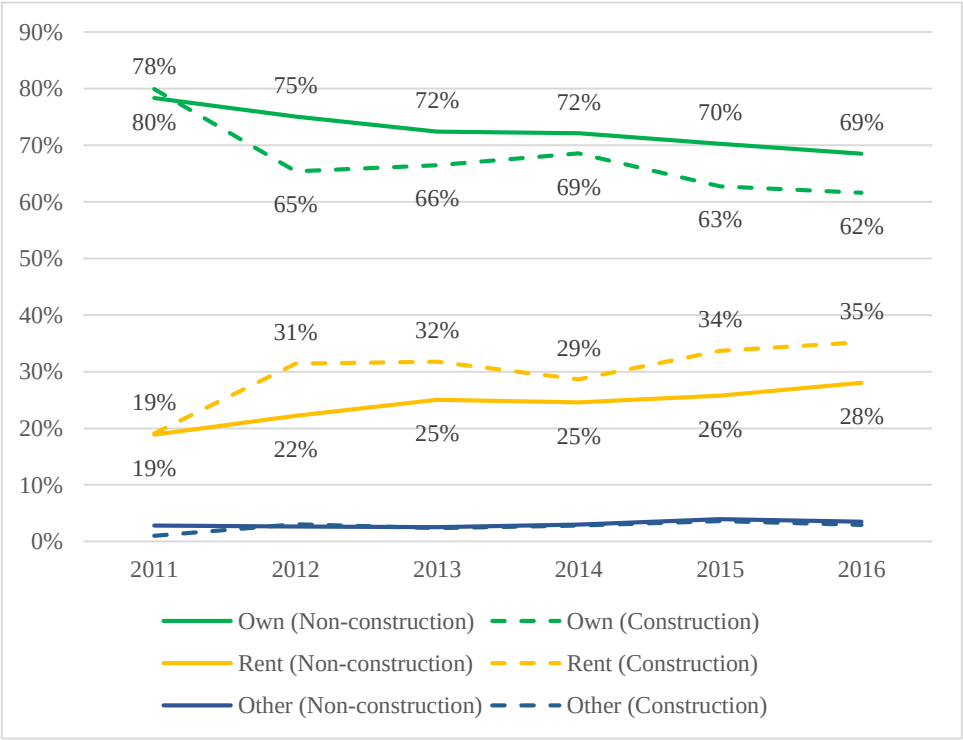

Figure 23 Trend of housing status in non-construction vs. construction (At WA level, 2011-2016)

As for type of building people live in, the information is not available in 2011. Based on the data from 2012 to 2016, construction workers and non-construction workers have very close distribution on average.

Table 9 Descriptive Summary of All the Variables (At WA level, 2011-2016)

	Non-construction	%	Construction	%
Age				
18-24	1853	6%	96	7%
25-44	10640	34%	542	38%
45-65	19166	61%	791	55%
Gender				
Male	14647	46%	1324	93%
Female	17012	54%	105	7%
Race				
White	26861	87%	1199	86%
Black	628	2%	18	1%
American Indian/Alaska Native	386	1%	27	2%
Asian	1169	4%	22	2%
Pacific Islander	185	1%	4	0%
Other race	1005	3%	85	6%
Multiple races reported	737	2%	41	3%
Ethic group				
Hispanic	2359	7%	156	11%
Not Hispanic	29139	93%	1264	89%
Marriage status				
Married	19236	61%	812	57%
Not married	12290	39%	609	43%
Highest degree				
None or kindergarten	55	0%	1	0%
Grade 1-8	516	2%	43	3%
Grade 9-11	796	3%	89	6%
Grade 12 or GED	5811	18%	601	42%
College 1-3 years	8945	28%	482	34%
College 4 years or more	15505	49%	212	15%
Annual family income				
<10k	445	2%	32	2%
10k-15k	594	2%	28	2%
15k-20k	1047	4%	69	5%
20k-25k	1642	6%	80	6%
25k-35k	2346	8%	114	9%
35k-50k	3696	13%	214	16%
50k-75k	5396	19%	300	23%
>75k	13812	48%	472	36%
Perceived general health				

Excellent	6978	22%	266	19%
Very good	12597	40%	469	33%
Good	9279	29%	523	37%
Fair	2416	8%	155	11%
Poor	367	1%	15	1%
Obesity				
Under weight	353	1%	6	0%
Normal	10331	35%	419	30%
Overweight	10780	36%	580	42%
Obesity	8237	28%	383	28%
Smoking status				
Current smoker	3930	13%	326	23%
Current non-smoker	27165	87%	1067	77%
Heavy alcohol consumption				
Yes	2274	7%	149	11%
No	28407	93%	1222	89%
Physical activity				
Physically active	26394	85%	1113	80%
Physically inactive	4609	15%	281	20%
CHD				
Had CHD	509	2%	30	2%
Not had CHD	31072	98%	1390	98%
Stroke				
Had stroke	299	1%	19	1%
Not had stroke	31318	99%	1406	99%
Asthma				
Had asthma	4367	14%	139	10%
Not had asthma	27177	86%	1282	90%
Health insurance				
Covered	28193	89%	1087	77%
Uninsured	3367	11%	330	23%
Housing condition				
Own	22917	73%	946	67%
Rent	7570	24%	436	31%
Other arrangement	976	3%	39	3%
Building Type (2012-2016)				
Mobile home	1565	6%	125	10%
Detached one-family house	19963	77%	905	75%
Attached home (duplex/etc)	849	3%	53	4%
Building with 1 - 4 apts/condos	712	3%	37	3%
Building with 5 + apts/condos	2510	10%	76	6%

Apt/Condo, units unknown	33	0%	0	0%
Other	232	1%	8	1%

4.2.3 Inferential Analysis

The linear regression model is used to compare the mean of K6 score among the non-construction and construction labor force. The logistic regression model is used to compare the odd of having SMI among the two groups mentioned above. In both models, all the covariates are adjusted as factors and the results are presented in Table 10. For every categorical variable, the first category is considered as the control group with which the rest categories are compared, thus results related to the linear and logistic regression are not presented for these control groups in the result section.

Table 10 Mean K6 Score and OR of SMI among two groups with covariates adjusted (At WA level, 2011-2016

	K6 Score				OR of SMI			
	Est	95% CI	Pr(>|t|)	Pr(>F)	e(Est)	95% CI	Pr(>|t|)	Pr(>F)
Occupation				0.414				0.672
Non-construction								
Construction	-0.07	(-0.251, 0.103)	0.414		0.89	(0.532, 1.502)	0.672	
Year				**<0.001**				**0.001**
2011								
2012	-0.02	(-0.141, 0.098)	0.721		1.69	(1.122, 2.553)	**0.012**	
2013	0.08	(-0.054, 0.206)	0.254		1.83	(1.191, 2.807)	**0.006**	
2014	0.22	(0.082, 0.358)	**0.002**		1.90	(1.213, 2.967)	**0.005**	
2015	-0.03	(-0.147, 0.096)	0.676		1.25	(0.805, 1.957)	0.316	
2016	-0.13	(-0.262, -0.003)	**0.045**		2.22	(1.454, 3.390)	**<0.001**	
Age				**<0.001**				**0.019**
18-24								
25-44	-0.45	(-0.681, -0.216)	**<0.001**		0.72	(0.492, 1.067)	0.103	
45-65	-0.98	(-1.211, -0.745)	**<0.001**		0.58	(0.388, 0.867)	**0.008**	
Gender				**<0.001**				**<0.001**
Male								
Female	0.33	(0.252, 0.404)	**<0.001**		1.48	(1.183, 1.862)	**<0.001**	
Race				0.149				0.887
White								
Black	-0.15	(-0.420, 0.125)	0.288		0.75	(0.361, 1.550)	0.435	
American Indian/Alaska Native	0.15	(-0.237, 0.541)	0.442		0.79	(0.364, 1.698)	0.540	
Asian	-0.25	(-0.452, -0.049)	**0.015**		0.81	(0.399, 1.654)	0.567	
pacific Islander	-0.29	(-0.834, 0.250)	0.291		0.35	(0.046, 2.592)	0.302	
Other race	-0.01	(-0.291, 0.277)	0.962		0.90	(0.461, 1.742)	0.746	

Multiple races reported	0.11	(-0.160, 0.376)	0.430		0.95	(0.532, 1.707)	0.871	
Ethic group				**0.002**				0.219
Hispanic								
Not Hispanic	0.33	(0.126, 0.543)	**0.002**		1.43	(0.809, 2.514)	0.219	
Marriage status				**<0.001**				**<0.001**
Married								
Not married	0.42	(0.339, 0.510)	**<0.001**		1.65	(1.289, 2.125)	**<0.001**	
Highest degree				**<0.001**				**<0.001**
None or Kindergarten								
Grade 1-8	-1.15	(-2.811, 0.515)	0.176		112711.93	(30869.850, 411533.552)	**<0.001**	
Grade 9-11	0.12	(-1.529, 1.771)	0.886		310213.90	(118517.106, 811972.777)	**<0.001**	
Grad 12 or GED	0.15	(-1.480, 1.771)	0.861		272356.99	(108811.364, 681714.897)	**<0.001**	
College 1-3 years	0.35	(-1.271, 1.979)	0.669		325483.15	(128696.374, 823172.218)	**<0.001**	
College 4 years or more	0.50	(-1.130, 2.120)	0.551		278775.37	(109129.630, 712141.231)	**<0.001**	
Annual family income				**<0.001**				**<0.001**
<10k								
10k-15k	-0.49	(-1.108, 0.137)	0.126		0.78	(0.421, 1.444)	0.429	
15k-20k	-0.68	(-1.258, -0.107)	**0.020**		0.68	(0.392, 1.179)	0.169	
20k-25k	-1.07	(-1.613, -0.530)	**<0.001**		0.67	(0.392, 1.137)	0.137	
25k-35k	-1.34	(-1.865, -0.816)	**<0.001**		0.48	(0.284, 0.806)	**0.006**	
35k-50k	-1.48	(-1.994, -0.961)	**<0.001**		0.45	(0.269, 0.762)	**0.003**	
50k-75k	-1.70	(-2.208, -1.183)	**<0.001**		0.30	(0.171, 0.522)	**<0.001**	
>75k	-1.72	(-2.234, -1.211)	**<0.001**		0.25	(0.141, 0.433)	**<0.001**	
Perceived general health				**<0.001**				**<0.001**
Excellent								
Very good	0.57	(0.496, 0.651)	**<0.001**		2.33	(1.410, 3.861)	**<0.001**	

Good	1.23	(1.128, 1.329)	**<0.001**		4.72	(2.867, 7.780)	**<0.001**	
Fair	2.86	(2.642, 3.072)	**<0.001**		13.08	(7.757, 22.048)	**<0.001**	
Poor	4.97	(4.285, 5.660)	**<0.001**		35.77	(19.639, 65.166)	**<0.001**	
Obesity				**<0.001**				**0.007**
Under weight								
Normal	-0.52	(-1.001, -0.047)	**0.031**		0.36	(0.195, 0.666)	**0.001**	
Overweight	-0.65	(-1.130, -0.173)	**0.008**		0.33	(0.180, 0.622)	**<0.001**	
Obesity	-0.70	(-1.186, -0.221)	**0.004**		0.35	(0.189, 0.656)	**<0.001**	
Smoke				**<0.001**				**<0.001**
Smoke								
Not smoke	-0.65	(-0.790, -0.511)	**<0.001**		0.60	(0.466, 0.763)	**<0.001**	
Heavy alcohol consumption				**<0.001**				**<0.001**
Yes								
No	-0.63	(-0.784, -0.472)	**<0.001**		0.55	(0.411, 0.748)	**<0.001**	
Physical activity				0.732				0.858
Physically active								
Physically inactive	-0.02	(-0.140, 0.098)	0.732		1.02	(0.798, 1.311)	0.858	
CHD				0.216				0.167
Had CHD								
Not had CHD	0.20	(-0.116, 0.515)	0.216		1.72	(0.798, 3.697)	0.167	
Stroke				0.100				0.127
Had stroke								
Not had stroke	-0.42	(-0.923, 0.079)	0.099		0.60	(0.314, 1.154)	0.127	
Asthma				**<0.001**				**<0.001**
Had asthma								
Not had asthma	-0.59	(-0.711, -0.473)	**<0.001**		0.64	(0.504, 0.816)	**<0.001**	
Health insurance				0.373				0.900

Covered								
Uninsured	0.07	(-0.087, 0.233)	0.373		1.02	(0.760, 1.367)	0.899	
Housing condition				**<0.001**				0.638
Own								
Rent	0.28	(0.164, 0.390)	**<0.001**		1.12	(0.863, 1.451)	0.398	
Other arrangement	0.43	(0.129, 0.732)	**0.005**		0.96	(0.550, 1.676)	0.887	

As for the K6 score, no significant difference is identified between construction workers and non-construction workers ($p=0.414$) with all covariates adjusted. The construction workers have a mean K6 score 0.07-point lower than the non-construction workers (95%CI: -0.251, 0.103).

As for the covariate age, those among 25-44 or 45-65 tend to have a significantly lower K6 score ($p<0.001$). People from 25-44 have a mean K6 score 0.45-point lower than those from 18-24 (95%CI: -0.681,-0.216) and people from 45-65 have a mean K6 score 0.98-point lower than those from 18-24 (95%CI: -1.211, -0.745).

As for gender, female tend to have a significantly higher K6 score ($p<0.001$), which is 0.33-point higher than that among male (95%CI: 0.252, 0.404). As for the ethic group, the non- Hispanic tend to have a significantly higher K6 score ($p=0.002$), which is 0.33-point higher that that among the Hispanic (95%CI: 0.126, 0.543).

As for the annual family income, the mean K6 score in the group of 15k-20k or higher is significantly lower than that in the group with annual family income less than 10k ($p<0.05$). The difference in the mean K6 score in these groups is 0.68-point (95%CI: -1.258, -0.107), 1.07-point (95%CI: -1.613, -0.530), 1.34-point (95%CI: -1.865,-0.816), 1.48-point (95%CI: -1.994. -0.961), 1.70-point (95%CI: -2.208,-1.183) and 1.72-point (95%CI: -2.234,-1.211) lower than the lowest category. As for the housing status, those who rent their house tend to have a significantly higher K6 score ($p<0.001$), which is estimated to be 0.28-point higher than those who own their house (95% CI: 0.164, 0.390).

As for smoking status, current non-smokers tend to have a significantly lower K6 score compared with the current smokers ($p<0.001$). It is estimated that the mean K6 score of the former group is 0.65-point lower than that among the latter group (95% CI: -0.790,-0.511).

For other covariates, they are also significantly associated with the mean K6 score, except the covariates race, physical activity, had CHD, had stroke and health insurance coverage.

As for the odds of SMI, with all covariates adjusted, no significant difference is identified between construction workers and non-construction workers (p=0.672). The odds among construction workers is 89% of the odds among non-construction workers (95%CI: 0.532, 1.502).

As for the covariate age, only those among 45-65 tend to have a significantly lower odds of SMI (p=0.008). The odds among people from 45-65 is 58% of the odds among those from 18-24 (95%CI: 0.388, 0.867).

As for gender, female tend to have a significantly higher odds of having SMI (p<0.001), which is 1.48 times the odds among male (95%CI: 1.183, 1.862). However, as for the ethic group, the non-Hispanic do not have a significantly higher odds of having SMI (p=0.219) compared with the Hispanic.

As for the annual family income, the odds of SMI in the group of 25k-35k or higher is significantly lower than that in the group of less than 10k. The odds of SMI in these groups is 48% (95%CI: 0.284, 0.806), 45% (95%CI: 0.269, 0.762), 30% (95%CI: 0.171, 0.522) and 25% (95%CI: 0.141, 0.433) of the odds in the lowest category. As for the housing status, no significant difference is found in the odds of SMI among those who own their house and those who rent their house (p=0.638).

As for smoking status, current non-smokers tend to have a significantly lower odds of SMI compared with the current smokers (p<0.001). It is estimated that odds in the former group is 60% of the odds in the latter group (95% CI: 0.466, 0.763).

For other covariates, they are also significantly associated with SMI, except the covariates race, physical activity, had CHD, had stroke and health insurance coverage.

5 Reflections on the Existing Data Sets

At the national level, permanent construction workers tend to have a significantly lower mean K6 score compared with non-construction workers. Temporary construction workers are found to have a higher mean K6 score than the permanent construction workers, though the difference is not significant at the 0.05 significant level. In terms of the odds of SMI, permanent construction workers are found to have significantly lower odds of SMI compared with non-construction workers. Temporary construction workers are found to have a higher odds of SMI than the permanent construction workers, though the difference is not significant at the 0.05 significant level, either.

At the state level, the information on the status of employment is unavailable, thus the comparisons of the mean K6 score and odds of SMI are conducted only between construction workers and non-construction workers. The results suggest that construction workers have a slightly lower mean K6 score and a slightly lower odds of SMI, and both of them are insignificant. Based on the results from the national level analysis, it is plausible that temporary construction workers may have a higher K6 score and odds of SMI in Washington State, too. Thus it would be worthwhile to collect the temporary employment information at the state level to have a better understanding of this population.

One potential explanation to the significant, lower mean K6 score and odds of SMI found only at the national level between non- and permanent construction workers could be the discrepancy in terms of the occupation categorization. Although both MEPS and BRFSS-WA categorize the respondents' occupation based on the Standard Occupational Classification (SOC), they use different strategies to present the information. With MEPS, people's occupation information is initially coded at the 4-digit level and it is condensed into broader groups for the protection of confidentiality. The same situation occurs with BRFSS-WA where the detailed occupation groups are aggregated by the Washington State Department of Labor and Industries. Thus at the national level, construction, extraction and maintenance are considered as one category while at the state level, construction and extraction are combined as one category but maintenance is in another category along with installation and repair. Based on the analysis of BRFSS-WA, combing people from maintenance with those from construction and extraction at the national level may considerably lower the mean K6 score and odds of SMI for this occupation category. Because at the state level, the mean K6 score of construction and extraction workers is 2.80

but 2.27 for the installation, repair and maintenance workers. Similarly, the prevalence of SMI of construction and extraction workers is 1.7% but 0.9% for the installation, repair and maintenance workers. It would be beneficial if both data sources use the same strategy to present the information, or make the data available at a more detailed level. In addition, one drawback of condensing the occupation information is losing the variation among different trades under the same occupation category and obscuring the profile of the occupation as a whole. For instance, the work condition of construction and building inspectors are very different from that of sheet metal workers, thus it is reasonable to speculate variance of the mental health performance between these two trades. It would be beneficial to have the detailed occupation information available in case when analysis done at the trade level is warranted.

Apart from the difference in terms of occupation categorization, the discrepancy between these two data sources also exists when it comes to variable nomenclature. For instance, both MEPS and BRFSS-WA collect information on the K6 score, however, the score is named as the Kessler Index by the former and as the Serious Mental Illness Index score by the latter. It would be beneficial if such variables are named in a way that is widely agreed in the field, which can ultimately increase the efficiency of data access and integration.

The discontinuity in the data collection is also found in the MEPS and BRFSS-WA. For instance, in MEPS, the information of the highest degree obtained by the respondents is collected from 2008 to 2015 except for 2013 and 2014. In BRFSS, the information of housing types the respondents live in is collected from 2008 to 2016, except for 2011. It would be helpful to have continuous information available for trend analysis.

Besides, in order to increase the utilization of data sources, it is crucial to step outside the box by looking into non-typical data sources. For instance, information on the temporary employment status is collected in MEPS whose major interest is on medical expenditures. Information on occupational and housing status is collected in BRFSS-WA whose focus is on people's health changes. Information of such secondary nature can easily be overlooked because it sits quietly along with a variety of other information and scatters across different data sources.

The knowledge to leverage this type of information hidden in non-typical data sources can be potentially very helpful to the research community at large, if the knowledge can be somehow documented, accumulated and disseminated. Ideally, mapping out the different data sources and providing ways for data integration will enable the scholars and stakeholders to better understand the social, economic, or even environmental factors impacting the construction workforce.

6 Conclusion

This research looks into the influence of temporary employment on the mental health of construction workers under the emerging U.S. social-economic environment. Data from MEPS and BREFF-WA were extracted and analyzed for this research purpose, with potential covariates such as income, housing, and lifestyle behaviors being adjusted.

Regardless of the employment status, the general construction workers' profile indicates a disadvantaged population compared with the non-construction workers. Although being a construction worker is not found to be associated with a significantly worse mental health performance at both the national and the state level, a construction worker does tend to have exposure to the industry characteristics which make him/her more prone to the negative outcome. For all the covariates such as age, highest education degree obtained, annual family income, perceived general health and smoking status which are identified with a significant negative association with the mental health performance, construction workers are always in worse conditions compared with non-construction workers.

Furthermore, temporary employment status is found to be associated with worse mental health performance within the construction industry. Temporary construction workforce tends to have higher mean K6 score and higher odds of SMI when compared with permanent construction workforce at the national level. Although the differences are not statistically significant, it might be due to aggregating maintenance workers with construction and extraction workers. With regard to the negative factors and when compared with permanent construction workers, temporary construction workforce consists of even younger workers, with lower education degree obtained, lower family income, poorer self-rated overall health and higher current smoking rate. Although there is no information available on the temporary employment in the BRFSS-WA data set, it is reasonable to speculate a worse mental health performance in temporary construction workers in the Washington State. However, due to the lack of data resource, it is still unclear what roles other typical temporary employment features (e.g. higher job insecurity or exposure to hazardous work conditions) play in undermining the mental health of this population. Moreover, there is no unitary method that can address the issue at once, since the characteristics identified are inherent to this population and require the efforts from all the stakeholders.

In order to promote the general wellbeing of the construction workers, more research efforts are required to raise the awareness and strengthen the understanding of the mentally demanding nature of the construction occupation. There has been insufficient research done to address the mental health aspect of the construction industry and attention has been dominantly focused on physical health. It is worthwhile for future studies to look into how different trades are possibly associated with better or worse mental health performance, how the construction industry specific characteristics like physical demands, long working hours, work-life conflicts etc., reshape the mental health aspect of the workforce, and how the mental health interacts with other major outcomes of interest such as productivity, injury rate, safety climate etc. before proper interventions could be devised to promote the mental health of the construction workers.

Meanwhile, it is also unacceptable if the flexibility guaranteed by the temporary employment is taken for granted. The variance in the labor force demand is one typical characteristic that distinguishes the construction industry from the other. It is beneficial for all stakeholders to address the issues coming along since it is an indispensable element in the overall workforce with which proactive management is better than ignorance. It is worthwhile for future studies to explore whether the negative impact of temporary employment is further escalated by the construction industry characteristics and how these factors are associated with other outcomes of interest.

Last but not the least, more effort is also required in the data collection process since it is the fundamental step toward valid and reliable analysis and interpretation. The incompleteness, inconsistency and discontinuity undermine the chances of such analysis. It is also going to improve the work efficiency of the researchers if the data set can be aggregated by standardized coding and documentation without unnecessary repetition, which will optimize the utilization of the data resource in turn.

7 Bibliography

Arndt, V., D. Rothenbacher, U. Daniel, B. Zschenderlein, S. Schuberth, and H. Brenner. "Construction work and risk of occupational disability: a ten year follow up of 14 474 male workers." Occupational and environmental medicine 62, no. 8 (2005): 559-566.

Barbeau, Elizabeth, M. Li, Yi Calderon, Patricia Hartman, Cathy Quinn, Margaret Markkanen, Pia Roelofs, Cora Frazier, and Lindsay Levenstein. "Results of a Union-based Smoking Cessation Intervention for Apprentice Iron Workers (United States)." Cancer Causes & Control 17, no. 1 (2006): 53-61.

Bodner, Todd, Mariah Kraner, Brittany Bradford, Leslie Hammer, and Donald Truxillo. "Safety, health, and well-being of municipal utility and construction workers." Journal of occupational and environmental medicine 56, no. 7 (2014): 771-778.

Borstad, John D., Blake Buetow, Emily Deppe, Jonas Kyllonen, Marie Liekhus, Cort J. Cieminski, and Paula M. Ludewig. "A Longitudinal Analysis of the Effects of a Preventive Exercise Programme on the Factors That Predict Shoulder Pain in Construction Apprentices." Ergonomics 52, no. 2 (2009): 232-44

Boschman, Van Der Molen, Sluiter, and Frings-Dresen. "Psychosocial Work Environment and Mental Health among Construction Workers." Applied Ergonomics 44, no. 5 (2013): 748-55.

Caban, Alberto J., David J. Lee, Lora E. Fleming, Orlando Gómez-Marín, William LeBlanc, and Terry Pitman. "Obesity in US workers: The national health interview survey, 1986 to 2002." American Journal of Public Health 95, no. 9 (2005): 1614-1622.

Coffeng, Jennifer K., Cécile RL Boot, Saskia FA Duijts, Jos WR Twisk, Willem van Mechelen, and Ingrid JM Hendriksen. "Effectiveness of a worksite social & physical environment intervention on need for recovery, physical activity and relaxation; results of a randomized controlled trial." PloS one 9, no. 12 (2014): e114860.

Dong, Xiuwen, Wang Xuanwen, and Katz Rebecca. "The construction chart book." USA: CPWR-The Center for Construction Research and Training (2018).

Dong XS, Wang X, Largay JA. “Second quarter data report: Temporary workers in the construction industry.” USA: CPWR-The Center for Construction Research and Training (2015).

Eriksen, H. R., C. Ihlebaek, A. Mikkelsen, H. Grønningsæter, G. M. Sandal, and H. Ursin. "Improving subjective health at the worksite: a randomized controlled trial of stress management training, physical exercise and an integrated health programme." Occupational Medicine 52, no. 7 (2002): 383-391.

Fan, Z. J., Bonauto, D. K., Foley, M. P., Anderson, N. J., Yragui, N. L., & Silverstein, B. A. (2012). Occupation and the prevalence of current depression and frequent mental distress, WA BRFSS 2006 and 2008. American Journal of Industrial Medicine, 55(10), 893-903.

Hammer, Leslie B., Truxillo, Donald M., Bodner, Todd, Rineer, Jennifer, Pytlovany, Amy C., and Richman, Amy. "Effects of a Workplace Intervention Targeting Psychosocial Risk Factors on Safety and Health Outcomes." BioMed Research International, 2015, BioMed Research International, Annual, 2015.

Kessler, Ronald C., Gavin Andrews, Lisa J. Colpe, Eva Hiripi, Daniel K. Mroczek, S-LT Normand, Ellen E. Walters, and Alan M. Zaslavsky. "Short screening scales to monitor population prevalences and trends in non-specific psychological distress." Psychological medicine 32, no. 6 (2002): 959-976.

Kessler, Ronald C., Patricia A. Berglund, Shanyang Zhao, Philip J. Leaf, Anthony C. Kouzis, Martha L. Bruce, Robert M. Friedman et al. "The 12-month prevalence and correlates of serious mental illness (SMI)." Mental Health, United States 5600 (1996).

Maes, Stan, Chris Verhoeven, France Kittel, and Hetty Scholten. "Effects of a Dutch work-site wellness-health program: the Brabantia Project." American journal of public health 88, no. 7 (1998): 1037-1041.

Olson, Ryan, Robert R. Wright, Diane L. Elliot, Jennifer A. Hess, Sharon Thompson, Annie Buckmaster, Kristy Luther, and Brad Wipfli. "The COMPASS pilot study: a Total Worker

Health™ intervention for home care workers." Journal of occupational and environmental medicine 57, no. 4 (2015): 406-416.

Palumbo, Mary Val, Ge Wu, Hollie Shaner-McRae, Betty Rambur, and Barbara McIntosh. "Tai Chi for older nurses: a workplace wellness pilot study." Applied Nursing Research 25, no. 1 (2012): 54-59.

Roberts, Hodgson, and Dolan. ""It's Driving Her Mad": Gender Differences in the Effects of Commuting on Psychological Health." Journal of Health Economics 30, no. 5 (2011): 1064-076.

Silla, Inmaculada, Francisco J Gracia, and Jos éMar á Peir ó. "Job Insecurity and Health-Related Outcomes among Different Types of Temporary Workers." Economic and Industrial Democracy 26, no. 1 (2005): 89-117.

Sorensen, Glorian, Elizabeth Barbeau, M. Stoddard, Anne Hunt, Mary Goldman, Kay Smith, Roberta Brennan, and Ann Wallace. "Tools for Health: The Efficacy of a Tailored Intervention Targeted for Construction Laborers." Cancer Causes & Control 18, no. 1 (2007): 51-59.

Szumilas, Magdalena. "Explaining odds ratios." Journal of the Canadian academy of child and adolescent psychiatry 19, no. 3 (2010): 227.

Talton, Jon. "Washington State Saw the Hottest GDP Growth in U.S. Last Year." The Seattle Times, May 17, 2017. Accessed June 4, 2018. https://www.seattletimes.com/business/economy/state-saw-the-hottest-gdp-growth-in-u-s-last-year/.

Torres, Blanca. "Washington State Ranks No. 1 for Combined Job and Wage Growth." The Seattle Times, February 16, 2016. Accessed June 4, 2018. https://www.seattletimes.com/business/economy/employment-and-wage-growth-in-washington-outpacing-other-states/.

U.S. Department of Health & Human Services, " Health-Related Quality of Life: Well-Being Concepts", Center for Disease and Control (CDC). https://www.cdc.gov/hrqol/wellbeing.htm#one (accessed April 1, 2018)

U.S. Department of Health & Human Services, "2014 Poverty Guidelines", Office of the Assistant Secretary for Planning and Evaluation (ASPE). https://aspe.hhs.gov/2014-poverty-guidelines (accessed March 27, 2018)

U.S. Department of Health & Human Services, "Medical Expenditure Panel Survey", the Agency for Healthcare Research and Quality (AHRQ) . https://meps.ahrq.gov/mepsweb/about_meps/survey_back.jsp (accessed March 27, 2018)

U.S. Department of Health & Human Services, "Total Worker Health", the National Institute for Occupational Safety and Health (NIOSH). https://www.cdc.gov/niosh/twh/totalhealth.html (accessed March 27, 2018)

U.S. Department of Health & Human Services, "Stress at Work", the National Institute for Occupational Safety and Health (NIOSH). https://www.cdc.gov/niosh/docs/99-101/default.html (accessed June 1, 2018)

U.S. Department of Labor, "Occupational Employment Statistics", the Bureau of Labor Statistics. https://www.bls.gov/oes/oes_emp.htm (accessed April 1, 2018)

U.S. Department of Health & Human Services, "What is mental health", the MentalHealth.gov. https://www.mentalhealth.gov/basics/what-is-mental-health (accessed June 1, 2018)

Virtanen, Marianna, Kivimki, Mika, Joensuu, Matti, Virtanen, Pekka, Elovainio, Marko, and Vahtera, Jussi. "Temporary Employment and Health: A Review." International Journal of Epidemiology 34, no. 3 (2005): 610-22.

Wang Xuanwen, Katz Rebecca, and Dong, Xiuwen. "Fourth quarter data report: Health, Healthcare, and Medical Expenditures among Construction Workers." USA: CPWR-The Center for Construction Research and Training (2016).

Washington State Department of Health (WSDOH), “Behavioral Risk Factor Surveillance System”. https://www.doh.wa.gov/DataandStatisticalReports/DataSystems/BehavioralRiskFactorSurveillanceSystemBRFSS-WA (accessed March 27, 2018)

8 Appendix

Table 11 Descriptive Summary of All the Variables (At national level, 2008)

	Non-construction	%	Permanent construction	%	temporary construction	%
Age						
28-24	1618	13%	128	11%	26	16%
25-44	5976	48%	642	54%	91	58%
45-65	4971	40%	413	35%	41	26%
Gender						
Male	5853	47%	1151	97%	154	97%
Female	6712	53%	32	3%	4	3%
Race						
White	8908	71%	1010	85%	138	87%
Black	2314	18%	123	10%	10	6%
American Indian/Alaska Native	128	1%	8	1%	2	1%
Asian	946	8%	26	2%	2	1%
Native Hawaiian/Pacific Islander	51	0%	1	0%	1	1%
Multiple races reported	218	2%	15	1%	5	3%
Ethic group						
Hispanic	3125	25%	431	36%	109	69%
Not Hispanic	9440	75%	752	64%	49	31%
Marriage status						
Married	7089	56%	749	63%	75	47%
Not married	5475	44%	434	37%	83	53%
Highest degree						
No Degree	1932	16%	329	28%	85	54%
GED	482	4%	65	6%	7	4%
High School Diploma	5476	44%	622	53%	52	33%
Bachelor's Degree	2321	19%	61	5%	3	2%
Master's Degree	931	7%	11	1%	3	2%
Doctorate Degree	244	2%	0	0%	0	0%
Other Degree	1075	9%	88	7%	7	4%
Annual personal wage						
<25k	5605	45%	482	41%	100	63%
25k-50k	4065	32%	474	40%	47	30%
50k-75k	1670	13%	154	13%	9	6%
75k-100k	683	5%	40	3%	2	1%
>100k	542	4%	33	3%	0	0%
Annual family income						
<25k	2209	18%	227	19%	57	36%

25k-50k	3328	26%	363	31%	53	34%
50k-75k	2474	20%	259	22%	28	18%
75k-100k	1753	14%	154	13%	12	8%
>100k	2801	22%	180	15%	8	5%
Poverty status						
Poor/Negative	1144	9%	128	11%	34	22%
Near poor	573	5%	62	5%	15	9%
Low income	1882	15%	189	16%	29	18%
Middle income	4170	33%	445	38%	61	39%
High income	4796	38%	359	30%	19	12%
Perceived general health						
Excellent	3299	26%	296	25%	54	34%
Very good	4459	36%	404	34%	45	28%
Good	3730	30%	370	31%	39	25%
Fair	921	7%	95	8%	19	12%
Poor	147	1%	18	2%	1	1%
Obesity						
Under weight	184	2%	7	1%	0	0%
Normal	4031	33%	295	25%	33	22%
Overweight	4310	35%	530	46%	82	55%
Obesity	3701	30%	326	28%	34	23%
Smoke status						
Current smoker	2071	19%	308	30%	41	29%
Current non-smoker	9021	81%	731	70%	100	71%
Physical activity						
Physically active	7139	57%	720	61%	67	43%
Physically inactive	5281	43%	454	39%	90	57%
CHD						
Had CHD	255	2%	29	2%	5	3%
Not had CHD	12304	98%	1153	98%	153	97%
Stroke						
Had stroke	153	1%	9	1%	1	1%
Not had stroke	12406	99%	1173	99%	157	99%
Asthma						
Had asthma	977	8%	63	5%	10	6%
Not had asthma	11584	92%	1119	95%	148	94%
Health insurance						
Covered by any private insurance	9315	74%	732	62%	30	19%
Covered by public insurance only	847	7%	48	4%	18	11%
Uninsured	2403	19%	403	34%	110	70%

Table 12 Descriptive Summary of All the Variables (At national level, 2012)

	Non-construction	%	Permanent construction	%	temporary construction	%
Age						
28-24	1802	13%	80	6%	19	12%
25-44	6753	47%	665	53%	89	54%
45-65	5732	40%	510	41%	57	35%
Gender						
Male	6701	47%	1219	97%	163	99%
Female	7586	53%	36	3%	2	1%
Race						
White	9800	69%	1042	83%	143	87%
Black	2810	20%	140	11%	14	8%
American Indian/Alaska Native	107	1%	10	1%	2	1%
Asian	1268	9%	42	3%	4	2%
Native Hawaiian/Pacific Islander	76	1%	4	0%	2	1%
Multiple races reported	226	2%	17	1%	0	0%
Ethic group						
Hispanic	4030	28%	504	40%	106	64%
Not Hispanic	10257	72%	751	60%	59	36%
Marriage status						
Married	7433	52%	757	60%	71	43%
Not married	6854	48%	498	40%	94	57%
Highest degree						
No Degree	995	14%	149	24%	21	30%
GED	230	3%	35	6%	5	7%
High School Diploma	3015	44%	358	57%	36	51%
Bachelor's Degree	1359	20%	40	6%	4	6%
Master's Degree	547	8%	0	0%	1	1%
Doctorate Degree	174	3%	0	0%	0	0%
Other Degree	576	8%	51	8%	3	4%
Annual personal wage						
<25k	6222	44%	447	36%	118	72%
25k-50k	4499	31%	518	41%	36	22%
50k-75k	1984	14%	197	16%	6	4%
75k-100k	817	6%	57	5%	2	1%
>100k	765	5%	36	3%	3	2%
Annual family income						
<25k	2551	18%	217	17%	74	45%

25k-50k	3729	26%	387	31%	39	24%
50k-75k	2826	20%	291	23%	22	13%
75k-100k	1890	13%	164	13%	12	7%
>100k	3291	23%	196	16%	18	11%
Poverty status						
Poor/Negative	1374	10%	129	10%	39	24%
Near poor	689	5%	68	5%	22	13%
Low income	2396	17%	219	17%	38	23%
Middle income	4777	33%	464	37%	38	23%
High income	5051	35%	375	30%	28	17%
Perceived general health						
Excellent	3914	27%	294	23%	55	33%
Very good	5165	36%	434	35%	47	28%
Good	4031	28%	403	32%	50	30%
Fair	1024	7%	109	9%	12	7%
Poor	146	1%	14	1%	1	1%
Obesity						
Under weight	189	1%	7	1%	2	1%
Normal	4686	34%	286	23%	44	27%
Overweight	4901	35%	519	43%	81	50%
Obesity	4206	30%	409	33%	36	22%
Smoke status						
Current smoker	2107	16%	284	25%	37	25%
Current non-smoker	10766	84%	854	75%	110	75%
Physical activity						
Physically active	7254	51%	749	60%	99	60%
Physically inactive	6855	49%	496	40%	65	40%
CHD						
Had CHD	237	2%	28	2%	1	1%
Not had CHD	14044	98%	1227	98%	164	99%
Stroke						
Had stroke	141	1%	7	1%	0	0%
Not had stroke	14140	99%	1248	99%	165	100%
Asthma						
Had asthma	1137	8%	73	6%	9	5%
Not had asthma	13147	92%	1182	94%	156	95%
Health insurance						
Covered by any private insurance	9969	70%	738	59%	41	25%
Covered by public insurance only	1116	8%	61	5%	17	10%
Uninsured	3202	22%	456	36%	107	65%

Table 13 Descriptive Summary of All the Variables (At national level, 2015)

	Non-construction	%	Permanent construction	%	temporary construction	%
Age						
28-24	1712	13%	84	8%	30	14%
25-44	6477	47%	521	51%	125	57%
45-65	5490	40%	419	41%	65	30%
Gender						
Male	6529	48%	1003	98%	213	97%
Female	7150	52%	21	2%	7	3%
Race						
White	9288	68%	856	84%	187	85%
Black	2618	19%	100	10%	22	10%
American Indian/Alaska Native	107	1%	15	1%	2	1%
Asian	733	5%	20	2%	2	1%
Native Hawaiian/Pacific Islander	478	3%	13	1%	0	0%
Multiple races reported	455	3%	20	2%	7	3%
Ethic group						
Hispanic	4002	29%	463	45%	141	64%
Not Hispanic	9677	71%	561	55%	79	36%
Marriage status						
Married	6793	50%	609	59%	103	47%
Not married	6886	50%	415	41%	117	53%
Highest degree						
No Degree	950	13%	126	23%	46	44%
GED	268	4%	49	9%	10	10%
High School Diploma	3176	44%	288	53%	38	36%
Bachelor's Degree	1410	19%	26	5%	3	3%
Master's Degree	641	9%	2	0%	0	0%
Doctorate Degree	159	2%	3	1%	0	0%
Other Degree	643	9%	53	10%	8	8%
Annual personal wage						
<25k	5770	42%	317	31%	118	54%
25k-50k	4307	31%	441	43%	72	33%
50k-75k	1900	14%	171	17%	26	12%
75k-100k	848	6%	70	7%	3	1%
>100k	854	6%	25	2%	1	0%
Annual family income						
<25k	2362	17%	149	15%	64	29%

25k-50k	3369	25%	316	31%	74	34%
50k-75k	2563	19%	226	22%	44	20%
75k-100k	1920	14%	167	16%	13	6%
>100k	3465	25%	166	16%	25	11%
Poverty status						
Poor/Negative	1290	9%	92	9%	44	20%
Near poor	631	5%	57	6%	12	5%
Low income	2117	15%	159	16%	48	22%
Middle income	4586	34%	412	40%	82	37%
High income	5055	37%	304	30%	34	15%
Perceived general health						
Excellent	3642	27%	275	27%	63	29%
Very good	4825	35%	340	33%	55	25%
Good	3965	29%	301	29%	70	32%
Fair	1075	8%	94	9%	27	12%
Poor	132	1%	14	1%	4	2%
Obesity						
Under weight	141	1%	11	1%	2	1%
Normal	3278	25%	194	20%	43	21%
Overweight	3632	27%	347	35%	79	38%
Obesity	6292	47%	433	44%	85	41%
Smoke status						
Current smoker	1632	14%	201	24%	39	22%
Current non-smoker	9829	86%	643	76%	140	78%
Physical activity						
Physically active	7029	52%	627	62%	116	53%
Physically inactive	6422	48%	382	38%	102	47%
CHD						
Had CHD	198	1%	19	2%	8	4%
Not had CHD	13455	99%	1004	98%	211	96%
Stroke						
Had stroke	165	1%	7	1%	0	0%
Not had stroke	13490	99%	1017	99%	219	100%
Asthma						
Had asthma	1145	8%	41	4%	10	5%
Not had asthma	12512	92%	982	96%	209	95%
Health insurance						
Covered by any private insurance	9989	73%	623	61%	75	34%
Covered by public insurance only	1720	13%	85	8%	34	15%
Uninsured	1970	14%	316	31%	111	50%

Table 14 Descriptive Summary of All the Variables (At WA level, 2011)

	Non-construction	%	Construction	%
Age				
18-24	205	4%	10	5%
25-44	1664	31%	63	32%
45-65	3536	65%	127	64%
Gender				
Male	2334	43%	174	87%
Female	3071	57%	26	13%
Race				
White	4684	90%	172	90%
Black	76	1%	1	1%
American Indian/Alaska Native	54	1%	4	2%
Asian	161	3%	4	2%
Pacific Islander	22	0%	0	0%
Other race	115	2%	5	3%
Multiple races reported	112	2%	6	3%
Ethic group				
Hispanic	389	7%	16	8%
Not Hispanic	5008	93%	183	92%
Marriage status				
Married	3427	64%	126	63%
Not married	1967	36%	74	37%
Highest degree				
None or kindergarten	7	0%	0	0%
Grade 1-8	110	2%	4	2%
Grade 9-11	135	2%	11	6%
Grade 12 or GED	989	18%	93	47%
College 1-3 years	1618	30%	60	30%
College 4 years or more	2542	47%	32	16%
Annual family income				
<10k	41	1%	1	1%
10k-15k	92	2%	1	1%
15k-20k	157	3%	4	2%
20k-25k	345	7%	17	9%
25k-35k	469	9%	21	11%
35k-50k	729	15%	42	22%
50k-75k	1052	21%	44	23%
>75k	2098	42%	59	31%
Perceived general health				

Excellent	1222	23%	38	19%
Very good	2100	39%	60	30%
Good	1581	29%	73	37%
Fair	439	8%	25	13%
Poor	58	1%	3	2%
Obesity				
Under weight	45	1%	1	1%
Normal	1800	35%	65	33%
Overweight	1866	37%	81	41%
Obesity	1389	27%	49	25%
Smoking status				
Current smoker	675	13%	51	26%
Current non-smoker	4704	87%	149	75%
Heavy alcohol consumption				
Yes	365	7%	19	10%
No	4902	93%	175	90%
Physical activity				
Physically active	4387	82%	150	75%
Physically inactive	941	18%	50	25%
CHD				
Had CHD	83	2%	2	1%
Not had CHD	5304	98%	197	99%
Stroke				
Had stroke	51	1%	3	2%
Not had stroke	5349	99%	196	98%
Asthma				
Had asthma	697	13%	22	11%
Not had asthma	4685	87%	176	89%
Health insurance				
Covered	4752	88%	146	73%
Uninsured	643	12%	53	27%
Housing condition				
Own	4201	78%	159	80%
Rent	1011	19%	38	19%
Other arrangement	151	3%	2	1%

Table 15 Descriptive Summary of All the Variables (At WA level, 2012)

	Non-construction	%	Construction	%
Age				
18-24	361	6%	15	6%
25-44	2182	34%	105	40%
45-65	3905	61%	144	55%
Gender				
Male	3049	47%	248	94%
Female	3399	53%	16	6%
Race				
White	5519	87%	215	83%
Black	109	2%	4	2%
American Indian/Alaska Native	62	1%	3	1%
Asian	214	3%	4	2%
Pacific Islander	45	1%	1	0%
Other race	257	4%	26	10%
Multiple races reported	133	2%	7	3%
Ethic group				
Hispanic	437	7%	34	13%
Not Hispanic	5984	93%	229	87%
Marriage status				
Married	3902	61%	149	56%
Not married	2521	39%	115	44%
Highest degree				
None or kindergarten	12	0%	0	0%
Grade 1-8	101	2%	8	3%
Grade 9-11	155	2%	21	8%
Grade 12 or GED	1191	18%	102	39%
College 1-3 years	1898	29%	92	35%
College 4 years or more	3085	48%	41	16%
Annual family income				
<10k	106	2%	7	3%
10k-15k	123	2%	6	2%
15k-20k	239	4%	16	6%
20k-25k	305	5%	19	8%
25k-35k	518	9%	24	10%
35k-50k	768	13%	45	18%
50k-75k	1181	20%	63	25%
>75k	2721	46%	69	28%
Perceived general health				

Excellent	1388	22%	42	16%
Very good	2570	40%	85	32%
Good	1884	29%	103	39%
Fair	512	8%	30	11%
Poor	88	1%	4	2%
Obesity				
Under weight	74	1%	2	1%
Normal	2146	35%	78	30%
Overweight	2259	37%	105	40%
Obesity	1684	27%	78	30%
Smoking status				
Current smoker	901	14%	52	20%
Current non-smoker	5505	86%	209	80%
Heavy alcohol consumption				
Yes	445	7%	20	8%
No	5893	93%	234	92%
Physical activity				
Physically active	5528	86%	212	80%
Physically inactive	916	14%	52	20%
CHD				
Had CHD	125	2%	9	3%
Not had CHD	6306	98%	255	97%
Stroke				
Had stroke	68	1%	3	1%
Not had stroke	6374	99%	261	99%
Asthma				
Had asthma	845	13%	30	11%
Not had asthma	5581	87%	232	89%
Health insurance				
Covered	5542	86%	177	67%
Uninsured	891	14%	87	33%
Housing condition				
Own	4812	75%	172	65%
Rent	1430	22%	83	31%
Other arrangement	171	3%	8	3%
Building Type				
Mobile home	406	6%	36	14%
Detached one-family house	4970	78%	191	73%
Attached home (duplex/etc)	188	3%	13	5%
Building with 1 - 4 apts/condos	184	3%	8	3%
Building with 5 + apts/condos	558	9%	12	5%

Apt/Condo, units unknown	0	0%	0	0%
Other	105	2%	3	1%

Table 16 Descriptive Summary of All the Variables (At WA level, 2013)

	Non-construction	%	Construction	%
Age				
18-24	304	7%	12	7%
25-44	1561	34%	62	36%
45-65	2680	59%	99	57%
Gender				
Male	2082	46%	162	94%
Female	2463	54%	11	6%
Race				
White	3879	87%	145	84%
Black	99	2%	2	1%
American Indian/Alaska Native	73	2%	3	2%
Asian	156	3%	3	2%
Pacific Islander	29	1%	0	0%
Other race	148	3%	12	7%
Multiple races reported	95	2%	7	4%
Ethic group				
Hispanic	307	7%	18	11%
Not Hispanic	4215	93%	153	89%
Marriage status				
Married	2701	60%	93	54%
Not married	1820	40%	79	46%
Highest degree				
None or kindergarten	8	0%	0	0%
Grade 1-8	69	2%	6	3%
Grade 9-11	99	2%	10	6%
Grade 12 or GED	841	19%	64	37%
College 1-3 years	1291	28%	68	39%
College 4 years or more	2231	49%	25	14%
Annual family income				
<10k	86	2%	2	1%
10k-15k	99	2%	5	3%
15k-20k	168	4%	16	10%
20k-25k	270	6%	8	5%
25k-35k	327	8%	13	8%
35k-50k	539	13%	28	17%
50k-75k	748	18%	42	25%
>75k	1977	47%	52	31%

Perceived general health				
Excellent	1031	23%	27	16%
Very good	1833	40%	58	34%
Good	1300	29%	66	38%
Fair	319	7%	21	12%
Poor	58	1%	1	1%
Obesity				
Under weight	57	1%	1	1%
Normal	1540	36%	54	32%
Overweight	1537	36%	70	41%
Obesity	1183	27%	44	26%
Smoking status				
Current smoker	588	13%	43	25%
Current non-smoker	3902	87%	126	75%
Heavy alcohol consumption				
Yes	340	8%	28	17%
No	4103	92%	141	83%
Physical activity				
Physically active	3704	85%	124	77%
Physically inactive	664	15%	38	23%
CHD				
Had CHD	63	1%	6	3%
Not had CHD	4471	99%	166	97%
Stroke				
Had stroke	31	1%	1	1%
Not had stroke	4509	99%	171	99%
Asthma				
Had asthma	650	14%	12	7%
Not had asthma	3888	86%	161	93%
Health insurance				
Covered	3863	85%	116	68%
Uninsured	667	15%	54	32%
Housing condition				
Own	3269	72%	115	66%
Rent	1133	25%	54	32%
Other arrangement	115	3%	4	2%
Building Type				
Mobile home	289	6%	18	10%
Detached one-family house	3453	76%	131	76%
Attached home (duplex/etc)	164	4%	6	3%
Building with 1 - 4 apts/condos	118	3%	8	5%

Building with 5 + apts/condos	456	10%	9	5%
Apt/Condo, units unknown	0	0%	0	0%
Other	41	1%	1	1%

Table 17 Descriptive Summary of All the Variables (At WA level, 2014)

	Non-construction	%	Construction	%
Age				
18-24	240	6%	19	11%
25-44	1255	32%	67	37%
45-65	2397	62%	94	52%
Gender				
Male	1737	45%	170	94%
Female	2155	55%	10	6%
Race				
White	3318	87%	163	91%
Black	84	2%	1	1%
American Indian/Alaska Native	53	1%	3	2%
Asian	138	4%	3	2%
Pacific Islander	22	1%	0	0%
Other race	95	3%	8	4%
Multiple races reported	89	2%	2	1%
Ethic group				
Hispanic	291	8%	16	9%
Not Hispanic	3580	92%	164	91%
Marriage status				
Married	2394	62%	101	57%
Not married	1476	38%	76	43%
Highest degree				
None or kindergarten	5	0%	1	1%
Grade 1-8	63	2%	4	2%
Grade 9-11	83	2%	12	7%
Grade 12 or GED	671	17%	77	43%
College 1-3 years	1053	27%	60	33%
College 4 years or more	2015	52%	26	14%
Annual family income				
<10k	59	2%	6	4%
10k-15k	80	2%	5	3%
15k-20k	138	4%	5	3%
20k-25k	174	5%	10	6%
25k-35k	269	7%	16	10%
35k-50k	450	12%	19	11%
50k-75k	659	18%	41	25%
>75k	1780	49%	65	39%
Perceived general health				

Excellent	841	22%	40	22%
Very good	1512	39%	56	31%
Good	1179	30%	67	37%
Fair	318	8%	16	9%
Poor	39	1%	1	1%
Obesity				
Under weight	57	2%	1	1%
Normal	1235	34%	52	30%
Overweight	1328	36%	81	46%
Obesity	1048	29%	42	24%
Smoking status				
Current smoker	451	12%	37	21%
Current non-smoker	3330	88%	138	79%
Heavy alcohol consumption				
Yes	282	8%	22	13%
No	3461	92%	150	87%
Physical activity				
Physically active	3390	87%	152	84%
Physically inactive	501	13%	28	16%
CHD				
Had CHD	64	2%	1	1%
Not had CHD	3819	98%	178	99%
Stroke				
Had stroke	34	1%	6	3%
Not had stroke	3847	99%	174	97%
Asthma				
Had asthma	569	15%	20	11%
Not had asthma	3304	85%	159	89%
Health insurance				
Covered	3563	92%	144	81%
Uninsured	313	8%	34	19%
Housing condition				
Own	2760	72%	122	69%
Rent	953	25%	51	29%
Other arrangement	115	3%	5	3%
Building Type				
Mobile home	222	6%	22	12%
Detached one-family house	3011	79%	130	73%
Attached home (duplex/etc)	115	3%	3	2%
Building with 1 - 4 apts/condos	99	3%	4	2%
Building with 5 + apts/condos	350	9%	17	10%

Apt/Condo, units unknown	0	0%	0	0%
Other	25	1%	1	1%

Table 18 Descriptive Summary of All the Variables (At WA level, 2015)

	Non-construction	%	Construction	%
Age				
18-24	404	7%	20	7%
25-44	2028	34%	118	38%
45-65	3556	59%	169	55%
Gender				
Male	2819	47%	284	93%
Female	3169	53%	23	7%
Race				
White	4997	85%	260	88%
Black	128	2%	3	1%
American Indian/Alaska Native	89	2%	8	3%
Asian	256	4%	3	1%
Pacific Islander	40	1%	1	0%
Other race	206	4%	14	5%
Multiple races reported	135	2%	7	2%
Ethic group				
Hispanic	513	9%	33	11%
Not Hispanic	5433	91%	272	89%
Marriage status				
Married	3617	61%	169	56%
Not married	2345	39%	135	44%
Highest degree				
None or kindergarten	14	0%	0	0%
Grade 1-8	86	1%	7	2%
Grade 9-11	167	3%	16	5%
Grade 12 or GED	1066	18%	136	44%
College 1-3 years	1619	27%	104	34%
College 4 years or more	3029	51%	44	14%
Annual family income				
<10k	88	2%	9	3%
10k-15k	113	2%	4	1%
15k-20k	185	3%	12	4%
20k-25k	293	5%	15	6%
25k-35k	394	7%	19	7%
35k-50k	612	11%	42	16%
50k-75k	947	18%	54	20%
>75k	2722	51%	113	42%
Perceived general health				

Excellent	1324	22%	57	19%
Very good	2443	41%	90	29%
Good	1732	29%	122	40%
Fair	424	7%	36	12%
Poor	65	1%	2	1%
Obesity				
Under weight	51	1%	1	0%
Normal	1941	35%	87	29%
Overweight	2002	36%	127	43%
Obesity	1519	28%	81	27%
Smoking status				
Current smoker	707	12%	75	25%
Current non-smoker	5103	88%	220	75%
Heavy alcohol consumption				
Yes	453	8%	35	12%
No	5279	92%	257	88%
Physical activity				
Physically active	4715	84%	226	80%
Physically inactive	881	16%	57	20%
CHD				
Had CHD	96	2%	9	3%
Not had CHD	5882	98%	294	97%
Stroke				
Had stroke	55	1%	4	1%
Not had stroke	5924	99%	302	99%
Asthma				
Had asthma	844	14%	29	10%
Not had asthma	5115	86%	275	90%
Health insurance				
Covered	5521	93%	250	83%
Uninsured	447	7%	52	17%
Housing condition				
Own	4196	70%	192	63%
Rent	1540	26%	103	34%
Other arrangement	237	4%	11	4%
Building Type				
Mobile home	360	6%	27	9%
Detached one-family house	4596	77%	230	76%
Attached home (duplex/etc)	189	3%	18	6%
Building with 1 - 4 apts/condos	149	3%	7	2%
Building with 5 + apts/condos	609	10%	18	6%

Apt/Condo, units unknown	20	0%	0	0%
Other	35	1%	2	1%

Table 19 Descriptive Summary of All the Variables (At WA level, 2016)

	Non-construction	%	Construction	%
Age				
18-24	339	6%	20	7%
25-44	1950	36%	127	42%
45-65	3092	57%	158	52%
Gender				
Male	2626	49%	286	94%
Female	2755	51%	19	6%
Race				
White	4464	85%	244	82%
Black	132	3%	7	2%
American Indian/Alaska Native	55	1%	6	2%
Asian	244	5%	5	2%
Pacific Islander	27	1%	2	1%
Other race	184	3%	20	7%
Multiple races reported	173	3%	12	4%
Ethic group				
Hispanic	422	8%	39	13%
Not Hispanic	4919	92%	263	87%
Marriage status				
Married	3195	60%	174	57%
Not married	2161	40%	130	43%
Highest degree				
None or kindergarten	9	0%	0	0%
Grade 1-8	87	2%	14	5%
Grade 9-11	157	3%	19	6%
Grade 12 or GED	1053	20%	129	42%
College 1-3 years	1466	27%	98	32%
College 4 years or more	2603	48%	44	14%
Annual family income				
<10k	65	1%	7	3%
10k-15k	87	2%	7	3%
15k-20k	160	3%	16	6%
20k-25k	255	5%	11	4%
25k-35k	369	8%	21	8%
35k-50k	598	12%	38	14%
50k-75k	809	17%	56	21%
>75k	2514	52%	114	42%
Perceived general health				

Excellent	1172	22%	62	20%
Very good	2139	40%	120	39%
Good	1603	30%	92	30%
Fair	404	8%	27	9%
Poor	59	1%	4	1%
Obesity				
Under weight	69	1%	0	0%
Normal	1669	34%	83	29%
Overweight	1788	36%	116	40%
Obesity	1414	29%	89	31%
Smoking status				
Current smoker	608	12%	68	23%
Current non-smoker	4621	88%	225	77%
Heavy alcohol consumption				
Yes	389	8%	25	9%
No	4769	92%	265	91%
Physical activity				
Physically active	4670	87%	249	82%
Physically inactive	706	13%	56	18%
CHD	5		0	
Had CHD	78	1%	3	1%
Not had CHD	5290	99%	300	99%
Stroke				
Had stroke	60	1%	2	1%
Not had stroke	5315	99%	302	99%
Asthma				
Had asthma	762	14%	26	9%
Not had asthma	4604	86%	279	91%
Health insurance				
Covered	4952	92%	254	84%
Uninsured	406	8%	50	16%
Housing condition				
Own	3679	69%	186	62%
Rent	1503	28%	107	35%
Other arrangement	187	3%	9	3%
Building Type				
Mobile home	288	6%	22	8%
Detached one-family house	3933	76%	223	77%
Attached home (duplex/etc)	193	4%	13	4%
Building with 1 - 4 apts/condos	162	3%	10	3%
Building with 5 + apts/condos	537	10%	20	7%

Apt/Condo, units unknown	13	0%	0	0%
Other	26	1%	1	0%