University of Nevada, Reno

Health Status and Behaviors among Casino Gaming Employees

Population-based Epidemiological Analyses

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Environmental Sciences and Health

By

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**Health Status and Behaviors among Casino Gaming Employees
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Abstract

Background: Previous studies reported the health effects associated with such harmful occupational exposures as environmental tobacco smoke (ETS), stress, working shift and noise. Currently more than 300,000 employees in the US who are working on the casino gaming floor potentially exposed to these working environment hazards. However, research on health conditions among the casino gaming employees is extremely limited. The present project is the first study which utilizes statewide population-based survey data to analyze health status and behaviors among the casino gaming employees in Nevada, which has more than 50% of the US casino operations.

Methods: General health status, chronic disease indicators, behavior risk factors and preventive indicators among Nevada respondents were collected through 2012, 2013 and 2014 Nevada Behavior Risk Factor Surveillance Systems (BRFSS). The casino gaming employment experience of respondents was asked. The complex stratified-cluster sampling method was used for data collection. In order to minimize such selection bias as non-response and non-coverage, weighing procedures and weighted multiple logistics models were conducted. Multiple imputation technique was used for handling missing values. Latent Class Analysis (LCA) was conducted to categorize the chronic disease indictors to groups with a high or low risk for chronic disease. Multilevel mixed model checked the nested cluster effects for variables from individual or community (county/region) multilevel (hierarchical) data. The statistical software M-Plus and SAS 9.4 were utilized.

Results: Among 13,646 respondents who completed the survey, 1,384 reported that they have worked on a casino gaming floor (weighted prevalence 11.2%), who reflect the 317,979 Nevada residents have ever worked on a casino gaming floor (CGFE). Results tend to suggest that CGFE is relatively less paid and with lower socioeconomic status. The groups with the highest percentage of CGFE exposure within a demographic category are Clark county (Las Vegas Area, 11.6%), female (12.3%), age group of 55-64 (16.1%), divorced (18.4%), high school or GED education (13.9%), household income at $35-49,999 (15.2%), and Race/Ethnicity as Black non-Hispanic (16.2%), respectively. In four categories total, thirty-three (33) health indicators were compared between CGFE and non-CGFE. After controlling for potential confounding factors, gaming floor employees are statistically significantly ($p<0.05$) associated with the following indicators: 1) General Health Status: Adjusted odds ratios (AOR) for fair/poor general health are 1.37 (95% CI 1.08-1.72, $p < 0.01$), experienced confusion or memory loss 1.63 (95% CI 1.21-2.19, $p =0.001$), and poor physical health (1.33, 95% CI 1.10-1.61, $p <0.001$) respectively; 2) Chronic disease Indictors: Asthma 1.32 (95% CI 1.01-1.75, $p =0.04$), COPD 1.45 (95% CI 1.06-1.96, $p=0.02$) arthritis 1.23 (95% CI 1.00-1.52, $p = 0.048$), Depression disorder 1.56 (95% CI 1.23-2.00, $p=0.000$), diabetes 1.47 (95% CI 1.09-1.96, $p=0.01$); 3) Behavior Risk Factors: Current smoking 1.52 (95% CI 1.20-1.92), binging drinking 1.37 (95% CI 1.05-1.82), heavy drinking 1.64 (95% CI 1.11-2.44), pain killer use 1.85 (95% CI 0.68-5.00) and attempting suicide 2.66 (95% CI 1.26- 5.58), respectively; 4) Preventive Health Indicators: CGFE has generally shown in positive direction with higher healthcare plans and higher preventive tests. After controlling confounding factors, most indicators no longer showed the significant difference except for HIV test 1.65 (95% CI 1.35-2.02, $p<0.0001$). CGFE is also highly associated with a high risk of chronic disease conditions (AOR=1.52, 95% CI 1.20-1.93, $p= 0.0005$).

Conclusions: People who have ever worked on a casino gaming floor (CGFE) are in relatively lower socioeconomic status. Although the current study does not provide the causal relationship, comparing to non-CGFE people, CGFE had significantly adverse effects in their health status and behavior risk factor indictors, especially in their risks for chronic diseases. Healthier employees are more productive and less costly, therefore the casino industry should be highly encouraged to work on employee quality of life assessment and motivated to minimize and eventually completely eliminate such occupational hazards as environmental tobacco smoke. In order to reveal the causal-effect relationships, further studies with advanced epidemiological designs on casino gaming floor occupational health are needed.

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Chapter 1: Background

1.1. Casino Gaming Industry in USA and Nevada

The gaming industry, as an element in the more encompassing leisure industry, is part of the fastest growing segment of the American economy of the service sector (Austrin & West, 2005). There are 48 states with legal gambling facilities in the United States, which approximately have 1,543 gambling facilities including casinos, horseracing tracks, greyhound tracks, sports betting parlous. In 2014, the casino gaming gross gaming revenue was $37.95 billion (UNLV center For Gaming Research, 2015). During the past 22 years, the casino work force has increased more than 67%, gaming equipment employ people from 198,657 in 1990 to 332,075 in 2012 (AGA, 2012). In 2014, there were 733,930 people directly employed by the gambling industry in the United States and this number is steadily growing as more states seek to legalize casinos (America casino guide: U.S. Casinos, 2015).

Nevada is the seventh largest state (by area) in the nation and is comprised of 17 counties spread across 110,540 square miles. It is a frontier state with 2.8 million residents (Nevada State Demographer) and is traditionally divided into three regions: Clark County (72.3% of the population, which includes the city of Las Vegas), Washoe County (15.2% of the population, which includes the city of Reno), and the balance of state in the rural and frontier counties (12.5% of the population). The vast space separating the rural, frontier, and urban areas is emphasized when one considers that the seven eastern states of New Hampshire, Vermont, New Jersey, Massachusetts, Delaware, Rhode Island, and Connecticut geographically fit within Nevada's borders. Between 2005 and 2014, the state of Nevada had a 16.5% increase in population, Clark County 18.9% increase, Washoe County a 10.3% increase, and the balance of state a 11.5% increase. With this growth, Nevada's population is becoming more racially diverse. The American Indian, Eskimo, or Aleut population increased 20.3% in the ten-year period from 2005 to 2014; the Asian/Pacific Islander population increased 26.0%, the Black population 13.6%, Hispanics 36.6% and Whites 7.9%.

Nevada has the largest gaming industries in the United State (total 337 gambling facilities (World casino directory, 2015). Its economy is heavily based on tourism, especially the industries of gambling and resort centered in Las Vegas, Reno and Lake Tahoe. Gambling taxes are a primary source of state revenue. The service sector employs about half of Nevada's workers. Nevada casinos are the most important component in the development of tourism destinations. In 2012, casino employees in Nevada were 170,206, more than 50% of total US Casino employees (AGA, 2012). There have been tremendous changes in Nevada's gaming industry from 1984 to 2014, many of which are reflected in its annual revenue figures. During that period, Statewide Gaming Revenues, total revenues have increased by 262%. (Nevada Gaming Revenues, 1984-2014, 2015).

Since casino gaming industry, where the job nature and work environment are quite different from other hospitality sectors (Wan, Chan, 2013), research has noted that working in the casino industry is tense and demanding (Wan, 2010), the casino workers are often exposed to hazards, such as cigarette smoke, in enclosed areas with no windows and poor ventilation (Wan and Pilkington, 2009), irregular work hours and workplace barrage of noise. However, there is no previous population-based study ever done. This study presents analysis of the health status and behaviors among the "ever" worked on casino gaming floor employees in Nevada utilizing statewide population-based survey data.

1.2. Potential Occupational Hazards in Gaming Working Environment

1.2.1. Stress

Stress is an unpleasant but not an entirely new condition. All of us are exposed to stressful situations at the societal, community, and interpersonal level (Schneiderman, 2005). The National Institute for Occupational Safety and Health (NIOSH) reported that in a workplace, there are 40% of workers who report their job is "very or extremely stressful, 26% of workers who report they are "often or very often burned out or stressed by their work" (NIOSH, 1998).

In casino gaming section, employees have to focus on delivering exceptional service quality, creating customer satisfaction and facing with players with high expectation. In addition, gaming industry and activities are in operation seven days a week and 24 hours per day. Employees work one of three shifts. Depending on the job title, employees take a variable several breaks per shift. Weekend and holiday nights are generally more crowded (United States Department of Labor Gaming Services Occupations, 2015; Sheng-Hshiung Tsaur, Ya-Yun Tang, 2012). Most of the jobs are physically demanding.

For example, gaming dealers spend most of their shift standing behind a table. Waitress /Waiters continuously service drink/food to customers. Managers and supervisors are constantly walking up and down the casino floor. A challenge for the service industry has always been to provide quality service that satisfies consumers. With intensive interaction with customers, service workers used a variety of emotion and problem-focused strategies to cope with the demands of the performance of such labor (Chiang, et al., 2010, Anderson, et al., 2002, Hsin-Hui 'Sunny' Hu a et al, 2010). Frey and his colleagues (James H. Frey, 2008) conducted a survey among the casino workers. The respondents indicated the job is stressful with boredom, low job autonomy, close supervision, arbitrary treatment, and low job security. More specifically, 86% dealers agreed that "they never know when they will be fired". Thus, low commitment to casino work or no career anchorage in the gaming industry exists for casino workers. Other results showed that 69% of casino work felt the job is "bored", 68% "less happy", and 57% "often felt the day would never end" (George Anderson, 2007).

Casino workers reported that they have to deal with stress. Among casino worker respondents, 75% of them identified stress as a significant cause of job dissatisfaction and 50% reported "a lot" to moderate stress. The study also indicated that 15% of medical claims from casino worker are stress related (George Anderson, 2005). Another study conducted by Field and colleagues shown that casino employees are often vulnerable to a range of physical and emotional problems which include long work hours, anti-social (shift work), tolerate rude and insulting behavior (higher work stress level).

Stress response is the complex psychophysiological processes. It involves two-way communication between the brain and the cardiovascular, immune, and other systems via neural and endocrine mechanisms (Bruce S. McEwen, 2007). The most immediate response to a stressful stimulus occurs via the direct neural innervations of end organs. The intermediate stress effects are due to the neuroendocrine "fight-or- flight" axis. (George S. Everly Jr., et al., 2012)

The mechanism of stress was described by Elizabeth O. Johnson in 1992 (Figure 1) that the stress system consists of brain elements, of which the main components are the corticotropin-releasing homrone (CRH) and locus ceruleus (LC)-norepinephrine (NE)/autonomic systems, as well as their peripheral effectors, the pituitary-adrenal axis and the autonomic system, which function to coordinate the stress response. Activation of the stress system results in behavioral and physical changes which allow the organism to adapt. This system is closely integrated with other central nervous system elements involved in the regulation of behavior and emotion, in addition to the axes responsible for reproduction, growth and immunity (Elizabeth O. Johnson, 1992).

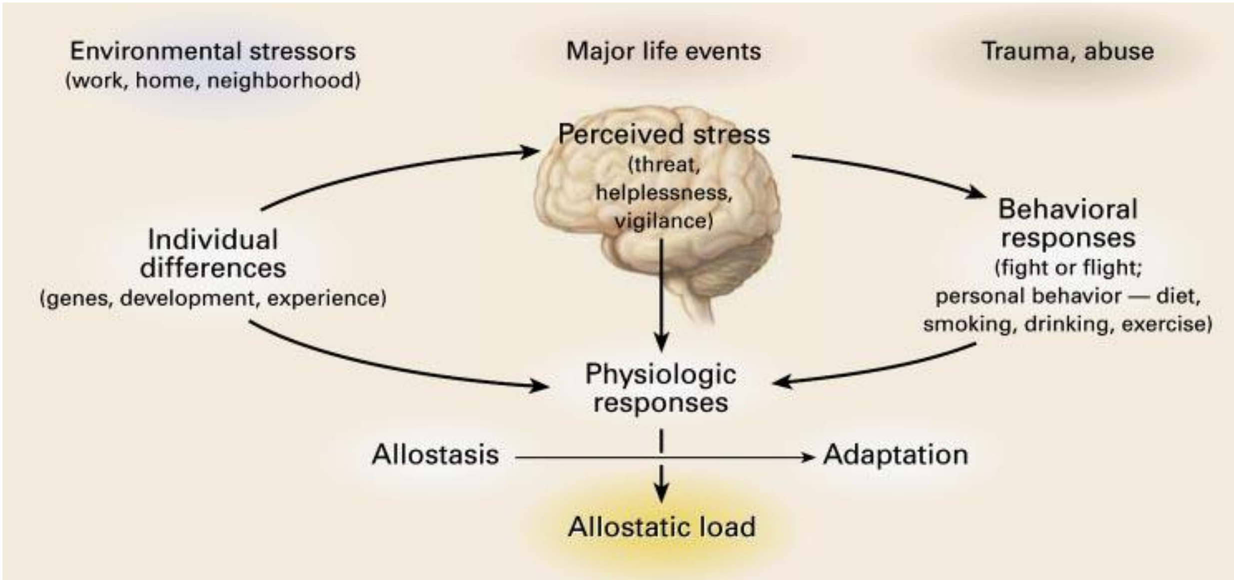

Fig 1. Central role of the brain in allostasis and the behavioral and physiological response to stressors. [From McEwen (211), copyright 1998 Massachusetts Medical Society.]

Stress can cause symptoms or consequences on behavior, cognition, and physiology. It might be associated with depression, hypertension, heart disease, anger and place employees at increased risk of morbidity and mortality (Furnham, 1997). The consequences could be classified the common symptoms of work stress into three areas: (1) physiological symptoms, (2) emotional symptoms, and (3) behavioral symptoms. Physiological symptoms of work stress can include fatigue, a decline in physical appearance, health complaints, and signs of depression. Emotional symptoms may include resentfulness and cynicism, appearance of apathy and boredom, a sad or depressed appearance, and expressions of frustration, hopelessness, and anxiety. Behavioral symptoms may entail absenteeism and tardiness, abuse of substances such as caffeine or alcohol, increased smoking, irritable or hostile behavior, and reduced productivity. (Furnham, 1997). An individual’s physical and psychological wellbeing and the characteristics of a family might affect the responses to the work stresses. As a prolonged response to chronic emotional and interpersonal stressors on the job, “burnout” is a usual form of reaction to stress and is most likely to occur among service workers unable to deal with excessive demands placed on them (Maslach et al.,2001, Stevens and Higgins 2002).

The relationship between psychosocial stressors and disease is affected by the nature, number, and persistence of the stressors as well as by the individual’s biological vulnerability (i.e., genetics, constitutional factors), psychosocial resources, and learned patterns of coping. (Neil Schneiderman, et al., 2005). McGuigan (1999) found that the early stage of stress may experience colds or minor infections, when the stress builds, the worker may begin to experience back pain, headaches, insomnia, arthritis, and skin disorders. Studies also showed that as one repeatedly reacts to events that are stressful, the disastrous effects on the body accumulate so that the individual becomes increasingly susceptible to emotional problems, accidental injuries, physical illnesses, and behavioral disorders.

1.2.2. Environmental Tobacco Smoke (ETS)

Environmental Tobacco Smoke (ETS) is also named Secondhand Smoke (SHS) (EPA). It is a strong and often predominant source of indoor $PM_{2.5}$ and the major source of public exposure to air pollution. An overview of global health threats implied that in 2010, 3.2 million people worldwide died prematurely as a result of outdoor air pollution, while 3.5

million people died prematurely because of indoor air pollution (Bob O'Keefe et al., 2012). Secondhand smoke causes an estimated 3,400 lung cancer deaths among the U.S. nonsmokers each year. At the meantime, there were still about 18% adults smoking in 2014. More than 40 million Americans caught in a web of tobacco dependence. Each day, more than 3,200 youth (younger than 18 years of age) smoke their first cigarette and another 2,100 youth and young adults who are occasional smoker progress to become daily smokers (Surgeon General Report, 2014).

American Lung Association suggested that $PM_{2.5}$ is likely the most lethal pollutant due to its ubiquity, ability to be easily inhaled and its deadly mix of chemicals. EPA concludes that fine particle pollution increases the risk of premature death from heart disease, lung disease and cancers, which are the three top causes of mortality in the U.S. Studies have proved that smoke free legislation significantly reduces the concentrations of the levels of fine particulate matter ($PM_{2.5}$) (Surgeon General, 2006; Repace, 2007). Although the indoor $PM_{2.5}$ standard is ambiguous, the U.S. Environmental Protection Agency (EPA) has dropped $PM_{2.5}$ standard for outdoor air from15 pg/m^3 to 12 pg/m^3 in 2012. On December 18, 2006, the U.S. EPA strengthened the 24-hour $PM_{2.5}$ standard from 65 µg/m^3 to 35 µg/m^3. However, $PM_{2.5}$ is the concentrations of indicators of secondhand smoke in the air of enclosed environments. In some smoking casinos, the indoor geometric means of $PM_{2.5}$ were 53.8 µg/m^3, 75 times higher than the outdoor level because of secondhand smoke. On average, at least 90% of the indoor $PM_{2.5}$ in smoking casinos is due to secondhand smoke. (Repace, 2011).

Abundant research has proved that environmental tobacco smoking exposures can cause multiple serious health effects including cancers, respiratory diseases, and cardiovascular diseases, even in the offspring of exposed parents. Good indoor air quality is crucial when a casino has a few thousands guests and a few hundreds staff on the weekends or during special events. However, the most gaming and hospitality industry is neither pro-smoking nor anti-smoking. The most casino floors are typically permit tobacco smoking by customers. These permits have resulted in greater SHS exposure among the employees who worked on casino gaming floor. Gaming services workers are often exposed to hazards of environmental tobacco smoke (ETS) from cigarettes, cigars, and pipes in enclosed areas with no windows and insufficient ventilation. The study (Maskarinec MP, 2000) found that bartenders have a 2 to 4 fold increase in secondhand smoke exposure compared to table waiting staff. At the meantime, Repace (2004) found that secondhand smoke contributed 90% to 95% of the respirable particle (RSP) air pollution during smoking, and 85% to 95% of the carcinogenic particulate polycyclic aromatic hydrocarbons (PPAH). RSP concentrations in casinos were, on average, 4 and 6 times, respectively, that of outdoor levels despite generous ventilation and low smoking prevalence (Repace, 2009).

Although there are gaming tables designated as non-smoking tables, the non-smoking tables are often located adjacent to tables where smoking is permitted. There are no physical partitions between smoking and non-smoking areas for employee cafeteria. A study indicated that in a sample of 21 smoking casinos from Reno and Las Vegas, gaming areas $PM_{2.5}$ level averaged as 45.2 mg/m^3 (95% CI, 37.7–52.7 mg/m^3) and adjacent nonsmoking casino restaurants have 27.2 mg/m3 (95% CI,17.5–36.9 mg/m^3) (Repace et al., 2011).

Studies also shown that work place exposure to $PM_{2.5}$ (ETS is a prolific source of $PM_{2.5}$ in indoor air) in the casino areas was well above what the Environmental Protection Agency (EPA) recommends as healthy. These employees, including dealers, slot attendants, racetracks, bingo parlors, managers and beverage employees, often face more severe exposure to ETS than other workforces due to weak or absent laws (Berman & Post, 2007). James L. Repace et al., (2011) have reported that about 50% of smoking casinos $PM_{2.5}$ level from ETS exceeded the level which could produce cardiovascular morbidity among nonsmokers after less than 2 hours of exposure, indicating the acute health risks towards to gaming workers.

Apparently, ventilation systems and air cleaning practices could not efficiently control $PM_{2.5}$ from ETS. Furthermore, studies indicated that employees working at the "non-smoking" tables did not have significant decreased exposure to ETS, compared with those working at smoking tables. This finding is highly corrected to the logic because these non-smoking tables were typically located directly adjacent to other tables where smoking was permitted. Non-smoking area is often un-separated from secondhand smoke contaminated areas.

Additionally, 88% of US commercial casinos and 100% of tribal casinos are exempt from state clean indoor air laws, and very few are smoke-free, since the casino industry opposes smoking bans (AGA, 2009; ANR, 2009). For example, Nevada, which has 54% of all the US commercial casinos (World Casino, 2009), prohibits smoking in casino restaurants, but permits smoking on the gaming floors. Within the past 20 years, Federal and state legislatures and city and county governments have passed laws aimed at prohibiting public smoking to reduce nonsmokers' exposure to ETS. In 2009, about 70% of the U.S. population is protected by smoke-free (SF) laws either in workplaces and/or restaurants and/or bars; however, the majority of gaming employees and patrons remain unprotected (Americans for Nonsmokers' Rights [ANR], 2009a, (ref: exposed to the demonstrable risk of secondhand smoke).

The Nevada Clean Indoor Air Act (NCIAA) was passed by a majority of Nevada voters and was effected in December, 2006. This act has provided a major change to Nevada's smoking laws in order to protect children and adults from secondhand smoke in most public places and indoor places of employment. It also allows governments of Nevada cities, counties and towns to enact smoking laws within their jurisdictions even stronger than the Nevada state law. However, lawmakers, during the 2009 and 2011 legislative sessions, have weakened the NCIAA by allowing adding exemptions to those outlined comparing to original voter-approved language in 2006. Due to these exemptions in NCIAA, smoking is still allowed in such places as gaming areas of casinos, although Casinos could decide to designate separate rooms or areas at gaming floor as non-smoking.

Numerous studies have confirmed that ETS exposures can cause multiple serous health effects such as cancer, respiratory disease, cardiovascular diseases, reproductive effects, and other specific outcomes such as diabetes, immune and autoimmune disorders etc. It also associated with all-cause mortality. Surgeon General Report has pointed out that there is no risk-free level of exposure to tobacco smoke.

There are about 19 known carcinogens in cigarette smoke. Carcinogenic mechanism of smoke includes chemical carcinogens and radioactive carcinogens. Chemical carcinogens such as pyrolytic products were found in smoke. Pyrolytic products bind to DNA and cause genetic mutations. Study shown polycyclic aromatic hydrocarbons (PAH) are toxicant to mutagenic epoxides. Among PAHs, benzo-pyrene is toxicant into an epoxide that irreversibly attaches to a cell's nuclear DNA, which may either kill the cell or cause a genetic mutation. Acrolein also irreversibly binds to DNA, causes mutations and thus also cancer. However, it needs no activation to become carcinogenic (Surgeon General Report, 2014).

In addition to chemical, nonradioactive carcinogens, tobacco and tobacco smoke contain small amounts of lead-210(210Pb) and polonium-210 (210Po) both of which are radioactive carcinogens. The combination of carcinogenic tar and radiation in a sensitive organ such as lungs increases the risk of cancer (Surgeon General Report, 2014). Also, study shown that when exposure to cigarette smoke activates an inflammatory cascade in the airway epithelium resulting in the production of a number of potent cytokines and chemokines, with accompanying damage to the lung epithelium, increased permeability, and recruitment of macrophages and neutrophils to the airway (Mio, T., 1997). Surgeon General (2010) has pointed out that low levels of exposure, including exposures to secondhand tobacco smoke, lead to a rapid and sharp increase in endothelial dysfunction and inflammation, which are implicated in acute cardiovascular events and thrombosis.

In respiratory disease, the causative role of smoking in the development of respiratory disease is well-established. The main pathological components of COPD are emphysema (the loss of gas-exchanging lung parenchyma), bronchiolitis (inflammation and fibrosis of small airways), and bronchitis accompanied by airway mucus hypersecretion. The mechanisms by which active smoking could contribute to the causation of asthma include chronic airways inflammation, impaired mucociliary clearance, impaired growth of the lungs during childhood, and increased bronchial hyper responsiveness (USDHHS 2004, 2006, 2010).

Through different combined evidences including Meta-analysis, exposure to ETS have proved to increase lung cancers incidences among non-smokers. Non-smoking co-workers of smokers have a 1.39 (39% more) relative risk than those non-smoking co-workers (A. Judson Wells, 1998). Previously, studies have focused on health effects of ETS on the respiratory system. More recent studies have found that increased risk on cancers rather than lung cancer after exposing to ETS such as cancers of cervical, bladder, nasal-sinus, and brain (surgeon’s general report, 2014).

It is been long known that heart diseases can be cause by active smoking. Studies have also found the associations between exposure to ETS exposure and heart diseases among those who never smoked. Among non-smokers with ETS exposures, the relative risk is between 1.2-1.3. (20% to 30% increase) in the risk of mortality of heart attacks (myocardial infarctions) or ischemic heart disease. These diseases are caused by inadequate oxygen supply to the heart caused due to constricted blood vessels therefore decreased blood supply) (Eisner MD et al.,1998). Elevated blood pressures, increased heart rates, and increased blood carbon monoxide level have been found among non-smokers who have angina pectoris heart disease exposed to ETS in both ventilated and unventilated rooms. Studies have also indicated that allergy symptoms can be aggravated by expose to ETS such as more irritating to respiratory systems of asthmatics and aggravate wheezing. Studies also found the health effects among new born to non-smoker mothers who had workplace ETS exposures, including higher risk of low birth weight, congenital anomalies, and smaller head circumference, as well as increased risk of having asthma or other allergy related symptoms in their childhood.

1.2.3. Shift Work

Shift work is an irregular or unusual hour work schedule, compared to those of a normal daytime work schedule. Many different work schedules can be described as shift work, including night work and rotating shift work. Studies indicated that 15-30% of the adult population is involved in some type of shift work in America and Europe (Alterman, T., 1998, Sheng-H. T., 2012). In Casino industries, the modern “24-hour Society” involves extension of basic services to general populations, requiring continuous human assistance and control over the work processes during the 24 hour day (Giovanni COSTA, 2010). Many casinos offer a variety of gaming activities, such as poker, blackjack, slot machines, craps, baccarat, and roulette. Gaming industry and gaming activities are seven days a week and 24 hours per day operations.

In the hospitality industry, the working environment is characterized by irregular and long working hours, role pressure, and work overload. Casino employees work one of three shifts. The number of employees working at a given time differs from the needs to serve the expected number of customers, typically, the nights of holidays and weekends are expecting to busier and have more crowded (Wang XS et al., 2011). Additionally, gaming floor employees could sometimes working long hours depending on the shift needs.

The most common effect of shift work is shift work sleep disorder, which can be caused by night shifts, rotating shifts, or even an early morning shift. The mechanism of sleep involves specific neuronal pathways, transmitters, and receptors composing the ascending arousal system that flow from the brainstem through the thalamus, hypothalamus, and basal forebrain to the cerebral cortex (Schwartz, 2008). Research shown that an ascending medial brainstem and diencephalic system of multiple nuclei with extensive reciprocal interconnections and system-wide sensitivity to neuromodulation controls the regular alternation and integration of the sleep-wake and REM (Rapid eye movement)-NREM (Non- Rapid eye movement) cycles (Pace-Schott et al., 2002). In neuroscience, James M. Krueger (2010) proposed that extracellular ATP (P2 receptors), released as a consequence of cell activity and acting via purine type 2 (P2) receptors to release cytokines and other sleep regulatory substances, in turn affect sleep. His study shown that a P2 receptor agonist, 2=(3=)-*O*-(4-benzoylbenzoyl) adenosine 5=-triphosphate (BzATP), increased NREMS and electroencephalographic (EEG) delta power while two different P2 receptor antagonists, acting by different inhibitory mechanisms, reduced spontaneous NREMS in rats (Figure 2).

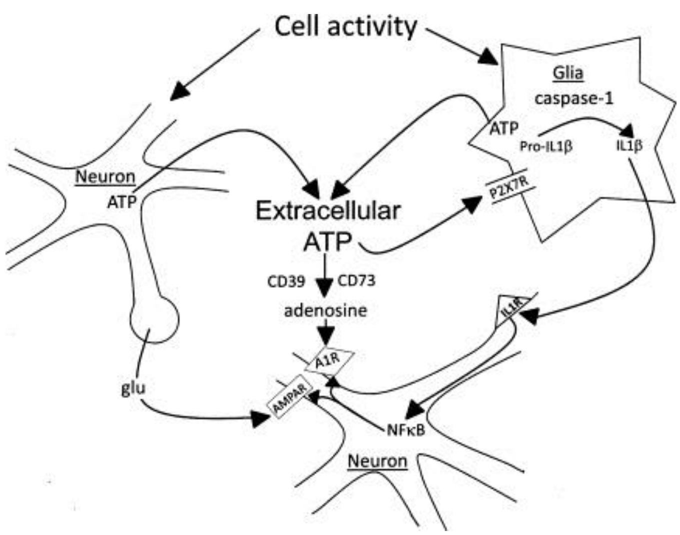

Fig. 2. Extracellular ATP involvement in sleep regulation. [From James M. Krueger (2010)]

Shift systems are also known to be associated with a variety of psychosocial and physiological problems that can affect the health of employees. This state of chronic circadian misalignment can lead to sleep and performance complaints but also contributes to the association between night work and adverse health outcomes, such as increased risk of metabolic syndrome (Wang XS et al., 2011), diabetes (Wang XS et al., 2011), autoimmune hypothyroidism (Magrini A et al.,2006), cardiovascular diseases [Frost P et al., 2009, Wang XS et al., 2011)] and some types of cancer (Wang XS et al., 2011, Straif K et al., 2007, Bonde JP et al., 2012) when compared to the general population. In addition, the sleep and cognitive deficits may potentially lead to enhanced injury risk in working environments. Most shift workers experience a disruption in the temporal alignment between endogenous circadian rhythms and their atypical sleep-wake schedule. These results suggest that the degree of circadian adaptation to night shift work is associated to different health indices (Boudreau P et al., 2013).

In addition to direct physiological health impacts, shift work may also be associated with health effect on employee's psychological and social life, which could then be responsible for deteriorating physiological health and overall well-being. For example, shift workers were disadvantaged to participate in social, cultural and casual activities which are mostly arranged according to the diurnal rhythms of the general population. The spouse and children constantly try to adapt to altered daily rhythms which further hampers the already complex temporal organization of family life (Matthias Vogel et al., 2012). These effects include fatigue, stress, eating disorder, broken marriages, relationship disharmony and changes in behavior (Begani, R.K., 2013)

1.2.4. Noise

Noise can be general defined as unwanted sound. Human ear is not equally sensitive to all frequencies of the audible sound spectrum. Noise sensitivity and noise effects can be differentiated within individuals. Loud background noise, such as music, traffic noise, or conversation exists everywhere. The noise level in the gaming environment is usually high. The employees often expose to chronic workplace barrage of noises. People may experience the constant ambient noise of jangling slot machines which encourage people to keep playing, loud band background music and the excited shouts as players hit a jackpot. In 2003, National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (noise levels) from employees at the Spirit Mountain Casino in Oregon. Noise from slot machines, gaming tables, and loud customers may be distracting to some, although workers wear protective headgear in areas where machinery is used to count money (AGA, 2012).

Studies have indicated the mechanism of health effect of noise. Maschke (2002) pointed out that noise can induce a non-specific response which consists primarily of neural and humoral processes. The nerve impulses induced by the noise find their way via the auditory cortex just as the amygdala to the hypothalamus-hypophysial system (Spreng 2000a). By these ways, noise can cause stress reactions in the body, during which adrenaline, noradrenaline and cortisol are excreted (e.g. Ising 2000). The intensity of the stress reaction was moderated e.g. by predisposition, experience and self-control patterns. The stress hormones stimulate the affected organs and among other things influence the cardiovascular system, metabolism and the blood lipids (Spreng 2000b).

National Institute for Occupational Safety and Health pointed out that ambient noise affects people’s health by increasing general stress levels and aggravating stress-related conditions such as high blood pressure, coronary disease, peptic ulcers and migraine headaches. Continued exposure does not lead to habituation; in fact, the effects worsen. Evans and Johnson (2000) suggested that noise is both stressful and harmful to health and decreases levels of enthusiasm. The results have indicated that individuals in the noise condition experienced higher levels of urinary epinephrine (marker of stress) and had fewer attempts at unsolved puzzles. The health consequences can be found after exposing to consistent elevated sound levels. In an elevated noisy workplace, noise can cause such health effects as sleep disturbance, annoyance, ischemic heart disease, vasoconstriction, hypertension, and even cause hearing impairment. Studies have found the associations between noise exposure and the changes in immune system and birth defects (Passchier-Vermeer W, Passchier WF, 2000). Studies also indicated that elevated noise can increase stresses, stimulate aggression, increase workplace accident rates, and other anti-social behaviors. (Kryter, 1994). Study shown that noise levels below the hearing damaging criterion cause annoyance, sleep disturbance, cognitive impairment, physiological stress reactions, endocrine imbalance, and cardiovascular disorders.(Babisch, 2011). The evidence from epidemiologic studies demonstrates that environmental noise is associated with an increased incidence of arterial hypertension, myocardial infarction, and stroke. (Thomas Mu¨ nzel 2014). Shift-worker, exposure to the accumulation of work-related noises and places with less opportunity for recovery from daily stressors (lack of restoration) may associate with cardiovascular effects (Van Kamp I, 2013).

Noise studies shown that noise increases in stress hormone levels such as adrenaline, noradrenaline and cortisol, which in turn may result in endothelial dysfunction and arterial hypertension and increase in cardiovascular risk (Babisch, 2003). The study shown that noise impairs cognitive performance; long-term exposure to relevant noise levels was associated with negative health outcomes. Importantly, an impact on cardiovascular and autonomic homeostasis has been shown (Mu nzel1, 2014).

1.3. Study Goals

Although there are plenty of studies on health status, behaviors, and quality of work life, as well as such potential occupational hazards in gaming working environment as stress, ETS, working shift and noise were noticed, research in the hospitality sub-population especially focused on casino gaming employees are very limited. Previous publications on population-based health status and risk factor behaviors among gaming employees have yet to be found.

The purpose of present the study is to use the statewide population-based survey data to analyze health status and behaviors among casino gaming employees in Nevada. The research questions include

A) What are the characteristics including socioeconomic status and other demographics of Nevada casino gaming employees?

B) What are the health status and behavior risk factors among casino gaming employees?

C) Does casino gaming working environment associate to higher risks of health status and health behaviors?

D) After controlling for other potential confounding factors, is casino gaming working environment as a sole attributing factor to higher health risks?

E) Are there any interactions among demographics, health status and behavioral risks?

F) If there are risk factors found towards health status, does this factor come from community level and individual level?

G) Do analytical results and conclusions differ when advanced analytical method applied to this complicated sample collection design using analyses methods such as multiple weighted logistics models, latent analysis, and multilevel mixed model analysis?

Chapter 2: Methodology

2.1. Behavioral Risk Factor Surveillance System (BRFSS)

BRFSS was developed and conducted to monitor state-level prevalence of the major behavioral risks and chronic diseases among adults (18+) in the United State as well as the District of Columbia and three U.S. territories. There are about 400,000 residents are interviewed by telephone annually (CDC BRFSS, 2015). In 2013, 491,773 interviews were conducted using this surveillance system. So far, BRFSS is the largest continuously conducted health survey system in the world, and is the major surveillance system that collects data about the U.S. residents regarding health conditions, health-related risk behaviors, and use of preventive services (CDC BRFSS, 1996).

The BRFSS questionnaire is designed by a working group of BRFSS state coordinators and CDC staff. Some of the questions are directly adopted from other national surveys, including the National Health Interview Survey (NHIS) or the National Health and Nutrition Examination Survey (NHNES). By using these adopted questions, which have been tested, states can compare their BRFSS data to other surveys.

Cognitive and field testing must be applied if new questions to be added to BRFSS questionnaire. For any new core questions or optional modules questions to be adapted, voted by majority of all state representatives is required. There are three parts in the questionnaire: 1) Core component includes demographic questions, current health conditions, health-related perceptions, and behaviors such as health care access, health status, tobacco use, alcohol consumption, disability, and HIV/AIDS risks. According to BRFSS guidelines, the core component questions should not be modified (CDC BRFSS overview 2013). 2) Optional modules include a group of questions on specific topics such as secondary smoking, mental illness, and diabetes cares. States have to option either to adapt the module or not (CDC BRFSS, 1996). 3) State-added questions are the questions developed and added to their BRFSS questionnaires. In order to do the further research from the present study, following questions have been devolved and added to Nevada BRFSS system in 2012, 2013 and 2014:

1) "Have you ever worked in the hospitality and service industry, for example, hotels, casinos, restaurants or bars?"

2) "How long did you work in the hospitality and service Industry?"

3) "Have you ever worked in any of these places such as
   a. "in housekeeping or room service?", "on a casino gaming floor?
   b. "in a bar or in restaurant with bar?"
   c. "in a bar or restaurant without bar?" or
   d. "in some other location" etc. casino or service related questions.

Sponsored by the CDC and Nevada State Division of Public and Behavior Health, Nevada BRFSS project is operated and conducted by the Nevada Center for Statistics, Evaluation, and Surveys (CSES) at University of Nevada, Reno and Cannon Center for Survey at University of Nevada, Las Vegas.

The survey data includes modules on health status, chronic health indicators, selected risk behaviors and preventive factors. In this study, all the questionnaires were derived from the CDC core model, optional model and stated added model and were divided into three categories, which included measures of respondents' perceived general health (e.g., self-reported general health), chronic health indicators (e.g., diabetes diagnosed), and engagement in health risk behaviors (e.g., tobacco use). As showed in Table 1, six measures were analyzed in general health status category such as "How do you think your general health is?" ," "During the past 30 days was your physical health not good?", " During the past 30 days was your mental health not good? ", "During the past 30 days did your poor physical or mental health kept you from doing your usual activities?, "During the past 30 days did your, experienced confusion or memory loss that is happening more often or is getting worse?", " and your "Body Mass Index (BMI)".Thirteen questionnaires associated with chronic health indicators based on subjects self-report their subjective health status and whether a doctor had diagnosed them with these chronic diseases. In this study, "chronic health indicators" component involved "high blood cholesterol, "heart attack", "angina or coronary heart disease", "stroke", "asthma", "skin cancer", "other cancer", "chronic obstructive pulmonary disease (COPD), "arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia", " depression", "kidney disease", "trouble seeing," and diabetes. There were 8 explanatory variables in health behaviors category which related to "exercise any during past 30 days?", smoke status, "alcohol consumption", "marijuana use", "illegal drug use", pain killer use" and mental health problem such as "ever seriously considered attempting suicide during past 12 months?" The last four measures were Nevada added residency questions which also included; preventive factors "participate in any physical activities or exercises", "had either a flu shot or a flu vaccine", "ever been tested for HIV?" ,"ever had a blood stool test using a home kit", "ever had a mammogram", "ever had a Pap test", and " had a Prostate-Specific Antigen test".

Table 1. Selected Questions from BRFSS Questionnaire

Health Status	Would you say that in general your health is: Excellent /Very good/Good/Faire/Poor
	During the past 30 days, was your physical health not good?
	During the past 30 days was your mental health not good?
	During the past 30 days, did poor physical or mental health keep you from doing your usual activities?
	Experienced confusion or memory loss that is happening more often or is getting worse during the past 12 month?*
	Body Mass Index (BMI≥25)
Chronic Health Indicator	(Ever told) had high blood cholesterol
	(Ever told) had a heart attack
	(Ever told) had angina or coronary heart disease
	(Ever told) had a stroke
	Ever told) had asthma
	(Ever told) skin cancer

	(Ever told) had any other type of cancer
	(Ever told) have Chronic Obstructive Pulmonary Disease
	(Ever told) have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?
	(Ever told) have a depressive disorder, including depression, major depression, dysthymia, or minor depression?
	(Ever told) have kidney disease
	Have any trouble seeing, even when wearing glass or contact lenses**
	(Ever told) have diabetes
Health Behavior	Participate in any physical activities or exercises during the past month
	Adults who are current smokers
	Binge drinkers (males having five or more drinks on one occasion, females having four or more drinks on one occasion)
	Heavy drinkers (adult men having more than two drinks per day and adult women having more than one drink per day)
	During the past 12 months have you ever seriously considered attempting suicide?*
	During the past 30 days, on how many days did you use marijuana or hashish?*
	During the past 30 days, on how many days did you use any other illegal drug?*
	During the past 30 days, on how many days did you use a pain killer to get high, like Vicodin, OxyContin (sometimes called Oxy or OC) or Percocet (sometimes called Percs)?*
Preventive factor	Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?

	During the past 12 months, have you had either a flu shot or a flu vaccine that was sprayed in your nose?
	Have you ever been tested for HIV?
	Have you ever had a blood stool test using a home kit?
	Have you ever had a mammogram
	Have you ever had a Pap test
	Have you ever had a Prostate-Specific Antigen test

*Nevada added questions

2.2 Sampling Design and Data Collection

The objective of BRFSS is investigating chronic health conditions and health-related risk behaviors of adults. Because the sample is based the entire population, stratified cluster random sampling design was utilized to select the primary sampling units which is a household. The current study has stratified Nevada population into three stratums: Clark County, Washoe County and the rest of the State. Both numbers of landline telephone and cellular phone were used as the random selection bases. BRFSS cellular telephone survey was collected in a manner similar to the BRFSS landline telephone survey. However, one important difference is that interviews conducted by landline telephones include random selection among adults within households, while cellular telephone interviews are conducted with adults who are contacted on personal (nonbusiness) cellular telephones. Adults residing in prisons, hospitals, nursing homes, college dormitories, or military bases are not eligible. In summary, BRFSS sampling is a complex sampling design, which involves stratification, clustering, and unequal probability of selection of participants and responding rates (Lu, MG. and Yang, W., 2012)

BRFSS data are obtained based on self-reported information. A Computer-Assisted Telephone Interview (CATI) systems were utilized during phone interviews. Both English/Spanish version are available for the questions. The telephone interviews were conducted during each calendar month. Before conducting interviews, each interviewer is given training on the BRFSS questionnaire and procedures before they are approved to work on BRFSS. Once data are received from a state, CDC staff run editing programs and cumulative data quality checks and note any problems in the files (BRFSS overview2013).

2.3. Statistical Analysis Strategy

2.3.1 Weighting procedures

A selected sample is only a small part of the population it came from. In order to evaluate a population accurately and avoid unequal probabilities of selection and unequal patterns of survey non response (violations), a selected sample should be reflected in the sample being represented with respect to all variables measured in the survey. The weights are usually developed in a series of stages to compensate for unequal selection probabilities, nonresponse, non-coverage, and sampling fluctuations from known population values (Brick and Kalton, 1996).

In BRFSS, the weighting methodology contains two sections: design weight and raking. Design weighting is conducted in order to reduce bias due to unequal probability of selection. Design weights are calculated using the weight of each geographic stratum (STRWT) the number of landline phones within a household (NUMPHON2) and the number of adults who use those phones (NUMADULT). For cellphone respondents, both NUMPHON2 and NUMADULT are set to 1. The formula for the design weight is:

Design Weight = STRWT * (1/NUMPHON2) *

STRWT- accounts for differences in the probability of selection among strata (subsets of area code/prefix combinations).

NUMPHON2-the number of landline phones within a household

NUMADULT- and the number of adults who use those phones

For cellphone respondents, both NUMPHON2 and NUMADULT are set to 1.

Iterative proportional fitting (or “raking”) methodology is also operated to weight the BRFSS data. Raking adjusts the data for demographic differences between those persons who are sampled and the population that they represent so that groups underrepresented in the sample can be more accurately represented in the final data set. This weighting methodology allows the introduction of additional demographic characteristics and more-accurately matches sample distributions to known demographic characteristics (BRFSS overview 2013). BRFSS ranking method includes categories of age, gender, race and ethnicity groups, education levels, marital status, regions, telephone source, renter/owner status. This paper adopted weighting methods that have been developed and applied to all analysis procedures (Lu, MG. and Yang, W., 2012).

Weighting Process:

FINALWT=GEOWT*DENWT*(1/NPH)*NAD*CSA*POSTSTRAT

Where

FINALWT- the final weight assigned to each respondent.

GEOWT -accounts for differences in the basic probability of selection among strata.

DENWT- accounts for differences in the basic probability of selection between telephone numbers from a stratum that is presumed to contain many households (a high density stratum) and telephone numbers from a stratum that is presumed to contain few households (a low density stratum).

1/NPH - The inverse of the number of residential telephone numbers in the respondent’s household.

NAD - The number of adults in the respondent’s household.

CSA -The ratio of the expected cluster size to the actual cluster size.

POSTSTRAT - The number of people in an age-by-sex category in the population of a region or a state divided by the sum of the products of the preceding weights for the respondents in that same age-by-sex category.

2.3.2. Descriptive Statistics

Descriptive statistics are used to describe the basic features of the data in the study, provide summaries about the sample and about the observations that have been made. For example, general statistics of social demographic variables such as gender, age, race, marital status, education, employment status, family income between the people "worked in the casino floor" and "do not work on the casino floor" were calculated to better understand sample characters.

Due to the complex sample design of the data set, which generally results in increased variance due to clustering and other design features (Kish, 1965), all the results present were weighted using SAS Survey procedures to correctly adjusts the standard errors , inverse of selection probabilities, reduce selection bias, minimize variances, change population base. A $\chi 2$ tests was used to see if there is a relationship/difference between the combined average of three years and the national 2013 health related variables.

2.3.3. Multiple Imputation (MI)

Missing data is a common problem in many data sets. Anyone involved in constructing data bases from a complex sample survey data set has nonresponse and the resulting missing values. Multiple imputation is a statistical technique designed to take advantage of the flexibility in modem computing to handle missing data. Each missing value is replaced by two or more imputed values in order to represent the uncertainty about which value to impute. It appropriately solves the missing-data problem at the beginning of the analysis. A MI based on log-linear modeling provides an elegant and sound solution form any missing data problems concerning categorical variables. An MI analysis involves three steps, first, an imputation model is formulated and a series of imputed datasets are created. Second, the analysis of each imputed dataset is carried out separately. Finally, the estimates from the imputed datasets are combined, or pooled, to generate a single set of estimates.

The multiple imputed versions of a data set reflect uncertainty about the imputed values, not only the missing values but also the unknown parameters of the imputation model, which is a requirement for obtaining unbiased standard errors in statistical analyses. (Vermunt, J.K., 2003). In this study, 5 sets of imputed values were created. These multiple imputed data sets are then analyzed by using standard procedures for complete data and combining the results from these analyses (pooling). No matter which complete-data analysis is used, the process of combining results from different imputed data sets is essentially the same.

The missing data mechanism is the process that generates missing values, that is, what predicts whether a given value is missing or not. Missing data mechanisms generally fall into three categories: missing completely at random, missing at random, and missing not at random.

$$P(R,Yobs,Ymis;\theta,\xi)= P(Yobs,Ymis;\theta)P(R|Yobs,Ymis;\xi) \text{ ----------------(1)}$$

$P(R|Yobs,Ymis;\theta)= P(R|Yobs;\theta)$--- (2)

If equation (2) holds, then the missing data are said to be missing at random (Rubin 1976; Little and Rubin 2002:12).

The actual imputation of the missing values involves generating random draws from the distribution P(Ymis|Yobs), which is defined as follows (Rubin 1987; Schafer 1997):

$P(Ymis|Yobs)= P(Ymis|Yobs;\theta)P(\theta|Yobs)d\theta = P(Yobs,Ymis;\theta) P(Yobs;\theta) P(\theta|Yobs)d\theta$------(3)

Where, $P(Yobs,Ymis;\theta)$ - the marginal distribution of the survey variables

$P(R|Yobs,Ymis;\xi)$ - the conditional distribution of the response indicators given the survey variables.

Multiple imputation method was carried out in this study on use of a variety of features in the SAS v9.3 (SAS Institute, Cary, NC) multiple imputation and survey procedures since "the ability of the multiple imputation process to incorporate statistically sophisticated techniques and draw from distributions of "plausible" values while accounting for the variability introduced by the process of selecting a value for the missing data point" (Rubin, 1987). In Nevada BRFSS data set, as a point of reference, the missing rates of the most of questions are less than 12.1%. The missing rates of the "chronic disease "category are less than 1% except for the question "Ever been told your blood cholesterol is high?"(16.6%).

2.3.4. Latent Class Analysis (LCA)

Latent Class Analysis (LCA) is a statistical method for grouping most likely subtypes of related cases (latent classes) from multivariate categorical data. Similar to other factor or cluster analysis, with multiple measured variables, this method is used to identify a small number of basic groups into which cases fall. LCA fits a statistical model (model based) to the data in an attempt to determine classes. (Fig. 3)

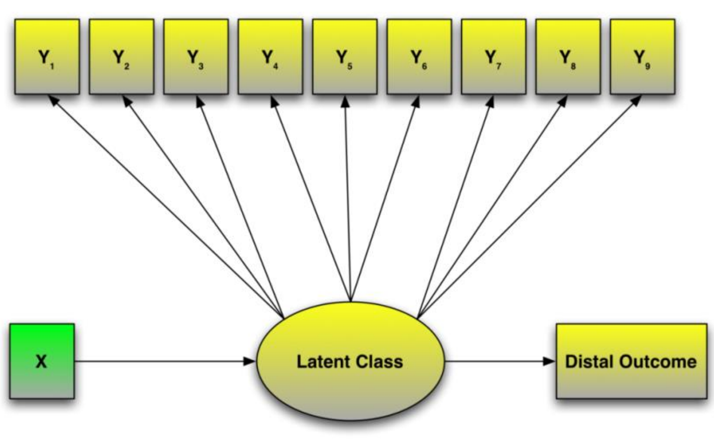

Figure 3 A Model for Latent Class Analysis and Latent Profile Analysis

Based on probability hypotheses and hypotheses algorithm, cases can be classified to their most likely latent class by means of “recruitment probabilities”. A recruitment probability is the probability that, for a randomly selected member of a given latent class, a given response pattern will be observed. The recruitment probabilities are calculated from the estimated conditional response probabilities in a straight forward way (see, e.g., Lazarsfeld & Henry, 1968).

LCA models are special cases of more general models called Finite Mixture Models (FMM). A finite mixture model expresses the distribution of a set of outcome variables, X, as a function of the sum of weighted distribution likelihoods:

$$f(\mathbf{X}) = \sum_{g=1}^{G} \eta_{\mathrm{g}} \ f(\mathbf{X}|g)$$

To construct the LCA model likelihood

A latent class model for the response vector of J variables (j=1,...,J) with C classes(c=1,...,C):

$$f(\mathbf{x}_i)=\sum_{c=1}^{C} \eta_{\mathrm{c}} \ \prod_{j=1}^{J} \pi_{jc}^{x_{ij}} (1-\pi_{jc})^{1-x_{ij}}$$

●ηc-the probability that any individual is a member of class c (must sum to one).

●xij-the observed response of individual i to item j.

●πjc-the probability of a positive response to item j from an individual from class c.

LCA is able to identify latent subgroups of distinct properties, estimate the proportion of the population in each latent subgroup, and specify different subgroup-specific growth trends allowing individual variation around subgroups, and test predictors of the trend and predictors of latent class membership. Latent class model can be used in the study of the relationship among a set of unobserved dichotomous outcomes that can be viewed as indicators or markers for the in observed variables (Leo A Goodman-LCA ref).

In this study, we are interested in studying health risk status among the adults population in Nevada. Rather than conceptualizing health risk status as a continuous variable, distinct categories or typologies were processed. For example, we think that people fall into one of two different types: high risk category and low risk category. Since we cannot directly measure what category someone falls into, this is a latent variable (a variable that cannot be directly measured). However, we do have a number of indicators that we believe are useful for categorizing people into these different classes. Using these indicators, we can create a model that allows us to categorize these people into different types of health risk classes. With these models, we are able to categorize people as to what kind of healthy level they are and determine whether the number of latent classes is the right number of classes.

There is no compelling statistical answer the question of the right number of latent classes. We need to combine theory, the goals of the study, and the statistical criteria to make the decision. Using Nevada BRFSS "chronic health indicator" data, two latent classes were acquired with 13 binary chronic health indicators after evaluating the sample-size, comparing log likelihood value Akaike (AIC), Bayesian (BIC), sample size Adjusted BIC, and Entropy measure as well as Vuong-Lo-Mendell-Rubin Likelihood ratio test, Lo-Mendell-Rubin adjusted LRT test, and parametric bootstrapped Likelihood ratio test etc. using the Mplus program.

2.3.4.1 Latent Class Analysis (LCA) Procedure and Conclusions

Two, three and four of latent class analysis were carried out to compare the models. Two-level latent class was chosen after evaluating the statistics of the models' output. Figure 2 shows the syntax of Latent Class Analysis.

```
Title:
Latent Class Analysis.
Data:
  File is disease.dat ;
Variable:
  names       = I1 I2 I3 I4 I5 I6 I7 I8 I9 I10 I11 I12 I13 ;
  usevariables = I1 I2 I3 I4 I5 I6 I7 I8 I9 I10 I11 I12 I13 ;
  categorical  = I1 I2 I3 I4 I5 I6 I7 I8 I9 I10 I11 I12 I13 ;
  classes = c(2);
Analysis:
  Type=mixture;
Plot:
  type is plot3;
  series is I1 (1) I2 (2) I3 (3) I4 (4) I5 (5) I6 (6) I7 (7) I8 (8) I9 (9) I10 (10)
I11 (11) I12 (12) I13 (13);


Savedata:
```

```
  file is
disease_save.txt
;
  save is cprob;
  format is free;
output:
  tech11 tech14;
```

The log likelihood value such as AIC, BIC, Adjusted BIC etc. is hard to interpret by itself, but they can be used to compare models in order to minimize it. This study used the sample-size adjusted BIC, and Entropy measure for comparing models. Ideally the same number of classes will minimize the AIC and BIC measures and have a strong entropy measure. Mplus reports both the Pearson Chi-square and the Likelihood Ratio Chi-square. These are asymptotically equivalent. They lead to the same decision in this case. Below is the output of “Test of the model fit”. Information Criteria

Akaike (AIC)	141161.031
Bayesian (BIC)	141762.728
Sample-Size Adjusted BIC	141508.495
(n* = (n + 2) / 24)	

Akaike—AIC = -2*LogLikelihood + 2p. Where p is number of free parameters (15).

Bayesian Information Criterion—BIC = -2*logLikelihood + p*ln(n). Where p is number of free parameters (15), n is sample size (1102).

Sample Size adjusted—Adj BIC = -2*logLikelihood + p[ln((n+2)/24). Muthén reports that simulation studies indicate this is superior to BIC.

The Lo-Mendell-Rubin adjusted likelihood ratio test has a computed value of 3669.205, and both the p value of Vuong-Lo-Mendell-Rubin test and the Lo-Mendell-Rubin adjusted LRT test are less than 0.05. The same as p value of Parametric Bootstrapped likelihood Ratio test. These suggest that two classes are sufficient and that three classes are not really needed. Thus two classes make a significant improvement in fit over a single and 3 or 4 classes. See Figure 4.

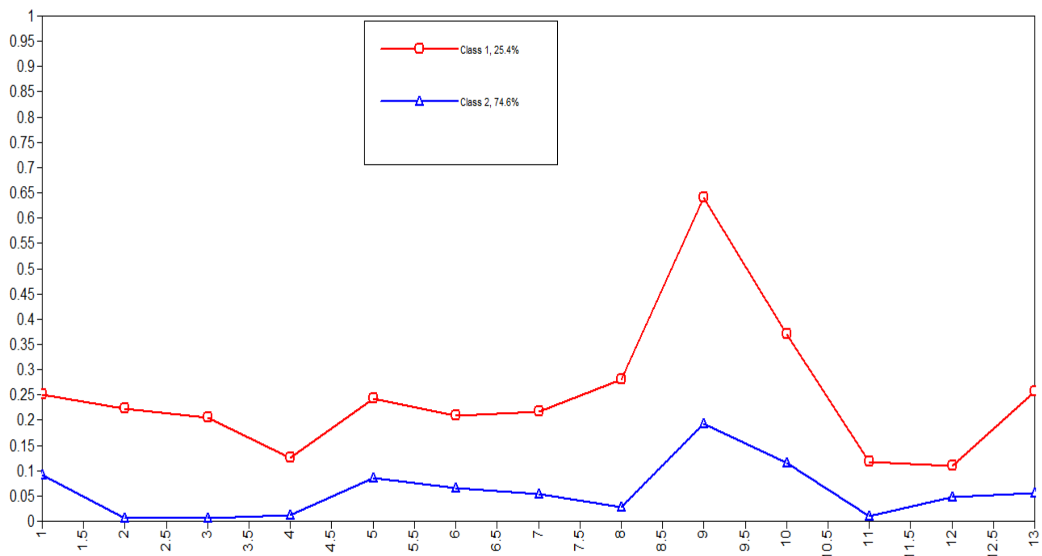

Figure 4 Latent Class Solutions with Two Classes

Overall, in this study, LCA is employed to group individuals into categories, each one of which contains individuals who are similar to each other and different from individuals in other categories (Muthén & Muthén, 2009). Proportions of 22.4% individuals were classified into the high risk class, 77.6% of individuals were in low risk class based on their most likely latent class membership. LCA was carried out to determine distinct health risk categories given presence/absence of several diseases, types of behavioral risk factors from survey responses by using Mplus software.

2.3.5. Multi-level Statistical Analyses

Multilevel data are very common in surveys, especially prevalent in the bio-medical sciences and in investigating state-level prevalence of the major behavioral risks. When the sample size is larger, information is likely to be observed on nested clusters at multiple levels, which are called “multilevel data” or “hierarchical data.

Conducting research at any of these levels while ignoring the detailed nested levels (individuals) or contextual levels (counties) may get inaccurate conclusions. Research has shown that ignoring a level of nesting in data can impact estimated variances and the available power to detect treatment or covariate effects (Donner & Klar, 2000; Julian, 2001; Moerbeek, 2004; Murray, 1998; Shadish, Cook & Campbell, 2002), can seriously inflate Type I error rates (Wampold & Serlin, 2000), and can lead to substantive errors in interpreting the results of statistical significance tests (Goldstein, 2003; Nich & Caroll, 1997).

Multi-level statistical analyses are statistical methods that specifically consider hierarchically or cluster structured nested data. These methods study the effects that vary by level of groups, estimate group level averages and are used to estimate and model variability in responses occurring within as well as between the higher-level units(O'Connell, 2010). Hierarchical or multilevel models are statistical models for handling data with hierarchical structures. These models better avoids aggregation bias and inflated standard error and evaluates group- and individual-level effects.

Multi-level statistical analyses model

$$\eta_{1ij} = \log\left\{\frac{P(R_{ij} \le 1)}{1 - P(R_{ij} \le 1)}\right\} = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}W_j + u_{0j}$$

$$\eta_{2ij} = \log\left\{\frac{P(R_{ij} \le 2)}{1 - P(R_{ij} \le 2)}\right\} = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}W_j + \delta + u_{0j}$$

As a result, the log odds of being at or below the lowest disease level for individual i in county j ($\eta 1 i$j) will be determined by the log odds of being at or below that disease level of a typical individual at a typical county ($\gamma 00$), the effect of the individual-level ($\gamma 10$ $X i$j) and county-level predictor ($\gamma 01 W$ j), as well as the county-level error [u0j, u0j ~ N (0,τ00)]. In addition, the log odds of being at or below the next disease level ($\eta 2 i$j) will also include the difference between the intercepts corresponding to this category and the preceding one (δ).

In this study, Multi-level statistical analyses method applied to participants organized at more than one level such as health risk levels, individual levels, and county levels. Therefore, we used multivariate regression analyses stratified by county category to obtain county or individual level-specific estimates. For example, we want to know if the prevalence of a specific chronic health indicator or behavior (dichotomous) or health risk levels (dichotomous) from the same county is more alike than an individual chosen at random from the population at large because of a common environment. In other words, what are the relationships between county and the likelihood of disease level (or having specific disease) while controlling for an individual's character?

2.3.6. Weighted Multiple Logistics Regression

Logistics Regression is used to assess the likelihood of a disease or health condition as a function of a risk factor and covariates such as age, sex, race, education level etc. Logistics regression analysis presents how much an accession in a given exposure variable affects the odds of the outcome. Multiple logistics regressions were used to explore associations between one outcome variable (i.e., chronic disease) and two or more exposure variables such as gender, age etc. In the other words, the purpose of multiple logistics regressions is to confine the relationship between the exposure variable and the outcome variable from the effects of one or more other variables (called covariates or confounders).   For example, multiple logistics regressions can answer the question, "how does gender affect the probability of having diabetes, after accounting for sex, age, race etc.?" The process that accounts for covariates or confounders is also called adjustment.

Surveylogistics

STRATUM, CLUSTER, WEIGHT

MODEL: Logit P(X) = $\alpha + \beta E + \sum V + \sum W$

E=Exposure, V=Potential Confounding, W=Effective Modifiers

In this study, the process of multiple imputation included application of the three step process of imputation using PROC MI, analysis of imputed data sets using SAS analysis procedures including survey procedures for complex survey data and use of PROC MIANALYZE for analysis of imputed data sets and output from general analytic procedures. Ensure the process imputes enough missing data to produce a monotone missing data pattern and then employs a subsequent imputation using logistics regression for imputation of remaining missing data.

Since the sampling design involved complex method including strata and cluster so weighting procedures were applied. Therefore, weighted Logistics Regression Analysis using PROC SURVEYLOGISTICS was performed to calculate prevalence ratios, evaluate the overall trend for significance, accounting for differences in the individual covariates such as age, sex, race, education, income, and employment statues. The effects of samples were examined by using multi-level statistical analyses (SAS version 9.3 SAS Institute, Cary, NC).

Chapter 3 Results

3.1. General Characteristic and Socio-demographics

The Behavioral Risk Factor Surveillance System (BRFSS) is a state-based telephone survey throughout the year in the United States. A cross-sectional study was designed to collect data along with the survey. In this study, data collection continued monthly over the three year period, which started from the beginning of 2012 and continued through the end of 2014. The research focused on health status, chronic health indicators, risk behaviors, and preventive factors in Nevada statewide adults. 13,646 interviews were conducted. Among these respondents, 35.5% were from 2012, 37.4% from 2013 and 27.1% from 2014. See Figure 5.

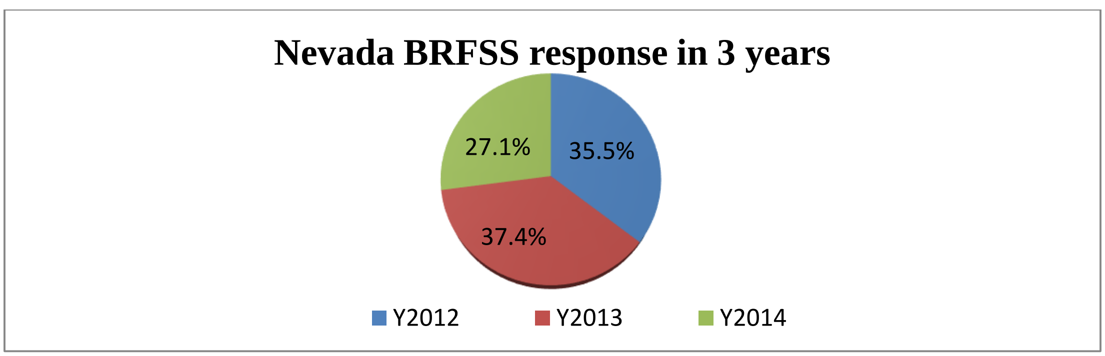

Figure 5 Distribution of the respondents in three years

Sample was drawn from three strata which represents three areas of Nevada: Clark County (Las Vegas Area), Washoe County (Reno Area) and the rest of the state. Clark

County occupied 66.5% of the respondents. 14.2% respondents were from Washoe County. The remaining of these two counties covered 19.2% of the respondents. (See Figure 6)

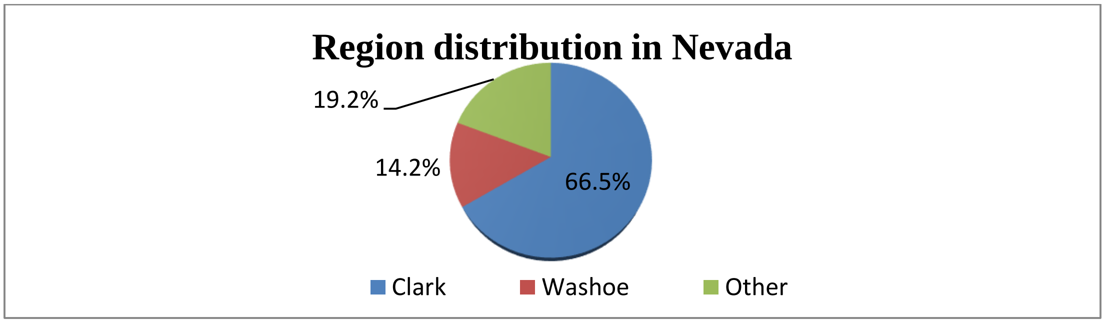

Figure 6 Distribution of the respondents among the regions

Table 2 summarizes the demographic characteristic difference between Nevada and the national BRFSS 2013 report. In general, the demographic distributions of samples from Nevada and the US are similar, but the Nevada sample has higher proportions of divorced individuals and lower college graduates, and higher ratio of Hispanics.

In Nevada, 50.2% population was males, slightly higher than females of 49.8%. The most significant population is in the age group 25-54 (54.2%), while 51.9% at the national sample. Married couples in Nevada are 48.8%, slightly lower than the national ratio of 51.5%, whereas the divorced ratio is 13.5%, 2.6% higher than the national ratio of 10.9%. The ratio of “College 4 years or more (College graduate)” is 20.0% in Nevada, significantly lower than the national ratio of 25.4%. There were 55.0% of the respondents identified as “White-Non-Hispanic”, also lower than the national distribution of 62.9%. In the meantime, Nevada has more Hispanics (23.9%) compare to the US of 16.2%.

Table 2 Exposure of characteristics among the subjects.

Demographic	**Category**	**N**	**Nevada (%)**	**US 2013 (%)**
Gender	Male	5811	50.2	48.6
	Female	7835	49.8	51.4
Age	Age 18 to 24	803	12.1	13
	Age 25 to 34	1479	18.2	17.2
	Age 35 to 44	1743	18.1	16.6
	Age 45 to 54	2279	17.9	18.1
	Age 55 to 64	2897	15.8	16.5
	65+	4445	17.9	18.6
Marital Status	Married	6757	48.8	51.5
	Divorced	2411	13.5	10.9
	Widowed	1611	6.1	6.7
	Separated	297	2.7	2.7
	Never married	1992	22.8	23.5
	A member of an unmarried couple	463	5.2	4.2
Education	Less Than H.S.	1121	16.8	15.1
	H.S. or G.E.D.	3676	29.7	28.4
	Some Post-H.S.	4513	33.5	30.7
	College Graduate	4282	20	25.4
Employment	Employed or Self-employed	6503	56.3	55.5
	Out of work	1006	9.9	7.5
	Homemaker/Student	1128	11	12.7
	Retired/Unable to work	4927	22.8	23.6
Income	< 15,000	1177	9.4	11.6
	15,000 - 24.999	2189	16.9	15.6
	25,000 - 34.999	1342	10.8	9.5
	35,000 - 49,999	1695	11.5	11.9
	> 50,000	5309	36	37.2
Race	White-Non-Hispanic	9851	55	62.9
	Black-Non-Hispanic	544	7.8	11.4
	Hispanic	1734	23.9	16.2
	Multiracial/Other	1303	11.9	7.5

3.2. Descriptive Statistics of Health Status, Chronic Health Indicators, Health Risk Behaviors and Preventive Factors between Nevada and USA

In order to understand the general health related status of the Nevada population, indictors of general health status, chronic diseases, health related risk behaviors and preventive factors between Nevada and the US were compared before further analyzing casino employees. Sample weights (weighted prevalence) were used to produce estimates that were generalizable to the Nevada population.

Compare for 29 indicators, there are 11 indicators with no statistical significances, 18 indicators are significantly different from the US respondents (12 better and 6 worse). Among five self-reported general health status indicators, Nevada respondents had a significantly lower rate of reported lack of physical health than the US average. For the thirteen chronic disease indicators, Nevada had lower rates of asthma, cancer, arthritis, depression, impaired vision, but had higher rates of kidney disease. Among four risk behavior comparisons, Nevada had higher rates of physical activities, lower binge drinking but had a higher rate of heavy drinkers. In the category of protective indicators, Nevadans had better rates for tests of HIV, and prostate cancer, but worse rates for tests of breast cancer, cervical cancer and colorectal cancer, as well as lower rates of flu shot and health insurance coverage.

Table 3-1 presents the prevalence of general health status comparison between Nevada and the US. There was no statistical significance between Nevada and the US in self-reported general health, BMI, no activity due to poor health, and lack of mental health (81.6% vs. 81.5%, 63.4% vs. 63.8%, 41.5% vs. 42.1%, 34.1% vs. 30.2%) respectively. The prevalence of poor physical health in Nevada is 34.3%, significantly lower than the national prevalence of 35.9%.

Table 3-1 Prevalence of general health status comparison between Nevada and the US

Health Status	**Response**	**Nevada (%)**	**US 2013 (%)***	**Positive/ Negative (Sig.)**	**P value**
General health	Excellent	18.0	18.7	*	0.122
	Very good	30.8	31.7		
	Good	32.8	31.1		
	Fair	13.3	13.3		
	Poor	4.9	4.8		
BMI	BMI<25	36.4	36.2	*	0.790
	BMI>=25	63.6	63.8		
physical health was not good	Yes	34.3	35.9	+	
	No	65.7	64.1		0.024
Mental health was not good	Yes	34.1	33.8	*	
	No	65.9	66.3		0.591
Can't do usual activities	Yes	41.5	42.4	*	
	No	58.5	57.6		0.427
	Yes	11.9	*	*	

Experienced confusion or memory loss	No	88.1

Table 3-2 shows the prevalence of chronic health indicators between Nevada and the US. Each measure of the chronic health indicators were estimated using two- ('yes' or 'no') or three- level responses, asking respondents whether they were ever told that they having chronic disease(s) such as heart attack, diabetes, etc. There is no statistically significant difference in prevalence estimates for the chronic health indicators such as "high blood cholesterol" (p =0.801), "heart attack, also indicated as myocardial infarction" (p= 0.432), "angina or coronary heart disease" (p= 0.449), "stroke."(p =0.493)," "skin cancer?"(p=0.921), and "COPD, emphysema or chronic bronchitis" (p =0.067) compare to the prevalence of the US sample.

Nevada has a lower prevalence of following chronic conditions: cancer (except skin cancer) 5.9% vs. 6.5%, p = 0.049; arthritis 22.5% vs. 24.9%, p = 0.0001; depression 16.4% vs. 17.6%, p =0.021; and diabetes 9.3% vs. 10.3%, p = 0.0001. However, Nevadans have a statistically significant higher prevalence of kidney disease 3.4% vs. 2.6%, p<0.0001 and vision impairment 17.5% vs. 16.2%, p = 0.0001.

Table 3-2 Prevalence of chronic health indicators

	Response		**P value**

Chronic Health indicators		Nevada (%)	US 2013 (%)*	Positive/ Negative (Sig.)	
High blood cholesterol	Yes	38.3	38.3	*	0.801
	No	61.0	61.0		
Heart attack	Yes	4.6	4.4	*	0.432
	No	95.0	95.1		
Angina or coronary heart disease	Yes	4.1	4.2	*	0.449
	No	95.2	95.1		
Stroke	Yes	3.0	2.9	*	0.493
	No	96.7	96.8		
Asthma Status	Current	7.6	8.9	+	<.0001
	Former	3.7	4.7		
	Never	87.8	85.7		
Skin cancer	Yes	5.8	5.8	*	0.921
	No	93.9	94.1		
Other type of cancer	Yes	5.9	6.5	+	0.049
	No	93.6	93.3		
Chronic Obstructive Pulmonary Disease	Yes	7.0	6.4	*	0.067
	No	92.6	93.1		
Arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia	Yes	22.5	24.9	+	<.0001
	No	76.9	74.6		
Depressive disorder	Yes	16.4	17.6	+	0.021
	No	82.8	81.9		
Kidney disease	Yes	3.4	2.6	-	0.001

	No	96.2	97.1		
Trouble seeing*	Yes	17.5	16.2	-	<.0001
	No	81.7	83.2		
	Not applicable (blind)	0.2	0.2		
Diabetes	Yes	9.3	10.3	+	<.0001
	Yes, but female told only during pregnancy	0.8	1.1		
	No	88.4	86.9		
	No, pre-diabetes or borderline diabetes	1.0	1.6		

* USA 2012 BRFSS Report

Table 3-3 is the tabulation of the comparison of health risk behaviors between samples from Nevada and the US. In Nevada, more than ¾ population participated physical activities during past 30 days, which is 3.9% higher than the ratio of the nation at 73.5% (p<0.0001). Although Nevada has lower binge drinking prevalence (14.5%) compared to the US 16.5% (p = 0.0486), its heavy drinking rates is significantly higher (6.4% vs. 6.0%, p=0.010). Cigarette smoking prevalence did not show statistical significances (17.6% vs. 18.2%, p=0.940) between Nevada and the US.

Table 3-3 Prevalence of health risk behaviors

Health Behavior	**Response**	**Nevada State (%)**	**US 2013 (%)***	**Positive/ Negative (Sig.)**	**P value**
Physical activities or exercises	Yes	77.4	73.5	+	<.0001
	No	22.4	26.5		
Current smokers	Not A Smoker	79.6	81.3	*	0.970
	Current Smoker	17.6	18.2		
Binge drinkers	Yes	14.5	16.5	+	0.049
	No	79.9	83.3		
Heavy drinkers	Yes	6.4	6.0	-	0.010
	No	87.8	94.0		

Table 3-4 presents the comparisons of protective factors between the sample of Nevada and the US. The results showed that almost half of indicators in the Nevada are in the positive direction while the half is worse. The positive indicators include HIV test (40.7% vs. 37.8%, p =0.0001) and Prostate-Specific Antigen test (58.3% vs. 51.8%, p = 0.0001). However, Nevada has statistically significant lower rates of health insurance plans (78.3% vs. 82.2% (p <0.001), flu shot (30.5% vs. 38.5%, p < 0.001), blood stool test (33.8% vs. 35.5%, p <0.001), Pap test (89.8% vs. 91.7%, p = 0.01), and mammograms test in women’s health (63.4% vs. 70.1%, P <0.001).

Table 3-4 Prevalence of preventive factors

Preventive factor	Response	Nevada (%)	US 2013 (%)*	Positive/ Negative (Sig.)	P value
Health care coverage	Yes	78.3	82.2	-	<.0001
	No	21.7	17.4		
flu shot/ vaccine	Yes	30.5	38.5	-	<.0001
	No	69.5	61.5		
HIV test	Yes	40.7	37.8	+	<.0001
	No	59.3	62.3		
Blood stool test	Yes	33.8	35.5	-	<.0001
	No	33.8	63.7		
Mammogram	Yes	63.4	70.1	-	<.0001
	No	36.6	29.9		
Pap test	Yes	89.8	91.7	-	0.01
	No	10.2	8.3		
Prostate-Specific Antigen test	Yes	58.3	51.8	+	<.0001
	No	41.7	48.2		

3.3. Characteristics of Casino Gaming Floors Employees (CGFE)

Nevada has the largest gaming industry in the world. In this study, 13,646 respondents completed the survey. Among them, 4,511 (37.2%) reported that they worked or ever worked in the hospitality and service industry, such as hotels, casinos, restaurants or bars and 1,384 (11.2%) worked or ever worked on a casino gaming floor.

As shown in Table 4-1, more than half of CGFE are females (54.8%), higher than males of 45.2% by 9.6 percentage points (p 0.03) compared to gender distribution in Non-CGFE 50.3% males and 49.7% females. Among CGFE, the overall average age is 49.7(95% CI 48.5-51.0), 3 years older than that of non-CGFE. The age group 45-64 covered almost half (45.6%) of total respondents. Age range "55 to 64" is the most significant age group (23.9%). Less young subjects (age 18-24) (3.4%) were observed. White Non-Hispanic employees were still the major race represented among CGFE (58.5%), but the proportion of Black Non-Hispanic is higher than non-CGFE (11.6% vs. 7.6%) while Hispanic has lower percentage as CGFE (18.3% vs. 24. 7%).

When comparing the education levels, the largest education level among CGFE is "H.S. or G.E.D" and "some post -H.S." which covered 74.4% of the total. Only 12.7% of college graduates were involved in CGFE, which is significantly lower than the ratio of the subjects who were non-CGFE (20.3%). Among CGFE, they were "Out of work" at the time of completing the survey was 12.7%, higher than the non-CGFE of 9.4%. Other job situations are similar between CGFE and non-CGFE. In terms of marital status, 45.0% CGFE claimed "married", lower than the ratio of non-CGFE 49.6%. However, the ratio of "Divorced" is 23.2% in CGFE, almost 10% higher than that of non-CGFE 13.0%. The household income for CGFE is relatively lower, with about 70% of CGFE (68.2%) whose income was less than $50,000 compare to the ratio of non-CGFE 36.9%.

Table 4-1 Characteristics Comparison between Occupation of Casino Gaming Floor and Non-Casino Gaming Floor

Demography	**Category**	**CGFE**	**95% C. L.**		**Non-CGFE**	**95% C. L.**	
Gender	Male	45.2	40.8	49.6	50.3	48.7	51.9
	Female	54.8	50.4	59.2	49.7	48.1	51.3
Age	Age 18 to 24	3.4	1.3	5.4	12.1	10.8	13.4
	Age 25 to 34	16.4	12.5	20.3	16.6	15.4	17.9
	Age 35 to 44	17.4	13.9	20.9	18.3	17.0	19.6
	Age 45 to 54	21.7	18.0	25.5	18.0	16.8	19.2
	Age 55 to 64	23.9	20.6	27.3	15.8	14.8	16.8
	65+	17.2	14.7	19.7	19.1	18.2	20.1
Marital Status	Married	45.0	40.6	49.3	49.6	48.1	51.2
	Divorced	23.2	19.4	26.9	13.0	12.0	14.0
	Widowed	7.9	5.8	10.0	6.6	5.9	7.2
	Separated	3.0	1.6	4.3	2.7	2.2	3.2
	Never married	17.2	13.7	20.8	22.0	20.6	23.5
	A member of an unmarried couple	3.5	1.9	5.1	5.3	4.5	6.0
Education	Less Than H.S.	12.9	9.6	16.1	17.8	16.3	19.3
	H.S. or G.E.D.	35.5	31.2	39.7	28.2	26.8	29.6

	Some Post-H.S.	38.9	34.6	43.3	33.8	32.3	35.2
	College Graduate	12.7	10.5	14.9	20.3	19.2	21.3
Employment	Employed or Self-employed	59.1	54.9	63.2	54.4	52.8	56.0
	Out of work	12.7	9.5	15.9	9.4	8.4	10.5
	Homemaker/Student	4.3	2.7	5.8	12.0	10.8	13.2
	Retired/Unable to work	24.0	20.9	27.0	24.2	23.0	25.4
Income	Income less than 15,000	11.3	8.4	14.2	9.4	8.4	10.5
	Income between 15,000 and 24.999	16.9	14.0	19.8	17.3	16.1	18.6
	Income between 25,000 and 34.999	11.8	8.8	14.8	10.4	9.4	11.4
	Income between 35,000 and 49,999	15.6	12.3	18.8	11.0	10.1	11.9
	Income more than 50,000	31.8	27.6	35.9	36.9	35.5	38.4
Race	White-Non-Hispanic	58.5	54.0	63.1	56.1	54.4	57.7
	Black-Non-Hispanic	11.6	8.4	14.7	7.6	6.7	8.5
	Hispanic	18.3	14.4	22.2	24.7	23.1	26.2
	Multiracial/Other	11.1	7.7	14.4	10.3	9.1	11.5

Table 4-2 provides the percentage of each demographic group of the subjects who worked on casino gaming floor. There are 1,384 respondents that reported they ever worked on a casino gaming floor, which represents 11.2% (weighted percentage) of total 13,646 respondents. The highest ratio from each demographic categories who have ever worked at casino gaming floor is Clark County (11.6%), females (12.3%), age group of 55-64 (16.1%), divorced (18.4%), high school or GED education (13.8%), currently out of work (14.6%), household income at $35-49,999 (15.2%), and Race/Ethnicity as Black-Non Hispanic (16.2%).

Table 4-2 Weighted Percent of Casino Gaming Floor as an Occupation by Demographic

Category	Region/Demography	CGFE	Percentage (%)	95% C.L.	
Total	N	1384	11.2		
Region	Clark	No	88.4	87.1	89.7
		Yes	11.6	10.3	12.9
	Washoe	No	88.9	87.6	90.3
		Yes	11.1	9.7	12.4
	Other	No	89.9	88.6	91.3
		Yes	10.1	8.7	11.4
Sex	Male	No	89.8	88.5	91.1
		Yes	10.2	8.9	11.5
	Female	No	87.7	86.4	89.1
		Yes	12.3	10.9	13.6

Age	Age 18 to 24	No	96.6	94.6	98.7
		Yes	3.4	1.3	5.4
	Age 25 to 34	No	88.9	86.1	91.7
		Yes	11.1	8.3	13.9
	Age 35 to 44	No	89.3	87.0	91.6
		Yes	10.7	8.4	13.0
	Age 45 to 54	No	86.8	84.3	89.2
		Yes	13.2	10.8	15.7
	Age 55 to 64	No	83.9	81.7	86.2
		Yes	16.1	13.8	18.3
	65+	No	89.8	88.3	91.2
		Yes	10.2	8.8	11.7
Marital	Married	No	89.7	88.5	91.0
		Yes	10.3	9.0	11.5
	Divorced	No	81.6	78.6	84.6
		Yes	18.4	15.4	21.4
	Widowed	No	86.8	83.5	90.0
		Yes	13.2	10.0	16.5
	Separated	No	87.9	82.6	93.2
		Yes	12.1	6.8	17.4
	Never married	No	91.0	89.0	93.0
		Yes	9.0	7.0	11.0
	A member of an unmarried couple	No	92.2	88.7	95.7
		Yes	7.8	4.3	11.3
Education	Less Than H.S.	No	91.6	89.3	93.8
		Yes	8.4	6.2	10.7

	H.S. or G.E.D.	No	86.2	84.3	88.1
		Yes	13.8	11.9	15.7
	Some Post-H.S.	No	87.2	85.5	89.0
		Yes	12.8	11.0	14.5
	College Graduate	No	92.6	91.4	93.8
		Yes	7.4	6.2	8.6
Employment	Employed or Self-employed	No	87.9	86.5	89.3
		Yes	12.1	10.7	13.5
	Out of work	No	85.4	81.8	89.1
		Yes	14.6	10.9	18.2
	Homemaker/Student	No	95.7	94.1	97.3
		Yes	4.3	2.7	5.9
	Retired/Unable to work	No	88.9	87.5	90.3
		Yes	11.1	9.7	12.5
Income	Income less than 15,000	No	86.8	83.4	90.2
		Yes	13.2	9.8	16.6
	Income between 15,000 and 24.999	No	89.0	87.1	90.9
		Yes	11.0	9.1	12.9
	Income between 25,000 and 34.999	No	87.4	84.2	90.7
		Yes	12.6	9.3	15.8
	Income between 35,000 and 49,999	No	84.8	81.6	87.9
		Yes	15.2	12.1	18.4
	Income more than 50,000	No	90.2	88.7	91.7
		Yes	9.8	8.3	11.3
Race/Ethnicity	White-Non-Hispanic	No	88.3	87.3	89.4
		Yes	11.7	10.6	12.7

	Black-Non-Hispanic	No	83.8	79.5	88.2
		Yes	16.2	11.8	20.5
	Hispanic	No	91.4	89.4	93.4
		Yes	8.6	6.6	10.6
	Multiracial/Other	No	88.0	84.4	91.7
		Yes	12.0	8.3	15.6

3.4. Descriptive Statistics of Health Status, Chronic Health Indicators, Health Risk Behaviors and Preventive Factors between CGFE and Non-CGFE

Table 5 presents the comparison of prevalence of health indicators between the subjects of CGFE and non-CGFE. The goal of this study is to investigate the health status and behavior risk factors among the people who "ever worked on the casino gaming floor". In order to better describe the feature of these measures, the total 34 indicators have been categorized into four groups: health status, chronic disease, risk behavior and preventive factors.

Among six "health status" indicators, four of them showed statistically worse for CGFE than non-CGFE, which including "general health is not good" (23.4% vs.18.5%, p 0.009), "experienced confusion or memory loss" (17.8% vs. 11.0% ($p < 0.001$), "poor physical health" (42.2% vs.   34.6%, $p <0.001$), "poor mental health" (39.5% vs. 34.3%, $p= 0.025$). Other two indicators such as "no activity due to poor health" and "body mass index" didn't show statistically significant differences.

Five of thirteen chronic disease indicators have shown significantly higher prevalence among CGFE than non-CGFE, while the other eight were not different. The non-statistically different indicators include high cholesterol (42.2% vs. 38.8%), heart attack (5.9% vs. 4.8%), coronary heart disease (5.6% vs. 4.1%), stroke (3.7% vs. 3.2), skin cancer (6.7% vs. 6.0%), other types of cancer (7.8% vs. 6.1%), kidney disease (4.1% vs. 3.5%) and vision impairs (22.3% vs. 18.0%). It should be noted that although there is no statistical significance, all eight indicators shows higher prevalence for CGFE. The five statistical significant indicators are asthma (15.3% vs.11.3%, $p= 0.01$), Chronic Obstructive Pulmonary Disease (COPD) (10.5% vs. 6.8%, $p=0.001$) arthritis (29.2% vs. 23.1% $p < 0.001$), depressive disorder (23.9% vs. 16.1%, $p<0.001$), and diabetes 13.4% vs. 9.5%, $p =0.006$).

In the “health related risk behavior” category, four indicators showed statistically higher risk for CGFE comparing to those of who are non-CGFE. There were 26.3% current smokers in the casino gaming employees, 9.2 percentage point higher compare to the subjects who did not work in the casino gaming floor (17.1%) ($p<0.0001$). In addition, a higher ratio of heavy drinkers (10.3% vs. 5.9%, $p <0.001$), more had suicide attempts (4.4% vs. 1.8%, $p =0.0073$), more “pain killer use” (1.7% vs. 0.5%, $p< 0.001$) were also observed. Although following behavior indicators did not reach a significant different level, all of them have shown that CGFE have higher risk than non-CGFE, they are physical exercise (74.6% vs. 77.2%), binge drinking (16.2% vs. 14.1%), marijuana use (6.9% vs. 5.2%) and other illegal drugs use (1.7% vs. 1.0%).

The “Preventive factor” category is the only group that casino gaming floor employees hold few indicators in a better way. Casino employees had significantly higher rates of HIV test (51.5% vs. 38.8%, p<0.0001) and mammogram test (73.2% vs. 64.1%, p= 0.02). Also, although no significant difference is found for the following indictors, but CGFE did show the trend for higher “health coverage” than non-CGFE (81.7% vs. 78.2%, p =0.080), higher rates of Pap test (93.7% vs.89.1%, p=0.058), and very similar rates for flu shot and blood stool test and Prostate-Specific Antigen test.

Table 5 Prevalence of Health Indicators between the subjects of CGFE and Non-CGFE

Category	Questionnaire	CGFE (%)	95% C. L.		Non_CGFE (%)	95% C. L.		Positive/Negative (Sig.)	P value
Health Status	General health is not good	23.4	19.7	27.0	18.5	17.2	19.7	-	0.0093
	Experienced confusion or memory loss	17.8	13.9	21.6	11.0	9.9	12.2	-	0.0001
	Physical health was not good	42.2	37.7	46.6	34.6	33.1	36.1	-	0.001
	Mental health was not good	39.5	35.1	43.9	34.3	32.7	35.8	-	0.0252
	Can't do usual activities b/c poor physical or mental health	42.7	36.9	48.5	41.0	38.9	43.2	*	0.5979
	BMI ≥ 25	62.6	58.2	67.0	64.7	63.2	66.3	*	0.3525
Chronic Disease	High blood cholesterol	42.2	33.7	50.7	38.8	35.8	41.8	*	0.49
	Heart attack	5.9	4.3	7.5	4.8	4.2	5.4	*	0.1634
	Coronary heart disease	5.6	3.9	7.2	4.1	3.5	4.6	*	0.0609
	Stroke	3.7	2.2	5.3	3.2	2.7	3.7	*	0.4952
	Asthma	15.3	12.0	18.5	11.3	10.4	12.3	-	0.0117
	Skin cancer	6.7	4.9	8.4	6.0	5.5	6.6	*	0.4816
	Other type of cancer	7.8	5.6	9.9	6.1	5.5	6.7	*	0.1045
	COPD	10.5	8.0	13.1	6.8	6.1	7.5	-	0.001
	Arthritis	29.2	25.6	32.8	23.1	21.9	24.3	-	0.0009
	Depressive disorder	23.9	19.9	27.9	16.1	15.0	17.3	-	<.0001
	Kidney disease	4.1	2.1	6.1	3.5	2.9	4.1	*	0.5044
	Trouble seeing	22.3	17.0	27.5	18.0	16.2	19.7	*	0.0977
	Diabetes	13.4	10.3	16.4	9.5	8.6	10.3	-	0.006
	Physical activities	74.6	70.9	78.3	77.2	75.9	78.5	*	0.1892

Health Behavior	Current smokers	26.3	22.4	30.3	17.1	15.9	18.3	-	<.0001
	Binge drinkers	16.2	12.9	19.5	14.1	13.0	15.3	*	0.1391
	Heavy drinkers	10.3	7.6	13.0	5.9	5.2	6.6	-	0.0001
	Suicide	4.4	1.7	7.1	1.8	1.3	2.3	-	0.0073
	Marijuana	6.9	4.5	9.4	5.2	4.4	6.1	*	0.162
	Illegal drug	1.6	0.5	2.6	1.0	0.7	1.4	*	0.2329
	Use a pain killer to get high	1.7	0.6	2.7	0.5	0.3	0.7	-	0.0006
Preventive factor	Health care coverage	81.7	78.3	85.1	78.24	76.8	79.7	*	0.0795
	Flu shot/vaccine	29.2	25.4	33.0	30.7374	29.3	32.1	*	0.4593
	HIV test	51.5	47.0	55.9	38.7792	37.2	40.4	+	<.0001
	Blood stool test	30.0	25.6	34.4	34.4006	32.6	36.2	*	0.0803
	Mammogram	73.2	66.6	79.8	64.0488	61.5	66.6	+	0.0189
	Pap test	93.7	90.1	97.3	89.0632	87.1	91.0	*	0.0581
	Prostate-Specific Antigen test	57.3	48.2	66.4	58.7272	55.4	62.0	*	0.7691

*Nevada added questions.

3.5. Odds Ratios between CGFE and Non-CGFE for Health Status, Chronic Health indicators, Health risk Behaviors and Preventive Factors

In order to control such potential confounding factors as age, sex, and education level etc., weighted multiple logistics regressions were conducted. All thirty four indictors from four categories have been treated as dependent variables for each tested model respectively. “Casino gaming floor” factor was used as a single independent variable to obtain the crude odds ratio (OR, without controlling confounders), then demographic factors (as potential confounding factors) were added to the model to obtain the multivariable-adjusted odds ratio (AOR, with controlling confounders). As shown in Table 6, odds ratios of health indicators for casino gaming floor employees were presented within four categories.

In the health status category, AOR for “general health was ‘fair/poor’” is 1.37 (95% CI 1.08- 1.72), representing general health is “fair/poor” in CGFE is 1.37 times (or 137% higher) than that of Non-CGFE ($p < 0.01$). Among CGFE, AOR for “experienced confusion or memory loss” is 1.63 ($p =0.001$), “poor physical health” is 1.33 ($p <0.001$). AORs of CGFE for “poor mental health”, “no activities due to poor health”, and “BMI” are very close to 1.0, however with no statistically significant difference (1.04, 1.02, and 0.86 respectively).

In the chronic health indicator category, higher incidence of chronic health diseases for CGFE was observed in all 13 measures. In regression analyses, the estimated association with the “working place” factor was unaffected (no significant relation) for the measures “high blood cholesterol (1.04, 95% CI 1.72-1.51)“, “heart attack”(1.19, 95% CI 0.83-1.69), “angina or coronary heart disease”(1.35, 95% CI 0.96-1.89), “stroke”(1.06, 95% CI 0.68-1.67), “skin cancer”(1.10, 95% CI 0.81-1.52), “any other types of cancer”(1.23, 95% CI 0.79-1.89),” kidney disease”(1.19, 95% CI 0.74-1.96), and “trouble seeing”(1.21, 95% CI 0.86-1.71)”.

Nevertheless, Log-probability analysis indicated that “worked on the casino floor” was significant predictor the prevalence of asthma, COPD, arthritis, and depressive disorder in the study population. The prevalence of “ever had asthma” is significantly higher in CGE. AOR is 1.32(95% CI 1.01-1.75). Alternatively, after considering confounders, subjects who worked on casino floor claimed “had asthma” which is 1.32 times more likely compare to the subjects who did not work on the casino floor. In addition, the same findings are found for the measures such as COPD, arthritis, depressive disorder, and diabetes. The incident of COPD is significantly associated with working place risk. The odds of subjects who had COPD among casino gaming employees is 1.45 (95% CI 1.06-1.96) times compared to the odds of non-CGFE. Also, the incidence of “arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?” is 1.23 times (95% CI 1.00-1.52) higher for CGFE compared to Non-CGFE. In addition to, the study shows “working place” factor does impact the incidence of “depressive disorder” ($p < 0.001$). The OR of “depressive disorder “is 1.67 (95% CI 1.32-20.8) and AOR is 1.56 (95% CI 1.23-2.00) compare the odds of CGFE to that of non-CGFE. For addressing to the question “(Ever told) you have diabetes”, those who worked on casino floor were 1.47 (95% CI 1.09-1.96) times more likely to have diabetes, compared to non-CGFE, after controlling confounders.

In the health behavior category, there was a negative (but insignificant) association with participating in “physical activity” and “worked on the casino gaming floor” factor (AOR, 0.97 95% CI 0.78-1.20). Alternatively, casino gaming floor employees participated in “physical activity” is 1.03 times more than that of non-casino gaming floor subjects. OR and Adjusted OR are 1.72 (95% CI 1.39-2.17) and 1.52(95% CI 1.20-1.92), respectively for the “current smokers”. In other words, a person who is “current smoker” in casino gaming employees is 1.52 times higher than that of non-CGFE. “Alcoholic beverages consumption” is also a problem. The AOR of “binge drinkers “(males having five or more drinks on one occasion, females having four or more drinks on one occasion)" is 1.37 (95% CI 1.05-1.82) times for casino gaming employees compared to that of non-CGFE. OR and AOR of "heavy drinker" were 1.72(95% CI 1.16-2.50) and 1.64 (95% CI 1.11-2.44), respectively, which means that the incident of heavy drinker is 1.64 times for the casino gaming employees compared to the non-CGFE after controlling confounders.

For the "Nevada State added questions", even with a significant difference for the incidence between the subjects of CGFE and non-CGFE, there is no significant difference for OR and AOR for the questions of marijuana use [AOR 1.47 (95% CI 0.97-2.22)], other illegal drug use [AOR 1.37 (95% CI 0.65-2.86)] and pain killer use [AOR 1.85 (95% CI 0.68-5.00)].

However, for the question "During the past 12 months have you ever seriously considered attempting suicide?" OR for non-adjusted and adjusted is 2.52 (95% CI 1.25-5.07) and 2.66 (95% CI 1.26-5.58), respectively, which is a statistically significant difference within this subpopulation. The same as the question "experienced confusion or memory loss", there is a statistically significant difference between CGFE and non-CGFE [OR: 1.75 (95% CI 1.31-2.33), (AOR: 1.63 (95% CI 1.21-2.19)].

Among the 6 measures of preventive indicators, there was no evidence shown that the association was restricted to the factor of casino gaming floor working place except "test for HIV". Casino floor employees had better but non-significant health insurance coverage [AOR of 1.20 (95% CI 0.89-1.62)]. AOR for "flu shot/vaccine" is 0.93 (95% CI

0.76-1.13), which indicates that the odds of "had flu shot/vaccine" in CGFE is 7% less likely than the odds in the subjects of non-CGFE. Higher ratio of "test HIV" was observed in CGFE. AOR for "test HIV" is 1.65 (95% CI 1.35-2.02), significantly higher than non-CGFE (p<0.0001). AOR for other preventive tests such as "blood stool test" (0.93, 95% CI 0.74-1.18), "mammograms" (1.22, 95% CI 0.74-2.01) "Pap" tests (1.74, 95% CI 0.86-3.51) for women, and "prostate-specific antigen test for men" (1.13, 95% CI 0.77-1.67) are not found significantly different between these two subpopulations.

Table 6 Odds Ratios of Health Indicators for Casino Gaming Floor Respondents

Category	**Questionnaire**	**OR**	**OR 95% C.I.**		**P value**	**AOR**	**AOR 95% C.I.**		**Positive/ Negative (Sig.)**	**P value**
Health Status	General health is not good	1.35	1.09	1.67	0.008	1.37	1.08	1.72	-	0.010
	Experienced confusion or memory loss	1.75	1.31	2.33	0.000	1.63	1.21	2.19	-	0.001
	Physical health was not good	1.37	1.14	1.67	0.001	1.33	1.10	1.61	-	0.004
	Mental health was not good	1.05	0.50	2.22	0.880	1.04	0.53	2.08	*	0.877
	Can't do usual activities b/c poor physical or mental health	0.94	0.73	1.21	0.597	1.02	0.78	1.32	*	0.904
	BMI ≥ 25	0.93	0.76	1.15	0.492	0.86	0.70	1.05	*	0.134
	High blood cholesterol	1.14	0.79	1.65	0.490	1.04	0.72	1.51	*	0.834

Chronic Disease	Heart attack	1.19	0.85	1.67	0.303	1.19	0.83	1.69	*	0.338
	Coronary heart disease	1.35	0.96	1.89	0.081	1.35	0.96	1.89	*	0.083
	Stroke	1.15	0.72	1.82	0.557	1.06	0.68	1.67	*	0.786
	Asthma	1.39	1.06	1.82	0.016	1.32	1.01	1.75	-	0.044
	Skin cancer	1.11	0.83	1.47	0.474	1.10	0.81	1.52	*	0.529
	Other type of cancer	1.27	0.84	1.92	0.243	1.23	0.79	1.89	*	0.340
	COPD	1.59	1.19	2.13	0.002	1.45	1.06	1.96	-	0.018
	Arthritis	1.35	1.11	1.64	0.002	1.23	1.00	1.52	-	0.048
	Depressive disorder	1.67	1.32	2.08	<.0001	1.56	1.23	2.00	-	0.000
	Kidney disease	1.18	0.70	1.96	0.536	1.19	0.74	1.96	*	0.466
	Trouble seeing	1.32	0.95	1.82	0.098	1.21	0.86	1.71	*	0.274
	Diabetes	1.47	1.10	1.92	0.008	1.47	1.09	1.96	-	0.012
Health Behavior	Physical activities	1.15	0.93	1.41	0.193	0.97	0.78	1.20	*	0.772
	Current smokers	1.72	1.39	2.17	<.0001	1.52	1.20	1.92	-	0.001
	Binge drinkers	1.30	1.00	1.67	0.050	1.37	1.05	1.82	-	0.020
	Heavy drinkers	1.72	1.16	2.50	0.008	1.64	1.11	2.44	-	0.014
	Suicide	2.52	1.25	5.07	0.010	2.66	1.26	5.58	-	0.010
	Marijuana use	1.25	0.83	1.85	0.275	1.47	0.97	2.22	*	0.069
	Illegal drug use	1.37	0.63	2.94	0.416	1.37	0.65	2.86	*	0.400
	Pain killer use	1.85	0.67	5.00	0.213	1.85	0.68	5.00	*	0.204
Preventive factor	Health coverage	0.80	0.63	1.03	0.0789	1.20	0.89	1.62	*	0.2382
	Flu shot/vaccine	0.07	0.88	1.30	0.484	0.93	0.76	1.13	*	0.4405
	HIV test	1.67	1.38	2.03	<.0001	1.65	1.35	2.02	-	<.0001
	Blood stool test	0.82	0.65	1.03	0.0806	0.93	0.74	1.18	*	0.5714
	Mammograms	1.53	1.07	2.20	0.0198	1.22	0.74	2.01	*	0.4277
	Pap test	1.82	0.97	3.43	0.0622	1.74	0.86	3.51	*	0.126

	Prostate-Specific Antigen test	0.94	0.63	1.40	0.7683	1.13	0.77	1.67	*	0.5246

Figure 3-1, 3-2, 3-3, and 3-4 illustrate the thirty-four indicators from four categories with their crude odds ratios, adjusted odds ratios and 95% confidence intervals (95% CI). The indicators with their CIs crossing 1 indicate that ORs or AORs are not significant, or alternatively, CIs apart from 1 indicate ORs or AORs are statistically significantly different.

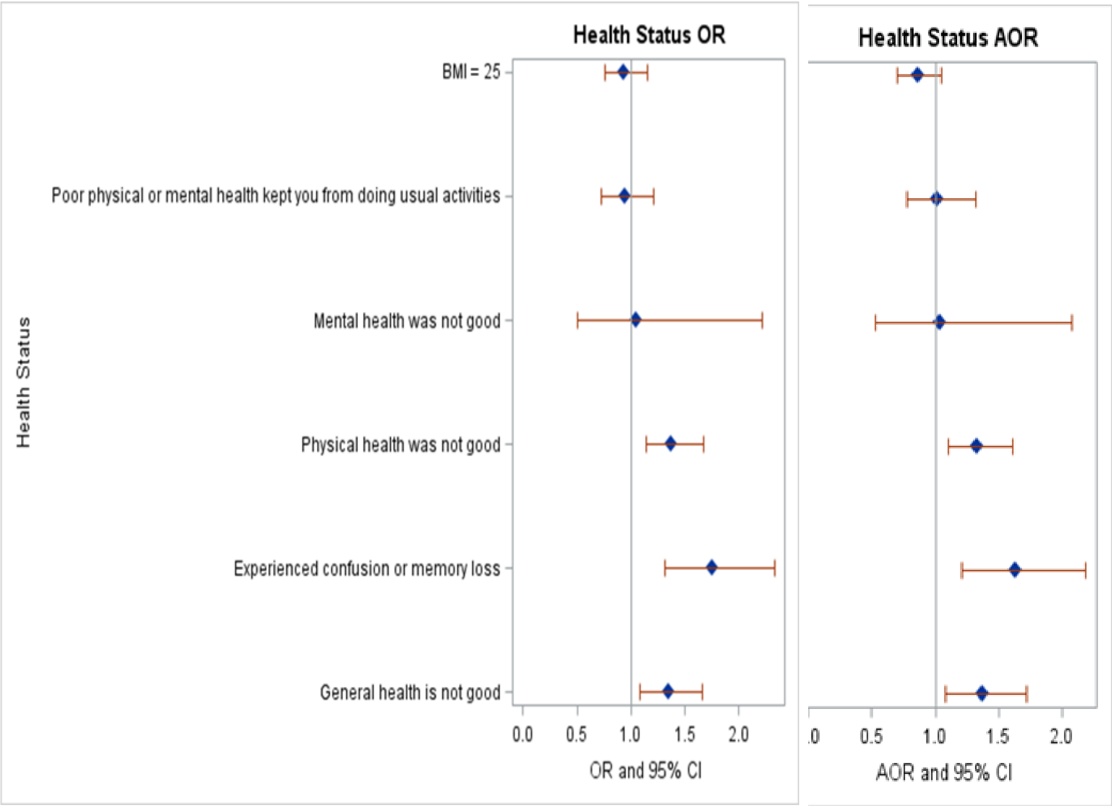

Figure 3-1 Health status comparison (OR and AOR) of the respondents between CGFE and non-CGFE.

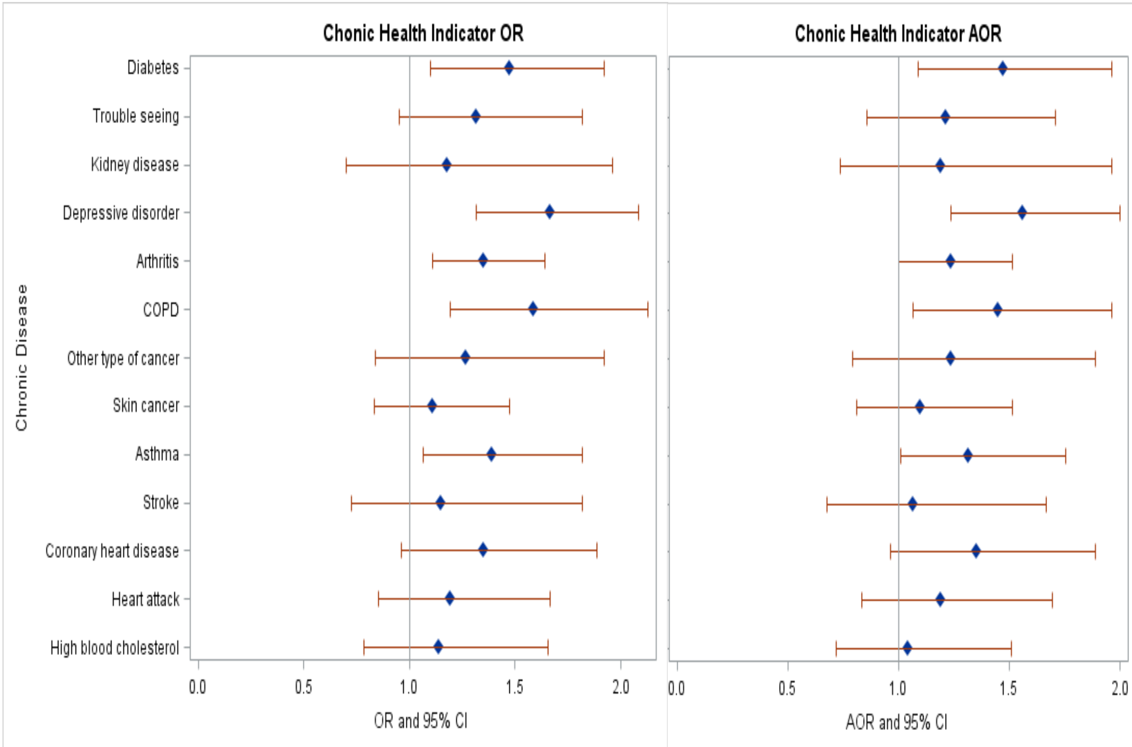

Figure 3-2 Chronic health indicators comparison (OR and AOR) between CGFE and non-CGFE.

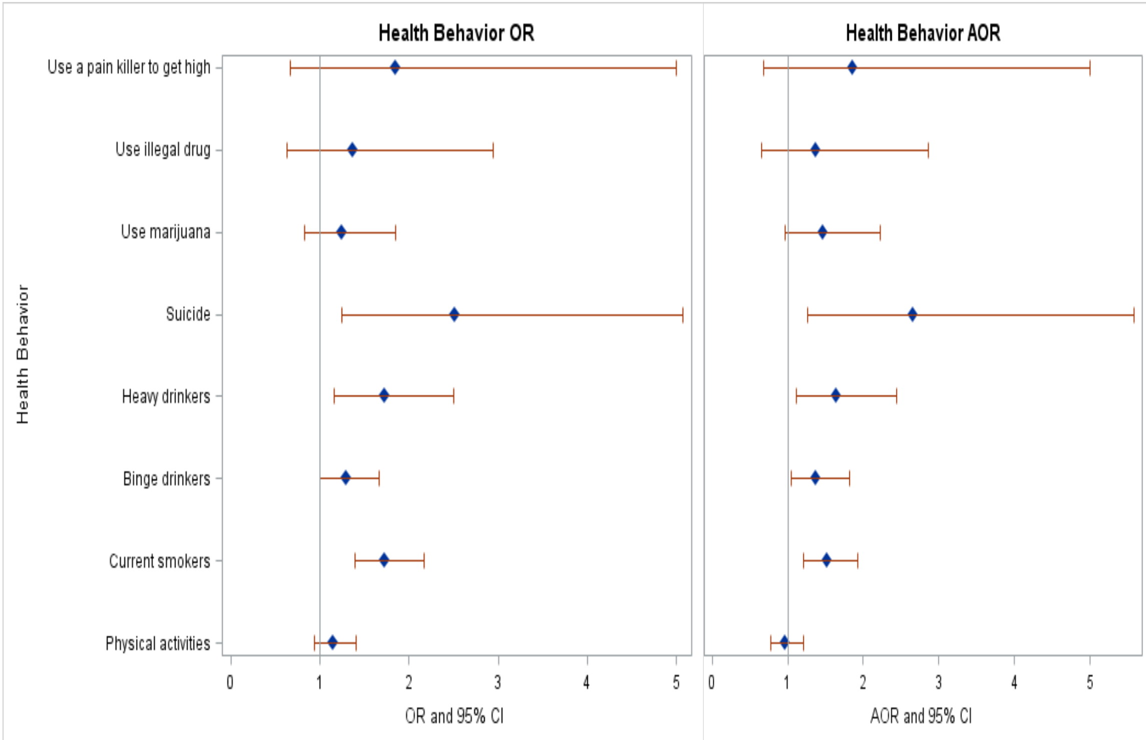

Figure3-3 health risk behaviors comparison (OR and AOR) of the respondents between CGFE and non-CGFE.

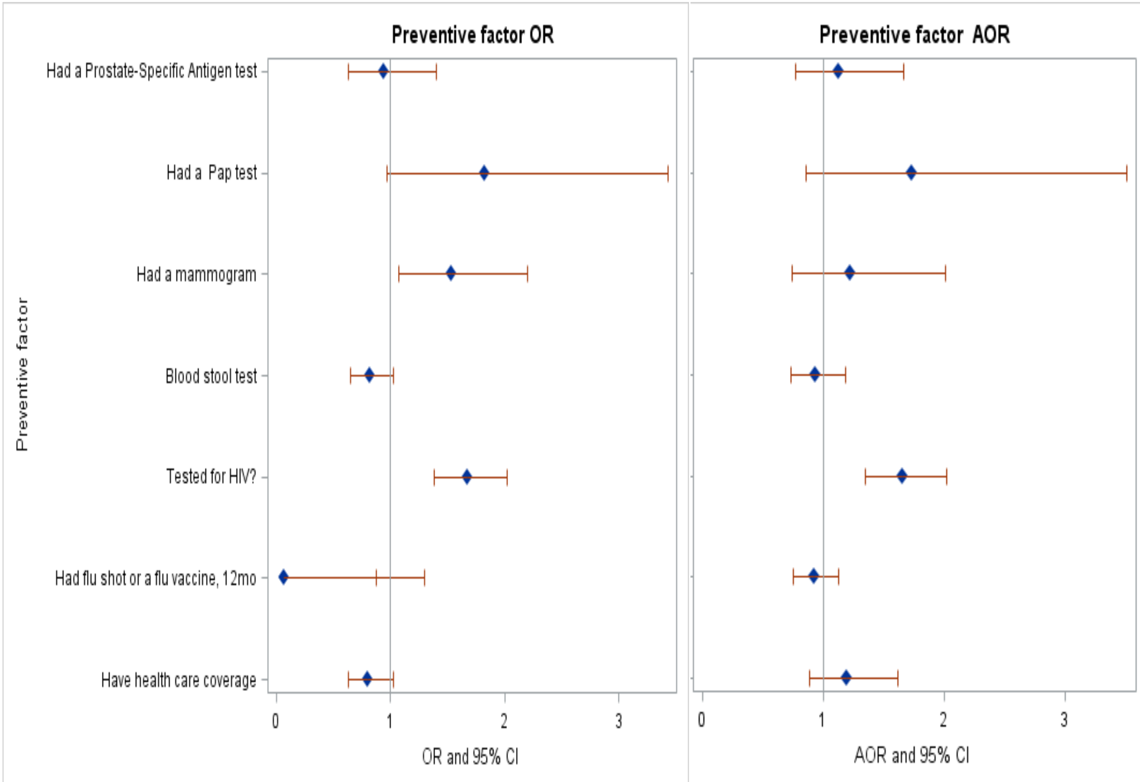

Figure 3-4 Preventive factors comparison (OR and AOR) of the respondents between CGFE and non-CGFE.

3.6. Odds Ratios between CGFE and Non-CGFE for High Risk of Chronic Disease Status

The thirteen chronic disease indicators were the focal point in our study. In order to provide comprehensive assessment of chronic disease status on each individual respondent, Latent Class analysis was carried out to statistically categorize an individual's chronic disease status depending on how they reported on these thirteen conditions. Based on Vuong-Lo-Mendell-Rubin Likelihood ratio test, Lo-Mendell-Rubin adjusted LRT test, and parametric bootstrapped Likelihood ratio test, a model was created to categorize thirteen chronic health indicators into two distinct classes: high risk and low risk. There was 22.4% participants fall into high chronic risk group, and 77.6% were in low chronic risk group. Table 7 describes the high chronic risk rates of the existing exposure to the “casino gaming floor” environment and other behavior risk factors.

Table 7 High Chronic Risk of Casino Gaming Environment and Behavior Risk Factors

Health Behavior	Response	High risk	95% C. I.		P value
Casino floor	Yes	23.6	20.1	27.1	<.0001
	No	16.3	15.2	17.3	
Participate in physical activities	Yes	25.3	23	27.6	<.0001
	No	13.7	12.7	14.7	
Adults who are current smokers	Yes	22.9	20.2	25.6	<.0001
	No	15.1	14.1	16.1	
Binge drinkers	Yes	10.4	8.1	12.7	<.0001
	No	17.6	16.5	18.6	
Heavy drinkers	Yes	17.0	12.6	21.5	0.769
	No	16.4	15.4	17.3	
Suicide	Yes	44.7	31.9	57.6	<.0001
	No	16.9	15.7	18.2	
Marijuana use	Yes	14.1	9.4	18.9	0.252
	No	17.2	16.2	18.2	
Illegal drug use	Yes	18.7	6.3	31.1	0.799
	No	17.2	16.1	18.2	
Pain killer use	Yes	26.4	14.4	38.4	0.078
	No	17.1	16.1	18.1	

Among casino gaming floor employees, the rates of “high risk” are significantly higher than those of who were non-CGFE (23.6% vs. 16.3%, p<0.001). As expected, smoking attributes to the high risk rate (22.9% vs. 15.1%, p<0.001). There is an immense higher rate of high risk among those who “had seriously considered attempting suicide during the past month” (44.7% vs. 16.9%, p < 0.001). It is interesting to find that subjects who participate in physical activities had a higher high risk rate while binge drinkers had a lower rate (25.3% vs. 13.7%, p<0.001 and 10.4% vs. 17.6%, p < 0.001 respectively). There are no statistical significances found in the high risk rates for other behavior risk factors such as heavy drinkers, marijuana use, other illegal drug use, and pain killer use.

Table 8 Odds ratio of high risk of chronic disease for risk effect

Questionnaire	OR	95% C. I.		P value	AOR	95% C. I.		P value
Casino floor	1.59	1.30	1.96	<.0001	1.52	1.20	1.93	0.0005
During the past month, participate in any physical activities or exercises	2.13	1.83	2.47	<.0001	1.56	1.29	1.88	<.0001
Adults who are current smokers	1.67	1.41	1.98	<.0001	1.66	1.36	2.03	<.0001
Binge drinkers	0.54	0.42	0.70	<.0001	0.94	0.71	1.23	0.6314
Heavy drinkers	1.05	0.76	1.45	0.7689	1.18	0.80	1.76	0.4035
During the past month, ever seriously considered attempting suicide*	3.97	2.34	6.71	<.0001	4.57	2.79	7.46	<.0001
During the past month, use marijuana*	0.79	0.53	1.18	0.2529	0.68	0.44	1.06	0.0891
During the past month, use illegal drug*	1.11	0.49	2.52	0.7989	1.37	0.45	4.10	0.5786
During the past month, use pain killer to get high*	1.74	0.93	3.24	0.0819	1.90	0.94	3.85	0.0725

*Nevada added questions

Table 8 shows the results of weighted multiple logistics regression models, for which the objective was to determine the relationship between high risk and casino gaming environment as well as behavior risk factors after controlling such potentially confounding factors as age, sex, and education level etc. Crude odds ratios (OR) were computed with high risk as a dependent variable and a risk factor as the independent variable for each model. While adjusted odds ratios (AORs) were calculated when high risk as a dependent variable and a risk factor as the exposure independent variable plus demographic factors as potentially confounding factor independent variables to each model.

As shown in table 8, after controlling for the potentially confounding factors, AOR for high risk among casino gaming floor (CGFE) employees remains statistically significantly higher than those of who are non-CGFE; In other words, CGFE has 52% increased odds to be at high risk than non-CGFE(1.52, 95% CI 1.20-1.93, $p<0.001$)

Besides presence or absence of the factor of “casino gaming floor”, other statistically significant AORs such as “Participate in any physical activities or exercises during the past month” (1.56, 95% CI 1.29-1.88, $p=0.001$), current smoking (1.66, 95% CI 1.36-2.03, $p<0.001$, and “Ever seriously considered attempting suicide during the past 12 months” (4.57, 95% CI: 2.78-7.46, $p<0.001$) were also found. “Binge drinking” is no longer significant after controlling for the confounders (0.94, 95% CI 0.71-1.23, p=0.631). Results on other behavior risk factors such as heavy drinking, marijuana use, illegal drug use and pain killer use did not show the statistically significant difference for their high risks. The AORs for “heavy drinking”, marijuana use, illegal drug use and pain killer use are 1.18, 0.68, 1.37 and 1.90 respectively. It is noticeable that very few respondents had positive answers to the substance use, therefore, the confidence interval for their ORs or AORs is wider and the chances to be statistically significant is smaller.

Our study data contains variables from individual levels such as age, gender, race, marital status etc. as well as from the community (which county the subjects live), which could be a potential effective modifier if the study results were impacted due to community level influences. On considering possible effect modification by demographic, region-specific models controlling for individuals were also assessed. Multi-level analysis though hierarchical models therefore were utilized to test if the high risk was effected by region-specific factors. Multi-level analysis provides the information of the likelihood of being at high health risk level variation across regions of respondents at a typical county. Using the estimates presented in the “Covariance Parameter Estimates”, we computed the correlation coefficient (ICC) that indicates how much of the total variation in the probability of being at high health risk is accounted for by the counties. In other words, how much percentage of the variability in the ratio for being at high risk of health is accounted for by the counties in our study, and how much percentage of the variability is to be accounted for by the individuals or other unknown factors. To be more meaningful, these coefficients were transformed into predicted probabilities. These predicted probabilities for Clark, Washoe and Other are 0.776, 0.755 and 0.772, respectively, and the region-stratified approach does not provide a test of statistically significant differences between the stratified predictor regions. That is, the health risk level was not significantly correlation with respondents who lived in different regions, therefore the results from weighted multiple logistics models showed in table 8 is valid.

Chapter 4: Discussion

4.1. Methodology Implementations of the Study

BRFSS is a public health surveillance system which enables states to evaluate their disease prevention and health promotion efforts. The purposes of BRFSS include identifying variations and distributions in health-related behaviors, targeting services, addressing emergent and critical health issues, proposing legislation for health initiatives, and measuring progress towards state and national health objectives. One of the advantages of using BRFSS as population-based studies is the standardized uniform design for the demographic and core questions which allow state-to-state comparisons for such sampling information as demographic and core health indicator distributions of the sample and its represented population. Another important advantage of BRFSS is its flexibility that permits states to add questions of their own design to reflect the emerging state specific health and behavior issues. The current study has incorporated four specific questions regarding service industry and gaming floor jobs in addition to other BRFSS health and risk behavior questions.

Although studies have noticed the potential hazards in working environment such as exposure to environmental tobacco smoke (ETS), stress, working shift and noise, there is very limited research on hospitality industry occupational health and studies that focused on casino gaming employees, especially based on the population level. The present project is the first study which utilizes statewide population-based survey data to analyze health status and behaviors among casino gaming employees in Nevada, a state which has more than 50% of the US casinos in operations. Our study enables us to compare the health status and behavior risk indicators between respondents of Nevada and the US, and between Nevada casino gaming employees and non-casino residents.

Besides the innovativeness of collecting data on casino gaming floor employees from a statewide population-based surveillance system, we also utilized several advanced technologies and skills throughout the process of data collection, management, analysis and dissemination. Built on complex sampling survey designed data collection procedures, advanced data analysis methods were applied to best reflect the sample to represent the real statewide population. Technologies involved in management and analysis include multiple imputations for missing values, descriptive statistics, weighted multiple logistics models, latent class analysis and multilevel mixed models.

BRFSS is a selected sample which represents a small part of the population it came from. It should represent all variables measured in the survey. To evaluate a population accurately, it is important to avoid unequal probabilities of selection and unequal patterns of survey non-response (violations). In order to minimize such selection bias as non-response and non-coverage, each respondent was given a weight based on a complex weighing procedure, and weighted multiple logistics models were conducted which were incorporated with the weight factor from each respondent, the strata factor from each regions and the cluster from each household. SAS survey procedures involving strata, cluster and weight were utilized throughout of this study in order to cope with the complex survey design as the sampling and data collection method.

Missing data is a common problem in many data sets. A typical complex sample survey is always experiencing nonresponse and the resulting missing values. It could seriously impact the effectiveness of multiple logistics models. With Multiple imputations, each missing value is replaced by two or more imputed values in order to represent the uncertainty about which value to impute. We used log-linear modeling for the missing data problems concerning categorical variables which involves imputation model formulation, creation of five imputed datasets, and pooled five separate datasets to generate a single set of estimates. SAS multiple imputation and survey procedures were applied to our data formatting prior to other statistical analysis.

Thirteen (13) chronic disease indicators were collected in this study. Besides checking each individual chronic disease indicator, we evaluated the overall chronic status after exposure to casino gaming floor environment and other behavior risk factors. Previous studies often either add all thirteen indicators as an index, treat the index as a continuous variable, or manually categorize them into groups based on numbers of present or absent of individual chronic conditions. However, drawbacks were found when this continues variable was created by giving each indicator an equal weight, or artificially setting a cutoff level by counting numbers of positive indicators, because in a clinical situation, these indicators are most likely unequally attributing to the overall chronic status. Latent Class Analysis (LCA) can establish a latent variable (a variable that cannot be directly measured) and meet our needs to categorize the chronic disease indictors to high or low chronic risk groups. LCA is a statistical method for grouping most likely of related cases (latent classes) from multivariate categorical data. Based on probability hypotheses and procedures, cases in our study were classified to their most likely latent class by means of recruitment probabilities. We have applied M-plus, a statistical software, and programing for the Latent Class procedures.

Multilevel data are very common in the bio-medical sciences, especially in investigating the state-level prevalence of major behavioral risks. When the sample size is larger, information is likely to be observed on nested clusters at multiple levels. BRFSS data has a typical multilevel feature because variables contain individual level (e.g. health status or behaviors of respondent) and community level (county or region in which a respondent resides). Conducting research at these levels while ignoring the detailed nested levels (individuals) may produce inaccurate conclusions. Research has shown that ignoring a level of nesting in data can impact estimated variances, and the available power to detect treatment or covariate effects (Shadish, Cook & Campbell, 2002), can seriously inflate Type I error rates (Wampold & Serlin, 2000), and can lead to substantive errors in interpreting the results of statistical significance tests (Goldstein, 2003). Multi-level statistical analyses are statistical methods that specifically consider hierarchically nested data. They better avoid aggregation bias, inflate standard error and accurately evaluate group- and individual-level effects. Applying the SAS mixed model procedures and hierarchy concepts to the estimates presented in the “Covariance Parameter Estimates”, we computed the correlation coefficient (ICC) that indicates how much of the total variation in the probability of health status is accounted for by the counties. In other words, how much of the percentage of the variability in the ratio for being at high risk of health is accounted for by the counties in our study, and how much of the percentage of the variability to be accounted for by the individuals or other unknown factors. After choosing and applying a series of advanced statistical analysis technologies, the results and conclusions from this study are expected to be more precise and dependable.

4.2. Characteristic of Study Subjects

A total 13,646 respondents completed Nevada BRFSS surveys during 2012 to 2014. When comparing Nevada BRFSS sample to the US BRFSS sample, most demographic distributions are similar to the US except Nevada has a lower percentage of college graduates and a higher percentage of Hispanics than the US average. In order to understand the general health related background information of the Nevada population, 34 health indicators between Nevada and the US were compared before further analyzing the casino employees. There are 11 indicators which did not show statistical significance but 18 other indicators are significantly different from the US respondents (12 better and 6 worse). Among five self-reported general health status indicators, Nevada respondents had a significantly lower rate of reporting being physically unhealthy than the US average. For the 13 chronic disease indicators, lower rates of asthma, cancer, arthritis, depression, impaired vision, diabetes and higher rate of kidney disease were observed in Nevada. Among 4 risk behavior comparisons, Nevada had a higher rate of physical activities, lower binge drinking but had a higher rate of heavy drinkers. In the category of protective indicators, Nevadans had better rates for tests of HIV, Pap, and prostate cancer, but worse rates for the tests of breast cancer, colorectal cancer and a lower flu shot and a lower health insurance rate. The results indicated that Nevada had an apparent better status for chronic disease indicators, and was mixed in preventive indicators and self-described less physically unhealthy status.

According to the US census, Nevada has been ranked the fastest growing state (the US Census, 2010). Previous research has shown that Nevada had an epidemiologic paradox, especially among Hispanic sub-population (Yang, 2009), which refers to have better health outcomes that paradoxically are comparable to their counterparts, even though the study community has a low socioeconomic status and low proactive factors. Research also shows that the health status of migrants depends on the reasons for their migration. If people migrate for employment, they may be healthier, whereas if they migrate to retire, they may initially be healthy, but have impending health problems. In the meantime, Yang and his colleagues (Yang, 2010) found that when comparing to longer-term residents, Nevada newcomers are younger, lower educated and are high percentage of Hispanics. The result showed a certain degree of the "epidemiologic paradox", which might reflect that Nevada has a higher percentage of transit population (Yang, et al. 2010), and tend to support the healthy migrant hypothesis that the newcomers to the state may have better general health than native or longer-term residents.

4.3. CGFE and Health Status, Chronic Health Indicators, Health Risk Behaviors

Among the 13,646 people sampled who completed the Nevada 2012-2014 BRFSS survey, 1,384 individuals reported that they have worked on casino gaming floor (weighted prevalence 11.2%), which snapshots 243,572 Nevada residents from the adult population of 2,174,750 (US Census, website) ever worked on casino gaming floor. Characteristics among the employees who worked on the casino gaming floor indicated that, when compared to the non-casino floor counterparts, the highest proportion in the demographic groups was female, age group of 55-64, divorced, high school or GED education, household income at $35,000-49,999, and Race/Ethnicity as Hispanic. Our results tend to suggest that the jobs on casino gaming floor are relatively less paid and with lower socio-economic status. The collection of the gaming floor employment information in this study was “ever worked”, therefore it should be noted that the current demographics might have time logs compared to current working on gaming floor. 16.1% of the CGFE in age group 55-64 stated that they worked in casino gaming floor, which that may reflect this older cohort have had more changes to work in the gaming industry than those younger groups due to this is a life time experience. Although current gaming status was not able to be assessed because of the limited survey space, the life time gaming industry experience used in this study provides an opportunity to reveal the accumulated health effects, therefore the comparisons subgroups between “ever worked” on gaming floor or “never worked” should be a more appropriate method to use for accumulating the long-term health conditions including chronic diseases and other behavioral risk factors.

If considering the factors that a gaming floor work environment needs to expose to environmental tobacco smoking, noises, and stresses, a low pay must deteriorate the attractiveness for this occupational sector. However, many employees have worked and stayed in this industry because of the job opportunities' less higher education requirement, relatively reliable, benefits, and chances to promote or transfer to other positions in casino. Although job nature and work environment in casinos are quite different from other hospitality sectors, residents in a large gambling center such as Las Vegas, people should be already be suited mentally and emotionally for the gaming positions, and view the working environment as typical hospitality job situations. Since good service quality is the cornerstone of success in casino business, which can be affected by the performance of employees. Quality of work life of casino employees is important. Wan and Chan (2013) studied casino employees' perceptions of their quality of work life from four casinos at Macau, China and found that besides a competitive compensation package, transparent promotion policies, more stable work schedules, and introducing non-smoking work areas are the top needs from the gaming employees. In fact a good quality of work life can make employees more satisfy, more productive and lower organizational costs.

Because of the job specialty, most of the jobs in casino are physically and mentally demanding such as prolonged standing and walking, dealing cards. Employees accost stress, shift work and noise every day. In our study, there is a significant high ratio of "depress disorder", "experience confusion or memory loss" and "arthritis" found in the casino gaming employees. The stress of casino employees not only comes from job itself but also comes from high expectation customers, this supports that besides intensively interactions with customers and need to use variety of emotion and problem-focused strategies to cope with the demands from customers (Anderson, et al., 2002), casino employees may have to face additional stressors coming from customers who emotionally unsatisfied if the gambling outcomes cannot match their expectations.

Previous studies indicated that stress can cause symptoms physiologically, emotionally and behaviorally changes. It might be associated with depression, hypertension, heart disease, anger and place employees at increased risk of morbidity and mortality (Furnham, 1997). Gaming floor occupational exposures to shift work and noise can also be potentially associated with physical, psychological and social health consequences. Reported health effects include sleep disturbance, annoyance, ischemic heart disease, vasoconstriction, hypertension, metabolic syndrome, diabetes and birth defects (Wang XS, 2011, Frost, 2009, AGA, 2012, Evans, 2000, Passchier-Vermeer W, Passchier WF, 2000). Also, standing is a natural human posture. But long term standing usually is designed into a work-related hazard. Studies shown that working in a standing position on a regular basis can cause soft tissue injuries such as sore feet, swelling of the legs, varicose veins, general muscular fatigue, low back pain, stiffness in the neck and shoulders, and other health problems. Excessive standing may causes the joints in the spine, hips, knees and feet to become temporarily immobilized or locked. This immobility can later increase the chance of rheumatic diseases due to degenerative damage to the tendons and ligaments (the structures that bind muscles to bones) (CCOHS, 2016).

Our results shown that there are significantly higher ratios of Asthma and COPD in CGFE (Asthma: 15.3% vs.11.3%, COPD: 10.5% vs. 6.8%, respectively) compare to Non-CGFE. Although we do not have the directly air quality data of casino gaming floor in this study, previous studies have addressed the air quality in casino and confirmed that there is a high level of air pollution due to secondhand smoke. The concentration of $PM_{2.5}$ in casino gaming areas was well above what the Environmental Protection Agency recommends as healthy (Repace 2011). Employees who work directly on the gaming floor, such as dealers, waiter/waitress, racetracks, bingo parlors, and managers etc. may face more severe exposure to SHS than other workforces. Abundant research has proved the associations of multiple diseases of the respiratory tract with smoking. The evidence is sufficient to infer that smoking is the dominant cause of chronic obstructive pulmonary disease (COPD) in the United States (Surgeon General Report, 2014) and smoking causes all elements of the COPD phenotype, including emphysema and damage to the airways of the lung (The U.S. Department of Health and Human Services, 2004, 2010). On the other hand, scientific evidence has established that SHS exposures associated with asthma exacerbation (Kaleta, 2010), environmental tobacco smoke is significant associated with worsened asthma symptoms among children (McCarville, 2013) and smoking worsens asthma in adults who smoke, which means that tobacco smoke can trigger an attack or make an attack worse (Surgeon General Report, 2014).

There is a significantly high ratio (26.3%) of “current smoker” was observed among the CGFE. The reasons for active smoke include psychological issues, habits, social pressures and physical dependence on nicotine. Nevada has a lower percentage of college graduates. High school or GED education, relatively lower socio-economic status is the characters of the gaming floor employees. Research has shown that lower-income and less educated populations are particularly burdened by tobacco use. Surgeon General’s Report on smoking in 1964, smoking has become ever more concentrated among populations with lower incomes and fewer years of education. CDC “Current Cigarette Smoking Among Adults” in 2015 pointed out that 26.3 percent of adults who are below the poverty level smoke, compared to 15.2 percent of adults who are at or above the poverty level; among adults 25 and older, 22.9 percent who do not graduate from high school and 43 percent with a GED smoke, compared to just 7.9 percent of those with a college education and 5.4 percent of those with a graduate degree. (Current Cigarette Smoking Among Adults—United States, 2005-2014.

The results also shown that there is a higher ratio of “binge drinker “(16.2%) and “heavy drinker” (10.3%) among CGFE. “Binge drinker” and “heavy drinker” is significant associated with casino gaming working environment. There are a lot of reasons to alcohol consumption. The one of the reasons is to alter the psychological state and wish to change their mental and emotional status. For example, when dealing with stressful days or nervous situations, people may tempted to have a glass of alcohol calm the nerves. On the other hand, drink alcohol also provides a sense of relief and disassociation from reality. Research shown that alcohol consumption associated with socioeconomic status. People in the most deprived neighborhoods were more likely to binge drink than in the least deprived, but were less likely to report excess consumption (Fone, D. L, 2012).

Nevada Clean Indoor Air Act (NCIAA) is Nevada's smoking laws in order to protect children and adults from secondhand smoke in most public places and indoor places of employment. Today, more than half of the US commercial casinos in Nevada followed the NCIAA. However, balancing the needs of the two distinct sets of smoking and nonsmoking customers, as well as those of the employees, due to the exemptions in NCIAA, smoking is still allowed in gaming areas of casinos. Although some casinos have decided to designate separate rooms or areas on gaming floor as non-smoking, the non-smoking tables are often located next to tables where smoking is permitted. The concentration of $PM_{2.5}$ due to SHS is still higher, gaming floor employees still expose to ETS which $PM_{2.5}$ exceeded the level recommends as healthy.

Our study has found that gaming industry employees are strongly associated with adverse health status, chronic diseases and risk behaviors. Although the findings cannot imply the causal relationship of outcomes due to casino job exposure, approved research apparently pointed out the potential health effects, either causing or worsening, for employees and customers with continuing exposure to these occupational hazards in a casino working environment. NIOSH recommends that workers should not be involuntarily exposed to tobacco smoke. This is best accomplished by totally eliminating tobacco use from any workplace and any public areas. However, before tobacco use can be completely eliminated, casinos should make efforts to protect employees and customers from ETS by isolating areas where smoking is permitted and significantly enhancing the ventilation systems. With the nationwide smoking health risk perception increase and smoking prevalence constantly decreasing among populations and casino customers for past decades, one can expect that casinos will be motivated to minimize and eventually completely eliminate ETS. These are also achievable tasks to reduce job stress, reduce working environment noises and reduce shifting working schedules. Through the quality of work life and needs assessment projects, casinos can obtain firsthand feedback from their employees and improve communications between employers and employees. A healthier employee should be more customer-friendly, more productive, more cost effective, which should be the common goal for both casino employers and employees.

4.4. CGFE and Risk of Chronic Disease

In this study, Latent Class Analysis (LCA) provided the opportunity to convert thirteen (13) chronic indictors to one comprehensive chronic disease status, e.g. high risk of chronic disease vs. low risk of chronic disease. We assessed the relationships between high risk of chronic disease with casino gaming floor (CGF) employment and other behavior risk factors. As expected, as shown in table 8 that after controlling for potentially confounding factors, high risk of chronic disease is highly associated with CGFE and the 52% odds increased if one ever worked in CGFE.

The study indicates that high risk of chronic disease is significantly associated with such risk behaviors as tobacco smoking. Surgeon General Report (2014) has pointed out that "Previous reports have tracked the evolution of cigarettes into the current highly engineered, addictive, and deadly products containing thousands of chemicals that are harmful in themselves, but the burning of tobacco produces the complex chemical mixture of more than 7,000 compounds that cause a wide range of diseases and premature deaths as a result". Also, since "secondhand smoke is the combination of smoke from the burning end of a cigarette and the smoke breathed out by smokers", one would expect a greater harmful effect when exposing to both of these two confirmed hazardous factors from "firsthand smoking" and "secondhand smoking" since an addictive effects even synergism might exist, which means the combined effects of exposures to two or more chemicals is greater than the sum of their individual effects.

It was also interesting that a higher risk chronic disease rate found in the group who with more physical activities, even after controlling for such factors as age, sex or education. Because BRFSS is a cross-sectional design which reflects the current behaviors and accumulated disease prevalence, it is possible that one has been diagnosed with a chronic disease and started to take such actions as physical activities to prevent physical health to be further deteriorated. We also found that binge drinkers have a significantly lower risk of chronic disease, which might reflect people with healthier status having low risk perceptions. However, when controlling for potential confounding factors, the protective factor of binge drinking was no longer significant. It could be attributed to the younger groups having a higher prevalence of binge drinking and yet had a bigger chance that they have not developed chronic diseases in young age.

4.5. CGFE and Protective Factors

Protective factors have been associated with positive health behaviors, including health insurance and preventive tests. The characteristics of individuals who choose healthy lifestyles are extremely important to the overall understanding of positive health behaviors and subsequent risk factors for morbidity and mortality. However, the numerous health indicators in the categories other than preventive factor are one-sided worsen among the gaming floor employees, even after adjusting for potential confounding factors. In this study, when comparing the general health status, chronic disease indicators, risk behaviors and preventive indicators between the gaming floor employees and non-gaming group, we found that although the gaming floor employees had some indicators especially in the preventive factors for the advantage situation, such as having higher prevalence of mammogram test, having health insurance and HIV test, after adjusting for potential confounding factors such as age, sex, education and race/ethnicity, those advantages (except HIV test) were no longer statistical significant but still towards to the positive directions. On the other hand, higher prevalence of HIV test often is considered as positive indicator; however, it might also imply the consequences of exposure to high risk of sexual behaviors.

In occupational health studies, traditionally researchers would expect “healthy worker effects”, which refers to that healthier persons have bigger probability to be selected to the job as well as to be healthy to maintain the job. Apparently, our results did not support the feature for this occupation compare to other jobs. Our study design is cross-sectional sampling which can provide associations and distributions of health status but cannot provide direct causativeness for the health outcomes. There is no evidence indicates that gaming floor jobs might cause these adverse health outcomes and risk behaviors, but the associations are highly significant. Overall, biologically, for the people working on gaming floor, especially doing long term employment, do have the chances to develop chronic diseases after exposing to ETS, stress, noise, and work shifting etc. In terms of health related risk behaviors, at least casino environment would not be protective factors for such behaviors as smoking and alcohol drinking.

4.6. Limitations of the Study

Although this is the first population-based large scale study on casino gaming employee health and behaviors with a series of advanced statistical analyses involved, it should be noted that there are several limitations in this study: 1) The health indicators evaluated are diverse and it cannot expect consistent results or the same weight from each indicator for all indicators; 2) Ever worked on gaming floor occupation information was collected but detailed occupational information such as the duration of job or current exposure questions were not included due to limited spaces a BRFSS system allowed; 3) Cross-sectional epidemiology method was used for the research design and data analysis, we cannot assess changes in individual health status behavior over time, therefore it is impossible to conclude if the associations are causal relationships; 4) The BRFSS does not collect information from institutionalized individuals, thereby excluding individuals residing in nursing homes, long-term-care, and correctional facilities; 5) As a self-report survey, the BRFSS is subject to recall bias and measurement bias, for example, a respondent may have a hard time to recall a health condition or behaviors, or have a hard time to understand the precise diagnosis terminology, and 6) only includes participants who spoke English or Spanish, and no other language available if a respondent does not speak these two languages.

4.7. Facts and Suggestions

During recent years, more and more casinos have noticed the hazard of air pollution on the casino gaming floor and have worked on testing and measuring the indoor air quality, improved the building's mechanical, engineering, electrical and computer systems. Casinos have begun studying air handlers, dampers, ductwork, computer controls and the overall design of each system to make the necessary corrections to improve buildings' ventilation system to achieve a higher efficiency to offset the current IAQ demands and reduce discomfort and health risks for employees and clients. But in order to thoroughly eliminate SHS in casino, smoke free casino is the only way.

The stress of casino employees not only comes from the job itself but also comes from high expectation customers. It would be beneficial employees if casinos provide stress training to the employees before going on duty in order to help them to handle with unsatisfied customers. In addition, positive, relaxing images in employee’s rest areas can be also an effective tool for relieving stress. Studies have shown that virtually any form of exercise can act as a stress reliever; the quickest way to relieve stress is to release endorphins (neurotransmitters that trigger a positive feeling) through exercise. Casinos may provide a gym center to the employees during their rest time for stress relief, to mentally and physically improve the health of the employees and create stable, high-quality guest services.

It is difficult to avoid the ambient noise in casinos such as people talking, glasses clinking, the sound of ratchets rattling as people pull levers, the whirl of the roulette wheel, the music of the machine as the client win, the shouts of encouragement as the dice roll and band performance in casinos. But lowing the sound of bells jingling and wheels clicking and decreasing the times of the band performances may be help to reduce the noise level in casinos.

Chapter 5: Summary

Nevada has the largest gaming industry in the United States with a total of 337 gambling facilities (world casino directory, 2015) and its economy is heavily based on tourism, casino industry is a primary tax source for state revenue. The service sector employs are about half of Nevada's workers. Nevada casinos are the most important component in the development of tourism destinations. In 2012, casino employees in Nevada were 170,206, more than 50% of the total US casino employees (AGA, 2012).

5.1. Previous Studies on Potential Occupational Hazards of CGFE

Previous studies indicated the potential occupational hazards in gaming working environment which include

1) Stress: The nature and work environment of casino gaming is quite different from other hospitality. The career of gaming industry and activities operate seven days a week and 24 hours per day, and are more crowded during weekend and holiday nights (Occupational Outlook Handbook, 2016-17 Edition; Tsaur, 2012.). Most of the jobs are physically and mentally demanding. A challenge for the service industry has always been to provide quality service that satisfies consumers. With intensive interaction with customers, service workers use a variety of emotion and problem-focused strategies to cope with the demands of the performance of such labor (Chiang, 2010; Anderson, 2002; Hu, 2010). Stress can cause side effects on behavior, cognition, and physiology. Studies indicated the associations between stress and

depression, hypertension, heart disease, anger and placed employees at increased risk of morbidity and mortality (Furnham, 1997);

2) Environmental Tobacco Smoke (ETS): Casino gaming floors typically permit tobacco smoking by customers; therefore employees are often exposed to the hazards of ETS from cigarettes, cigars, and pipes in enclosed areas with no windows and insufficient ventilation. Previous studies have confirmed that there is a high level of $PM_{2.5}$ which is mainly due to secondhand smoke in casinos. There are 3.5 million people who die prematurely because of indoor air pollution (British medical journal The Lancet). The EPA concludes that fine particle pollution increases the risk of premature death from heart disease, lung disease and cancers, which are the three top causes of mortality in the U.S. Although the Nevada Clean Indoor Air Act (NCIAA) was affected in 2006, smoking is exempted and is still allowed in such places as gaming areas of the casinos.

3) Shift Work: In the hospitality industry, the working environment is characterized by irregular and long working hours. Shift systems are known to be associated with a variety of psychosocial and physiological problems that can affect the health of employees, including increased risk of metabolic syndrome (Wang, 2011), diabetes (Wang, 2011), autoimmune hypothyroidism (Magrini, 2006), cardiovascular diseases (Frost, 2009, Wang, 2011) and some types of cancer (Wang, 2011; Straif, 2007; Bonde, 2012) compared to the general population. In addition, the spouse and

children constantly try to adapt to altered daily rhythms which further hampers the already complex temporal organization of family life (Vogel, 2012);

4) Noise: Noise from slot machines, gaming tables, loud background sound, and loud customers is usually higher than the healthy level. Study shown that continued exposure does not lead to habituation but the effects worsen. In an elevated noisy workplace, noise can cause such health effects as sleep disturbance, annoyance, ischemic heart disease, vasoconstriction, hypertension, and even cause hearing impairment. Studies have also found the associations between noise exposure and the changes in immune system and birth defects (Passchier-Vermeer W, 2000; Kryter, 1994).

Although plenty of previous research has been conducted on potential occupational hazards of stress, ETS, shift work, and noise, research in the hospitality sub-population, especially focused on casino gaming employees is scarce. No previous publications have been found which report on population-based health status and risk factor behaviors among gaming employees. The present project is the first study which utilizes statewide population-based survey data to analyze health status and behaviors among casino gaming employees in Nevada with the features of uniqueness and advanced statistical analysis, which include a) complex sampling survey designed data collection, multiple imputations for missing values, descriptive statistics, weighted multiple logistics models, latent analysis, and multilevel mixed models.

5.2. The Summary Highlight of the Findings from this Study:

1) 13,646 respondents who completed the survey and 1,384 (weighted prevalence 11.2%) reported that they have worked on casino gaming floor (CGFE);

2) CGFE group has relatively lower socio-economic status including lower income and lower education;

3) Among thirty-three (33) self-reported health indicators compared between CGFE and non-CGFE, twenty (20) did not show statistically significant differences;

4) General health status indicators that are statistically significantly worse among CGFE include poor general health, experience confusion, and poor physical health;

5) Chronic disease indicators that statistically significantly worse among CGFE include asthma, COPD, arthritis, depression, and diabetes;

6) Behavior risk factors that are statistically significantly worse among CGFE include current smoking, binge drinking, heavy drinking, and suicide attempts;

7) Protective factors that are statistically significantly better among CGFE include HIV test;

8) When converting thirteen (13) chronic indictors to one comprehensive chronic disease index, CGFE is highly associated with the high risk of chronic disease conditions.

In general, CGFE has overwhelmingly showed overall worsened health conditions and risk behaviors than the non-CGFE group. Although there is no direct evidence from this study that links the worsened health and behavior outcomes to casino job exposure, sufficient previous research has proved that there are potential health risks after long-term exposure to such occupational hazards as stress and ETS. The factors and determinants that contribute to health outcomes include healthcare, genetics, individual behavior, social environment and physical environment. The current health status and behaviors of the CGFE group should be viewed as a warning sign. Risk perceptions, attentions, concerns and improvement plans are urgently needed by policy makers, public health professionals, CGFE individuals and casino operators.

5.3. Suggestions and Plans

1) Eventually, CGFE workers should not be involuntarily exposed to tobacco smoke. Before tobacco use is able to be completely eliminated from CGFE environment, casinos could make strong efforts to protect employees and customers from ETS by isolating areas where smoking is permitted and significantly enhancing the ventilation systems.

Because awareness of the health risk of smoking has increased nationwide and the prevalence of smoking has decreased among the general population in recent decades, casino could set up a goal to motivate themselves to minimize and eventually completely eliminate ETS. With the nationwide smoking health risk perception increases and smoking prevalence constantly decrease among populations and casino customers for past decades, casinos could setup a goal and to be motivated to minimize and eventually completely eliminate ETS.

2) These are also achievable tasks to reduce job stress, working environment noises and work schedules. Through quality of work life and needs assessment projects, casinos can obtain firsthand feedback from their employees and improve communication between employers and employees. A healthier employee should be more customer-friendly, more productive, more cost effective, which should be the common goal for both casino employers and employees.

3) Although this is the first population-based study on CGFE health status and behaviors, there are limitations of a cross-sectional study design of BRFSS surveys. In order to reveal the causal-effect relationships, further studies with advanced epidemiological designs on casino gaming floor occupational health are needed. For example, A) a case-control study, an observational epidemiological study that can set persons with certain diagnosed diseases as the case group and a suitable control group of persons without the disease but with very similar for socio-economic and genetic factors, then check the CGFE as the suspected attribute factor to the disease; and B) A cohort study design, which is a group of people who share a common characteristic or experience within a defined period (e.g., CGFE employees), and the comparison group may be the general population from the same community but non-CGFE. Cohort studies can either be conducted prospectively or retrospectively from archived records. The study groups follow a group of people who do not have the disease for a period of time and see who develops the disease (new incidence) which strongly aids in studying causal associations; though distinguishing true causality usually requires further corroboration from further clinical tests. One of the critical advantages of prospective cohort study is that it can help

determine risk factors (e.g. CGFE exposure) for contracting a new disease because it is a longitudinal observation of the individual through time, and with a the collection of data at regular intervals, so recall error is reduced.

Reference

A Report of the Surgeon General, 2014 URL: http://www.surgeongeneral.gov/library/reports/50-years-of-progress/50-years-of-progress-by-section.htm

American Gaming Association (AGA) 2012 State of the states: the AGA survey of casino entertainment. URL: http://www.americangaming.org/industry-resources/state-information/nevada.

American Gaming Association (AGA), 2009 URL: https://www.americangaming.org/

Alterman T, Luckhaupt SE, Dahlhamer JM, Ward BW, Calvert GM. Prevalence rates of work organization characteristics among workers in the U.S.: Data from the 2010 National Health Interview Survey. Am J Ind Med, 2012.

America casino guide: U.S. Casinos - Statistics & Facts, 2015. URL: http://www.statista.com/topics/1053/casinos/

American cancer society. Cancer Facts & Figures 2016. URL: http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-047079.pdf

American foundation of suicide prevention. Suicide Statistics. URL:
http://afsp.org/about-suicide/suicide-statistics/. 2014

American Gaming Association (AGA). 2013 AGA Survey of Casino Entertainment.
URL: https://www.americangaming.org/about

Americans for Nonsmokers' Rights (ANR). Americans for Nonsmokers' Rights. URL:
http://no-smoke.org/

Anderson, B., Provis, C., Chappel, S. The recognition and management of emotional
labour in the tourism industry. Bibliography, 2002. ISBN 1 876685 71 9.

Anderson, G., MSW, LCSW, BCD. Anger and Stress in Casinos. URL:
http://www.andersonservices.com

Anderson,B., Provis C., Chappel,S. The recognition and management of emotional
labour in the tourism industry. CRC for Sustainable Tourism Pty Ltd, 2002
Bibliography.ISBN 1 876685 71 9.

Austrin,T., West, J. Skills and surveillance in casino gaming: work, consumption and
regulation. Work Employment Society 2005; 19; 305 DOI: 10.1177/0950017005053175.

Babisch W. Stress hormones in the research on cardiovascular effects of noise. Noise Health. 2003 Jan-Mar; 5(18):1-11.

Babisch W. Cardiovascular effects of noise. Noise Health 2011; 13:201-204

Berman, M., & Post, C. Tobacco Control Legal Consortium, Secondhand Smoke and Casinos. URL: http://andersonservices.com/2007/07/anger-and-stress-in-casinos-2/, 2007.

Berman, M., & Post, C. Secondhand smoke and casinos. Tobacco Control Legal Consortium. Retrieved January 22, 2009, URL: http://www.wmitchell.edu/tobaccoLaw/docu ments/casino.pdf.

Bonde JP, Hansen J, Kolstad HA, Mikkelsen S, Olsen JH, et al. Work at night and breast cancer - report on evidence-based options for preventive actions. Scand J Work Environ Health 38: 380–390.

Boudreau P, Dumont GA, Boivin DB. Circadian Adaptation to Night Shift Work Influences Sleep, Performance, Mood and the Autonomic Modulation of the Heart. PLOS ONE 8(7): e70813. doi:10.1371/journal.pone.0070813, 2013.

Brick, JM., Kalton, G. Handling missing data in survey research. Statistical Methods in Medical Research, 5, 215-238.

Bruce S. McEwen. Physiology and Neurobiology of Stress and Adaptation: Central Role of the Brain. Physiological Reviews 2007 Vol. 87 no. 3, 873-904 DOI: 10.1152/physrev.00041.2006.

Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2016-17 Edition.

CDC, 2011. Asthma in the US. URL: http://www.cdc.gov/vitalsigns/asthma/.

CDC, 1996. Employee Assistance Professionals Association Survey. URL: http://www.cdc.gov/brfss/questionnaires/

CDC, 2013. CDC BRFSS overview 2013.

CDC, 2015. Behavioral Risk Factor Surveillance System technical documents and survey data. URL: http://www.cdc.gov/brfss/annual_data/annual_data.htm, 2015.

CDC"Current Cigarette Smoking among Adults—United States, 2005-2014," Morbidity and Mortality Weekly Report (MMWR), 64(44):1233-1240, November 13, 2015, http://www.cdc.gov/mmwr/pdf/wk/mm6444.pdf.

CDC, 2016. International Cancer Control. URL: http://www.cdc.gov/cancer/international/.

Chiang, F.F.T., Birtch, T. A., Kwan, H. K. The moderating roles of job control and work-life balance practices on employee stress in the hotel and catering industry. International Journal of Hospitality Management 29 (2010) 25–32.

Donner, A., & Klar, N. Design and Analysis of Cluster Randomization Trials in Health Research. London: Arnold, 2000, pp.178, ISBN: 0-340-69153-0.

Eisner MD, Smith AK, Blanc PD. Bartenders' Respiratory Health after Establishment of Smoke-Free Bars and Taverns. JAMA. 1998 Dec 9; 280(22):1909-14.

Evans GW, Johnson D. Stress and open-office noise. J Appl Psychol. 2000 Oct; 85(5):779-83.

Fone, David L., Farewell, Daniel M., White, J., Lyons, Ronan A., Dunstan, Frank D. Socioeconomic patterning of excess alcohol consumption and binge drinking: a cross-sectional study of multilevel associations with neighborhood deprivation. BMJ Open 2013; 3:e002337 doi: 10.1136/bmjopen-2012-002337.

Frey, J. H. and Carns, D. E. (1987), "The Work Environment of Gambling Casinos". Anthropology of Work Review, 8: 38–42. doi:10.1525/awr.1987.8.4.38.

Frost P, Kolstad HA, Bonde JP. Shift work and the risk of ischemic heart disease - a systematic review of the epidemiologic evidence. Scand J Work Environ Health 35: 163–179. 2009.

Furnham, A., Bradley, A. Music while you work: The differential distraction of background music on the cognitive test performance of introverts and extraverts. Applied Cognitive Psychology, vol. 11, 445±455 (1997).

General Surgeon's Report, 2014. URL: http://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm.

George S. Everly Jr., Jeffrey M. Lating. The Anatomy and Physiology of the Human Stress Response

Giovanni COSTA. Shift Work and Health: Current Problems and Preventive Actions. Safety Health Work 2010; 1:112-123 | DOI:10.5491/SHAW.2010.1.2.112.

Goldstein, H. Multilevel Statistical Models, 3rd edtion. Published in 2003 by Hodder Arnold.

Goodman, Leo A. Latent Class Analysis: The Empirical Study of Latent Types, Latent Variables, and Latent Structures. Cambridge, England: Cambridge University Press.pp. 3–55.

Hu, H.H., Cheng C.W. Job stress, coping strategies, and burnout among hotel industry supervisors in Taiwan. The International Journal of Human Resource Management, 21:8, 1337-1350, DOI: 10.1080/09585192.2010.483867.

Institute for Occupational Safety and Health (NIOSH). URL: http://www.cdc.gov/niosh/, 1998.

Ising, H. and C. Braun (2000): Acute and chronic endocrine effects of noise: Review of the research conducted at the Institute for Water, Soil and Air Hygiene. Noise & Health 7, 7-24 Back to cited text no. 6

Johnson EO, Kamilaris TC, Chrousos GP, Gold PW. Mechanisms of stress: A dynamic overview of hormonal and behavioral homeostasis. Neuroscience & Biobehavioral Review, Vol 16, Issue 2, 1992, Pages 115-130.

Julian, Marc. W. The consequences of ignoring multilevel data structures in nonhierarchical covariance modeling. Structural Equation Modeling, 8(3), 325-352, 2001.

Kaleta, D., Kinga Polanska, Piotr Wojtysiak, Anna Koziel, Magdalena Kwasniewska, Paulina Miskiewicz and Wojciech Drygas. Effective protection from Exposure to Environmental Tobacco Smoke in Poland: The world Health Organization Perspective. International Journal of Occupational Medicine and Environmental Health 2010; 23(2):123 – 131 DOI 10.2478/v10001-010-0014-7.

Keefe, Bob O., Cohen, A. Outdoor Air Pollution among Top Global Health Risks in 2010. British medical journal The Lancet, 2012.

Kish, Leslie. Survey Sampling.

Krueger, James M. , Ping Taishi, Alok De, Christopher J. Davis, Bradley D. Winters, James Clinton,James M. Krueger, Ping Taishi, Alok De, Christopher J. Davis, Bradley D. Winters, James Clinton. ATP and the purine type 2 X7 receptor affect sleep. J Appl Physiol 109: 1318–1327, 2010.

Kryter, Karl D. The handbook of hearing and the effects of noise: 11physiology, psychology, and public health. Boston: Academic Press. 11ISBN 0-12-427455-2.).

Lazarsfeld, Paul F., Henry, Neil W. Latent Structure Analysis. Boston: Houghton Mifflin.

Little, R.J.A, Rubin, D. B. Statistical Analysis with Missing Data, 2nd edition. New York: John Wiley.

Lu, Minggen and Yang, Wei. Multivariate Logistics Regression Analysis of Complex Survey Data with Application to BRFSS Data. Journal of Data Science 10(2012), 157-173.

Magrini A, Pietroiusti A, Coppeta L, Babbucci A, Barnaba E, et al. Shift work and autoimmune thyroid disorders. Int J Immunopathol Pharmacol 19:31–36, 2006.

Mark G. Wilson, David M. DeJoy, Robert J. Vandenberg, Hettie A. Richardson and Allison L. McGrath. Work characteristics and employee health and well-being: Test of a model of healthy work organization, 2004.

Maschke C, Harder J, Ising H, Hecht K, Thierfelder W. Stress Hormone Changes in Persons exposed to Simulated Night Noise. Noise Health [serial online] 2002 [cited 2016 Feb 29]; 5:35-45. Available from: http://www.noiseandhealth.org/text.asp?2002/5/17/35/31836

Maslach, C., Schaufeli, W.B., and Leiter, M.P. Job Burnout. Annual Review of Psychology 52, 397–422.

McGuigan, F. J. Encyclopedia of stress. Boston: Allyn & Bacon.

Mio, T., Romberger, D J, Thompson, A B, Robbins, R A, Heires, A, and Rennard, S I. Cigarette smoke induces interleukin-8 release from human bronchial epithelial cells. American Journal of Respiratory and Critical Care Medicine, Vol. 155, No. 5 (1997), pp. 1770-6. doi: 10.1164/ajrccm.155.5.9154890.

Moerbeek, Mirjam. The Consequence of Ignoring a Level of Nesting in Multilevel Analysis. Multivariate Behavioral Research, 39, 129–149.

Murray, David M. Design and analysis of group-randomized trials. Oxford University Press; New York: 1998.

Munzel, T., Gori, T., Babisch, W, and Basner, M. Cardiovascular effects of environmental noise exposure. European Heart Journal (2014) 35, 829–836 doi:10.1093/eurheartj/ehu030.

Muthén, Bengt O. & Muthén,Linda K. Categorical Latent Variable Modeling Using Mplus: Cross-Sectional Data.

National Institute of drug Abuse (NIH). Drug Facts: Nationwide Trends.

Nevada Gaming Revenues, 1984-2014. Calendar Year Revenues for Selected Reporting Areas, February 2015, Center for Gaming Research.

Nich C, & Caroll K. A Comparison of Traditional versus Random-effects Regression Models in the Analysis of Longitudinal Follow-up Data from A Clinical Trial. Journal of Consulting and Clinical Psychology (Impact Factor: 4.85). 05/1997; 65(2):252-61. DOI: 10.1037/0022-006X.65.2.252.

O'Connell, Ann A. An illustration of Multilevel Models for Ordinal Response Data.

OSH Answers Fact Sheets. Canadian Centre for Occupational Health & Safety, 2016.

Pace-Schott, Edward F., Hobson, J. Allan. Basic Mechanisms of Sleep: New Evidence on the Neuroanatomy and Neuromodulation of the NREM-REM Cycle. Neuropsychopharmacology: The Fifth Generation of Progress. Edited by Kenneth L. Davis, Dennis Charney, Joseph T. Coyle, and Charles Nemeroff. American College of Neuropsychopharmacology   2002.

Passchier-Vermeer W, Passchier WF. Noise exposure and public health. Environmental Health Perspectives. Environmental Health Perspectives. 108 (Suppl 1), 123-131.

Repace, J. L., Ruo-TingJiang, Viviana Acevedo-Bolton, Kai-Chung Cheng, NeilE. Klepeis, Wayne R.Ott, LynnM.Hildemann. Fine particle air pollution and secondhand smoke exposures and risks inside 66 US casinos. Environmental Research111 (2011)473–484.

Rose Kamaga Begani, Alphonse Zuivani Begani, Alphonse Zuivani Begani, Kinangase Pokasui. Impact of shift work amongst security guards in Impact of shift work amongst security guards in Madang. Contemporary PNG Studies: DWU Research Journal Volume 18, May 2013.

Rubin, D. B., Multiple Imputation for Nonresponse in Surveys. J. Wiley & Sons, New York.

Rubin, D. B. Inference and Missing Data. Biometrika, Vol. 63, No. 3 (Dec., 1976), pp. 581-592.

Schafer, J. L. The Analysis of Incomplete Multivariate Data.

Schneiderman, N., Ironson, G., and Siegel, S. D. Stress and Health: Psychological, Behavioral, and Biological Determinants. Annu Rev Clin Psychol. 2005; 1: 607–628. doi:10.1146/annurev.clinpsy.1.102803.144141.

Schwartz, Jonathan R.L, and Roth, Thomas. Neurophysiology of Sleep and Wakefulness: Basic Science and Clinical Implications. Curr Neuropharmacol. 2008 Dec; 6(4): 367–378. http://dx.doi.org/10.2174%2F157015908787386050.

Shadish, W., Cook, T., and Campbell, D. Statistical Conclusion Validity and Internal Validity. Boston:Houghton Mifflin, p. 33-63.

Sheng-Hshiung Tsaur, Ya-Yun Tang. Job stress and well-being of female employees in hospitality: The role of regulatory leisure coping styles. International Journal of Hospitality Management, 2012.

Spreng, M. (2000a): Central nervous system activation by noise. Noise & Health 7, 49-57 Back to cited text no. 14

Spreng, M. (2000b): Possible health effects of noise induced cortisol increase. Noise & Health 7, 59-63 Back to cited text no. 15

State of the States. The AGA survey of casino entertainment, 2013. URL: http://www.americangaming.org/sites/default/files/aga_sos2013_rev042014.pdf.

Stevens, M. and Higgins, D.J. Studies of human service practitioners, people in daily contact with others, have shown a high incidence of job burnout. Child Abuse Review Vol. 11:313-331 (2002) DOI: 10.1002/car.754.

Straif K, Baan R, Grosse Y, Secretan B, El Ghissassi F, et al. Carcinogenicity of shift-work, painting, and fire-fighting. Lancet Oncol 8: 1065–1066.

Surgeon General Report, 2004. Smoking & Tobacco Use. URL: http://www.cdc.gov/tobacco/data_statistics/sgr/2004/complete_report/.

Surgeon General Report, 2010. Healthy People 2010: General Data Issues. URL: http://www.cdc.gov/nchs/data/hpdata2010/hp2010_general_data_issues.pdf.

Surgeon General Report on Smoking and Health, 2014. URL: http://academicdepartments.musc.edu/scquits/resources/surgeongeneral.htm

Thomas Mu¨ nzel, Tommaso Gori,Wolfgang Babisch, and Mathias Basner. Cardiovascular effects of environmental noise exposure. Eur Heart J. 2014 Apr 1; 35(13): 829–836.

Tsaur, S.H., Tang, Y.Y. Job stress and well-being of female employees in hospitality:The role of regulatory leisure coping styles. International Journal of Hospitality Management 31 (2012) 1038– 1044.

United States Casino Stats. World casino directory 2015. URL: http://www.worldcasinodirectory.com/.

United States Department of Labor Gaming Services Occupations, 2015. URL: www.bls.gov/ooh/personal-care-and-service/gaming-services-occupations.htm#tab-3.

United States Department of Labor Gaming Services Occupations. Work Environment. URL: http://www.bls.gov/ooh/personal-care-and-service/gaming-services-occupations.htm#tab-3.

United State Commercial Casino Revenues States with Commercial and Racetrack Casino, 2001-2014) UNLV center For Gaming Research, 2015 http://gaming.unlv.edu/reports/national_annual_revenues.pdf

US Census. URL: http://www.census.gov/2010census/.

Van Kamp I, Davies H. Noise and health in vulnerable groups: a review. Noise Health. 2013 May-Jun; 15(64):153-9. doi: 10.4103/1463-1741.112361.

Vermunt, Jeroen K. Multiple imputation of incomplete categorical data using Latent Class Analysis.

Vogel, M., Braungardt,T., Meyer, W. , Schneider, W. The effects of shift work on physical and mental health. J Neural Transm (2012) 119:1121–1132 DOI 10.1007/s00702-012-0800-4.

Wampold, B. E. & Serlin, R. C. The consequence of ignoring a level of nesting in multilevel analysis analysis of variance. Psychological Methods, 5,425-433.

Wan Yim King Pennya, Chan Sow Hup Joanne. Casino employees' perceptions of their quality of work life. International Journal of Hospitality Management 34 (2013) 348–358.

Wang XS, Armstrong ME, Cairns BJ, Key TJ, Travis RC. Shift work and chronic health conditions: the epidemiological evidence. Occup Med (Lond) 61: 78–89 doi:10.1093/occmed/kqr001.

Wells, A. Judson. Lung Cancer from Passive Smoking at Work. American Journal of Public Health. 1998:88:1025-1029.

WHO, 2015. World cancer day. URL: http://www.who.int/cancer/en/.

World casino directory: United States Casino Stats. URL: http://www.worldcasinodirectory.com/american-casinos/casino-list.

World Casino, 2009. URL: http://www.worldcasinodirectory.com/united-states.

Yang, W., Qeadan, F. and Smith-Gagen, J. Examination of Health Behaviors in a Dynamic Population. Journal of Epidemiology and Community Health. 65:1140-1144, 2011.

Yang, W., Qeadan, F., Gagen, S. The Hispanic Epidemiological Paradox in the Fastest Growing State in the US. Hispanic Health Care International. 7 (3), 130-141, 2009.

Yang, W., Qeadan, F., Cook, D., and Smith-Gagen, J. Heterogeneity of Odds Ratios over Time in Cross Sectional Trend Studies: An Overweight-Obesity Example from a Nationwide Population-based Study. Advances and Applications in Statistics. 17 (2), 175-190, 2010.

Yim King Penny Wan. Exploratory assessment of the Macao casino dealer's job perceptions. International Journal of Hospitality Management, 29 (1) (2010), pp. 62–71.