The Impact of Smoking Cessation Duration on The Health-Related Quality of Life (HRQoL) of Adults in The United States

By:

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ABSTRACT

Background: Smoking in all its types is harmful and reduces its consumers' health. Many diseases are linked to smoking. Without doubt, it possible that smoking might decrease individuals' health related quality of life (HRQoL) which includes general health, physical health, mental health and activity limitations.

Aim of the study: As there are no studies that provided a clear and complete understand of the impact of smoking cessation on the health-related quality of life of adult people in the United States. Also, there is no study gave a comprehensive view of the impact of smoking cessation duration on health-related quality of life of adults of United States. For that reason this research intends to investigate behavioral factors that include smoking, quitting smoking and frequency of smoking and its impact on HRQoL of adults in the United States.

Methodology: In this research we intend to use the most recent data from Behavioral Risk Factor Surveillance System (BRFSS) 2014. Several statistical analysis methods will be applied in order to analyze the data using Statistical Analysis System Software (SAS) 9.4.

Results: Smoking in adults increases general health problems more than adults who do not smoke by 16.59%, activity limitations by 124.93%, physical health problems by 38.05%, and mental health problems by 55.59%. Also, quitting smoking within past month in adults increases general health problems by 25.17%, activity limitations by 21.826%, physical health problems by 25.479%, and mental health problems by 106.235% more than in quitting smoking within past 10 years in adults. Additionally,

everyday smoking in adults increases general health problems by 20.466%, activity limitations by 3.052%, physical health problems by 32.355%, and mental health problems by 71.299% more than in not at all smoking in adults.

Conclusion: We can confirm that some behavioral factors which include smoking status, quitting smoking and frequency of smoking affect HRQoL of adults of the United States. More importantly with increased smoking cessation duration, HRQoL of adults in the United States clearly improves.

ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

HIV	Human Immunodeficiency Virus
CDC	Centers for Disease Control and Prevention
COPD	Chronic Obstructive Pulmonary Disease
SIDS	Sudden Infant Death Syndrome
HRQoL	Health Related Quality of Life
BRFSS	Behavioral Risk Factor Surveillance System
ACS	American Cancer Society
FDA	Food and Drug Administration
CO	Carbon Monoxide
CHD	Coronary Heart Disease
ENDS	Electronic Nicotine Delivery System
USB	Universal Serial Bus
CVD	Cardiovascular Diseases
PAD	Peripheral Arterial Disease
SGRs	Surgeons General Report
DNA	Deoxyribonucleic Acid
ED	Erectile Dysfunction
WHO	World Health Organization
SAS	Statistical Analysis System Software
ODS	Output Delivery System
ANOVA	Analysis of Variance
LDA	Linear Discriminant Analysis
OR	Odds Ratio

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Chapter I

Introduction

1.1 Background:

Without doubt smoking in all its types is harmful and reduces its consumers' health. Many diseases are linked to smoking.

In fact according to the CDC, smoking is the primary avoidable cause of death and disease in the United States. More than 480,000 deaths in the United States yearly are caused by cigarette smoking. Statistics shows that deaths caused by smoking are more than deaths caused by the following causes altogether:

-Human immunodeficiency virus (HIV)

-Drug use (Illegal)

-Alcohol use

-Car -accident injuries

-Gun shoot -related incidents

Also, more than 10 times deaths from cigarette smoking of U.S. citizens than deaths of all the wars fought by the U.S. all through history [1].

Being a smoker you are at risk to develop lung disease where the airways and the alveoli in the lungs are damaged. Most cases of lung cancer are caused by cigarette smoking. Approximately 9 out of 10 of lung cancer deaths in both genders are caused by smoking. Also, women death from lung cancer higher than it is due to breast cancer each

year. Smoking is dangerous on people with asthma since that tobacco can induce an attack or make it worse [1].

Among the lung diseases that smoking causes chronic obstructive pulmonary disease (COPD) that includes emphysema and chronic bronchitis [1]. Epidemiological studies showed that smoking is the main cause of chronic obstructive pulmonary disease (COPD) [2]. According to the CDC, 8 out of 10 deaths are resulting from smoking-related COPD.

Also, statistics shows that if you are a smoker (men and women) the risk to die from all causes is increased [1].

Over the last 50 years, the possibility to die from smoking is greater than before in both genders in the United States [1].

The possibility for smokers to develop heart diseases, lung cancer and stroke is higher than nonsmokers. Statistics shows that the risk for smokers to develop coronary heart disease and stroke is 2 to 4 times. In case of lung cancer, the risk in smokers from men is 25 times and in women 25.7 [1].

Moreover, smoking also increase the risk in its consumers to develop cardiovascular diseases. Smoking can cause stroke and coronary heart disease that are one of the main causes of deaths in the United States. According to the CDC, people who smoke less than five cigarettes each day are at risk to have early signs of cardiovascular disease. People who smoke their blood vessels can be thick and narrow which causes a faster heart beat and increase the blood pressure. Having a thick and narrow blood vessel can increase the chance to develop blood clots [1].

Additionally, if you are smoker, the chance to develop any kind of cancer in your body is highly possible. Cancers caused by smoking include Bladder, Blood (acute myeloid leukemia), Cervix, Colon and rectum (colorectal), Esophagus, Kidney and Ureter, Larynx, Liver, Oropharynx (includes parts of the throat, tongue, soft palate, and the tonsils), Pancreas, Stomach, Trachea, Bronchus, and Lung. It is possible that one of every three cancer deaths in the United States would not happen if nobody smoked [1].

In women, smoking can reduce the ability for a woman to become pregnant and, if pregnant, it can affect the baby's health. The risks of smoking before and after birth include early delivery, stillbirth (death of the baby before birth), low birth weight, crib death, Sudden infant death syndrome (SIDS), ectopic pregnancy, and facial clefts in infants. Moreover, smoking affects men's fertility and increase the chance for birth defects and miscarriages [1].

Cigarette smoking affects bones health, oral health (teeth and gums) and decrease ones immunity. Also, it can increase the risk of having cataracts and age-related macular degeneration [1].

Smoking can cause type 2 diabetes mellitus. Also, the chance of smokers to develop diabetes is 30-40% increased than nonsmokers [1].

1.2 Goal and Objectives:

The main goal of this study is to determine the effect of smoking cessation duration on HRQoL on adult people in the United States.

The Objective of this study is:

 Determine the effect of smoking cessation duration on health-related quality of life (HRQoL) of adult people in the United States.

1.3 Research Hypothesis:

Smoking cessation duration have statistically significant effect on health-related quality of life (HRQoL) (involving: general health, activity limitations, physical health and mental health) of adult people in the United States.

1.4 Data & Methods of this study:

This study is going to use the most recent data (2014) from Behavioral Risk Factor Surveillance System (BRFSS) from Centers for Disease Control and Prevention (CDC) in order to determine the effect of smoking cessation duration on HRQoL of adult people in the United States [3].

BRFSS is the first nation system of health surveys using the telephone to get data from the United States residents asking about the conditions of their health. BRFSS data (2014) has 464,664 patients, 38,198 of them stopped smoking [3].

Chapter II:

Literature Review

2.1 Introduction:

Without doubt smoking in all its types is harmful and reduces its consumers' health. Many diseases are linked to smoking (figure 1).

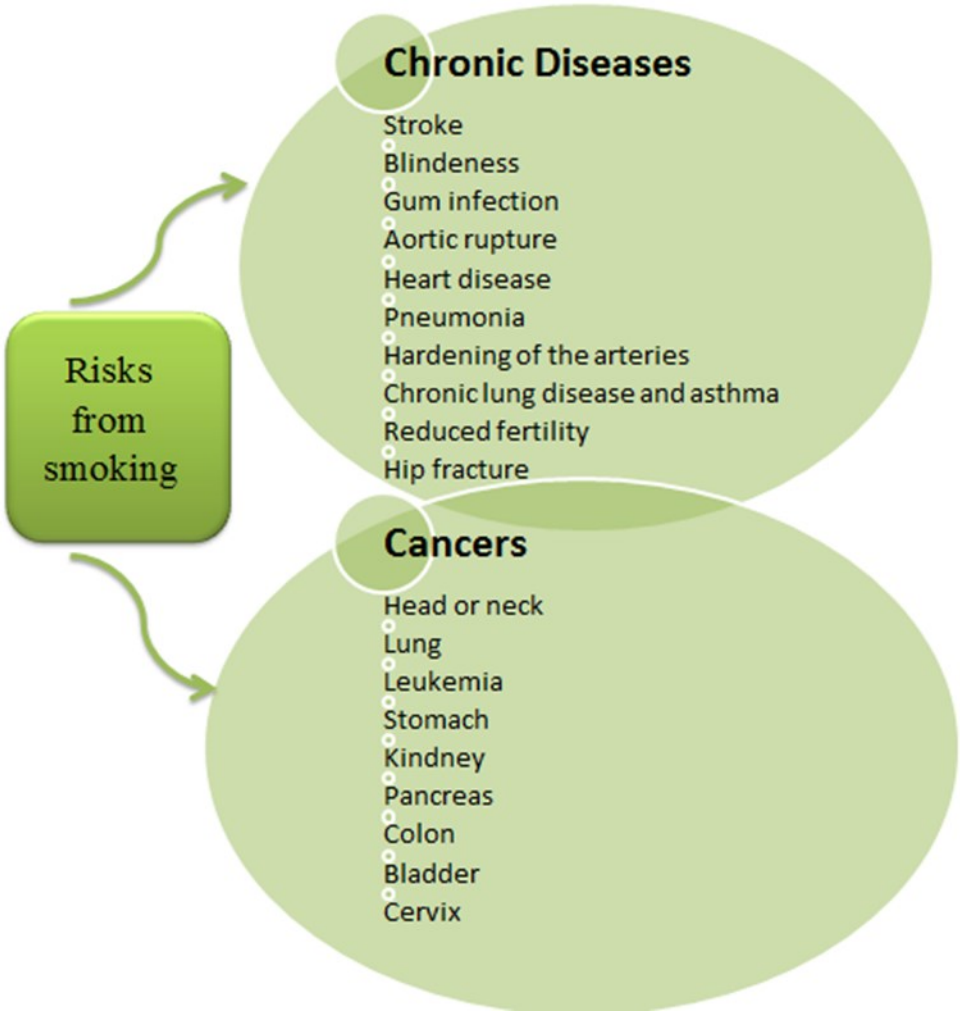

Figure 1. *Risks from smoking* [1].

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yearly are caused by cigarette smoking [1]. Statistics shows that deaths caused by smoking are more than deaths caused by the following causes altogether:

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Also, statistics shows that if you are a smoker (men and women) the risk to die from all causes is increased [1-5].

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Moreover, smoking also increase the risk in its consumers to develop cardiovascular diseases. Smoking can cause stroke and coronary heart disease that are one of the main causes of deaths in the United States [1-6]. According to the CDC, people who smoke less than five cigarettes each day are at risk to have early signs of cardiovascular disease. People who smoke their blood vessels can be thick and narrow which causes a faster heart beat and increase the blood pressure. Having a thick and narrow blood vessel can increase the chance to develop blood clots [1].

Additionally if you are smoker, the chance to develop any kind of cancer in your body is highly possible (figure 1). Cancers caused by smoking include Bladder, Blood (acute myeloid leukemia), Cervix, Colon and Rectum (colorectal), Esophagus, Kidney and Ureter, Larynx, Liver, Oropharynx (includes parts of the throat, tongue, soft palate, and the tonsils), Pancreas, Stomach, Trachea, Bronchus, and Lung. It is possible that one of every three cancer deaths in the United States would not happen if nobody smoked [1].

In women smoking can reduce the ability for a woman to become pregnant and if pregnant it can affect the baby's health [1-7]. The risks of smoking before and after birth include early delivery, stillbirth (death of the baby before birth), low birth weight, crib death, Sudden infant death syndrome (SIDS), ectopic pregnancy and or facial clefts in infants. Moreover, smoking affects men's fertility and increase the chance for birth defects and miscarriages [1].

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Smoking can cause type 2 diabetes mellitus. The chance of smokers to develop diabetes is 30-40% increased than nonsmokers [1-8].

2.2 Is there any safe formula of tobacco?

The negative effects of smoking on consumers' health are not specific on one type. According to the American Cancer Society (ACS) there is no safe formula of tobacco [9].

2.2.1 Hand rolled, natural, herbal, light cigarettes:

Most people who smoke think that light cigarettes or the ones with low-tar have less possible health effect on them. However, many research studies revealed that smoking health effects are not lower even in these kinds of cigarettes. Furthermore, the FDA (Food and Drug Administration) prohibited using the terms "light, mild, and low" in cigarettes trades, only if, with the permission of the FDA [9].

Studies have shown that roll-ups cigarettes have a serious health effect. When comparing the effect of factory-made cigarettes with roll-ups cigarettes, it has been found that the latter have an increased chance to develop different kind of cancers includes larynx (voice box), esophagus (swallowing tube), mouth, and pharynx (throat) [9].

The following is a study conducted by Laugesen, et al., where they compared smoking pattern and instant possible toxicity between roll-ups and machine-made cigarettes in 26 roll-ups and 22 machine-made volunteer male cigarette smokers. The finding of the study is that roll-ups smoking were linked to more exposing to smoke per-cigarette, same breath levels of CO, and even more hazardous than machine-made cigarettes with the use of filters. The study recommended that roll-ups cigarettes packages should have warnings of its true health risks. Even though that roll-ups cigarette contain lower amount of tobacco, were smoked heavily. Users of roll-ups used more time puffing (28 seconds per cigarettes) compared to machine-made (22 seconds). Roll-ups users inhaled 25% of smoke often 17 puffs whereas machine-made users 14 puff. The inhalation of smoke was higher in roll-ups than machine-made by 28%. Moreover, CO boost for tobacco smoked was considerably more in roll-ups than machine-made group (10.8 ppm/g for the first and 7.6 ppm/g for the latter) [10].

Also, nowadays in the smoke trade a type of cigarettes that is being sold as "natural" claimed to be free of chemicals and made with 100% cotton filters. However, no studies proved that those kinds of cigarettes are less risky than other types of cigarettes. Scientists believe that smoke from any kind of cigarettes produces

chemicals and toxins that can cause cancer and other health risks. Having said that even herbal cigarettes that does not contain tobacco produces tar and carbon monoxide that have hazardous health effects [9-11].

2.2.2 Menthol cigarettes:

According to the American Cancer Society menthol cigarettes are more dangerous than unflavored cigarettes. Many menthol smokers tend to use this kind of cigarettes because of the cooling feeling it leaves when inhaled. Thus, it reduces the cough and the dry felling in the throat that smokers usually have. Menthol cigarette smokers can inhale deeper and hold the smoke longer [9]. The following figure shows the increase use of menthol cigarettes among US smokers in 2012-2014 compared to 2008-2010 [12].

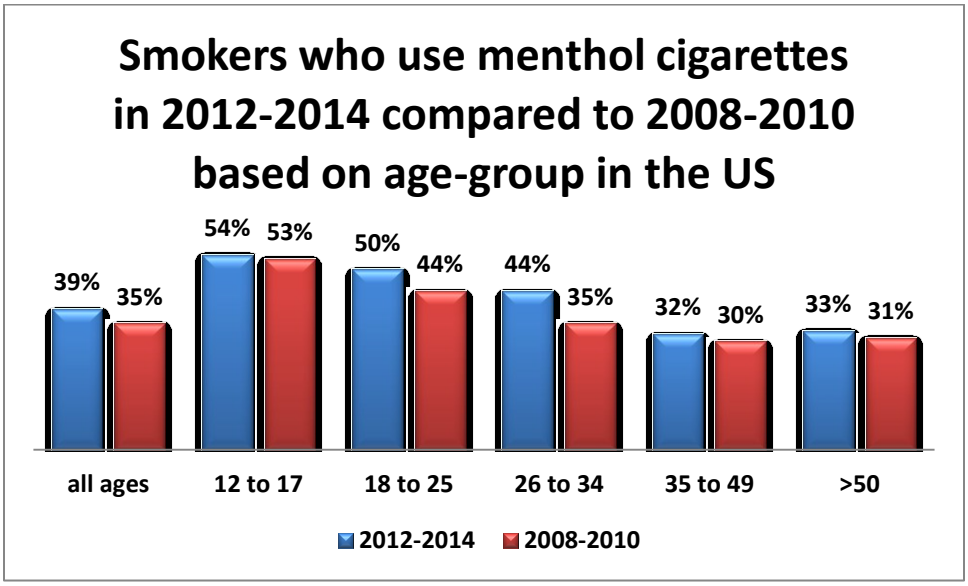

Figure 2. *Smokers who use menthol cigarettes in 2012-2014 compared to 2008-2010 based on age-group in the US* [6].

According to Besaratinia & Tommasi, 2015, menthol cigarettes biological consequences are greater than regular cigarettes. Those biological effects include; but not limited to, the following:

- In-vitro studies revealed that the penetration of tobacco carcinogen nitrosonornicotine and nicotine through mucus tissue, stopping cell production, and cause cytotoxicity are increased by smoking menthol.

- Menthol can extend the presence of the additive toxics components in the body since it delay the metabolism of nicotine.

- It is possible that by adding menthol to tobacco can induce development of other toxic components in the smoke that wouldn't have been appeared without the addition of menthol [13].

2.2.3 Cigars and little cigars:

A lot of people choose cigar smoking thinking that it is less dangerous than cigarettes. In fact one large cigar contains the same amount of tobacco as one pack of cigarettes. The reason that cigars' have a different taste and smell than cigarettes, is the way it is made. The chemical and bacterial reaction that happens when processing cigars changes the tobacco and gives it its unique taste. There are different sizes of cigars that include small cigars, cigarillos (slightly larger), and large cigars (contains tobacco and nicotine that is equal to whole pack of cigarettes). Similar to cigarettes, cigars hold hazardous health effects regardless of it sizes. Statistics shows that the possibility of cigar smokers to die from cancer of the mouth, throat, larynx, and

esophagus is 4 to 10 times than nonsmokers [9,14-15]. Current cigar use in the United States among adults can be viewed in the following figure (3).

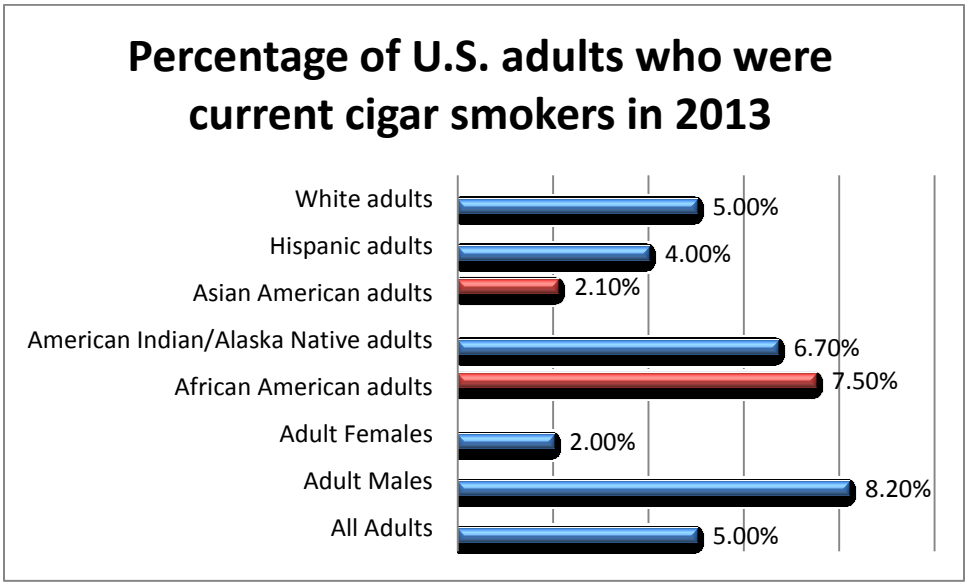

Figure 3. *Percentage of U.S. adults who were current cigar smokers in 2013* [14].

A thorough review has been conduct on the available studies on cigar smoking and all-cause and cause-specific mortality risks. Scientists examined 3 databases of epidemiological studies (22 studies) which observed the relationship between cigar smoking and all-cause deaths and smoking-related deaths. The study identified that cigar smoking was related with all-cause deaths, oral cancer, esophageal cancer, pancreatic cancer, laryngeal cancer, lung cancer, coronary heart disease (CHD), and aortic aneurysm. Even so, relative mortality risk for oral, esophageal, and laryngeal cancers were greatly increased in cigar smokers who didn't inhale smoke [16]. Also, another similar study was conducted to investigate the association between cigar smoking and mortality from cancers of the lung, oral cavity/pharynx, larynx, esophagus, bladder, and pancreas. The results from the study concluded that there is a

strong relationship between cigar smoking and mortality from different types of cancer [17].

2.2.4 Clove cigarettes (kreteks):

This kind of cigarettes is imported from Indonesia. Kreteks contains tobacco, ground cloves and its oil and other flavors. Similar to cigarettes, they are dangerous. This kind of cigarettes and other flavored ones attracts more commonly younger smokers because of its "untrue image" that is all natural and safe. Many lung problems has been reported with kreteks includes low oxygen levels, pulmonary edema, and inflammation. Compared with nonsmokers, kreteks smokers might develop abnormal lung function 20 times more [9].

A study that included 10 adult smokers, scientists observed the amount of nicotine delivered, physiologic, and subjective effects of kreteks cigarettes compared with the participants' own brand. It was found that the average time takes to smoke and amount of puffs is greater in kreteks cigarettes than own brand, which was (549s) and (15.1 puffs) in the first and (314s and 9.4 puffs) in the latter. It was also noticed after smoking kreteks an increase in the arterial plasma nicotine and the produced Carbone Monoxide (17.6 ng/ml; 4.5 ppm) which was not significantly different than after smoking own brand (17.4 ng/ml; 6 ppm). Scientists stated that the participants reported a desirable taste of clove cigarettes which led the study team to expect the reason for this kind of cigarettes to attract younger smokers. The scientists concluded with the fact that clove cigarettes deliver a greater amount of nicotine, Carbone Monoxide and possibly other toxics [18].

2.2.5 Bidis (flavored cigarettes):

This kind of cigarettes created in India and other Southeast Asian countries which uses specific tobacco leafs that are native to Asia. It is mostly common among young smokers in the United States (figure 4) for the reason that it comes in interesting flavors such as cherry and chocolate. Bidis delivers high levels of nicotine 3 to 5 times; even though they have less tobacco than regular cigarettes, which give smokers a quick buzz. People who choose smoking Bidis think that it is a safer choice; however, it has the same dangerous effect as cigarettes. People who use this kind of cigarettes their chance to develop heart attacks, emphysema, chronic bronchitis, and cancer are increased than nonsmokers [9-19].

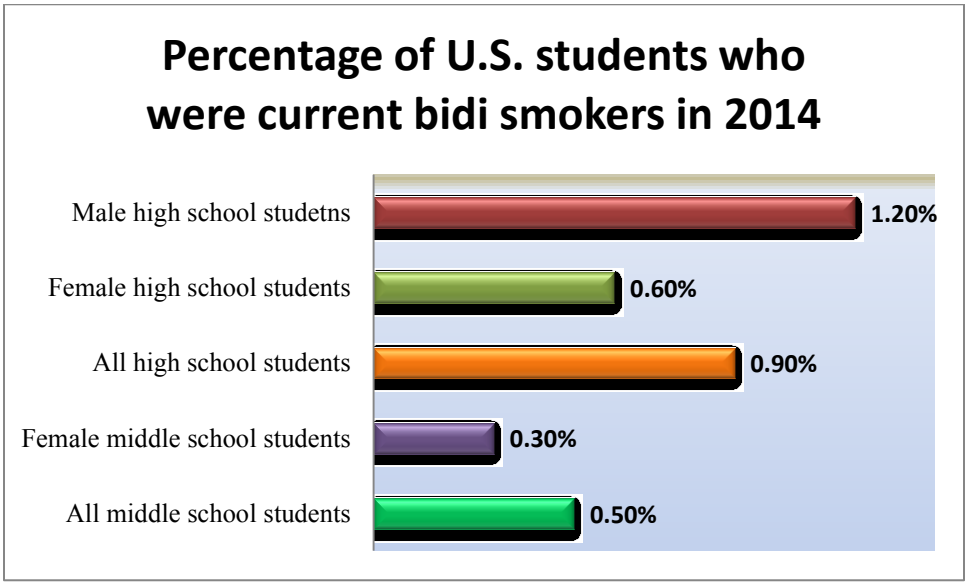

Figure 4. *Percentage of U.S. students who were current bidi smokers in 2014* [19].

2.2.6 Hookahs (water pipes- narghile):

This type of smoking originally started in Asia and the Middle East. It became popular among young US people when gathered to talk and spend time together. It basically works by burning the tobacco that has been flavored. Nowadays new forms of hookah have been around such as steam stones which are used instead of tobacco and rechargeable hookah pens. The latter works the same as electronic cigarettes. The new forms of hookah are claimed to be purer and a better substitute for the regular hookah, however that has not been verified [9-20]. In the smoking sales, hookah is advertised as a safe substitution to cigarettes, yet it is not true. Smoke from hookah contains the same level; or even higher than, cigarettes of toxins such as carbon monoxide, nicotine, tar, and heavy metals. Many health conditions has been linked to smoking hookah includes lung cancer, coronary artery disease, high blood pressure chronic bronchitis, emphysema, dental problems, and osteoporosis [9-21]. Moreover, sharing hookah increase the chance to pass infections [9,22-23].

A recent study was conducted to evaluate the health effects of Shisha or water-pipe smoking in male college students in Kuwait. The study included 525 males in the period between September to October of the year 2013. Demographic and health complaints were collected through a questioner. A comparison was made for the outcome variables of health condition between smoking shisha, cigarettes, or both, and nonsmoking. There were 243 current smokers of the 525 participants, among those smokers 52 smoked shisha, 69 cigarettes and 122 smoked both shisha and cigarettes. The number of smokers who used shisha and reported persistent cough, chest pain and rapid heart rate, were fewer than those who smoked cigarettes. For persistent cough (4 vs. 13% or 2/52 vs. 15/69; $p = 0.007$), chest pain (4 vs. 23% or

2/52 vs. 16/69; p = 0.004) and rapid heart rate (12 vs. 28% or 6/52 vs. 19/69; p = 0.04). However, the results of other health complaints which include asthma, respiratory infections, shortness of breath, high blood pressure and increased blood sugar levels, were similar between the two kinds of smokers. The findings of the study reveals that smoking shisha is not safer than smoking cigarettes with the exclusion of health complaints such as cough, chest pain and rapid heart rate; in fact people who smokes both are in great dangerous to develop worse health effects [24] (figure 5)

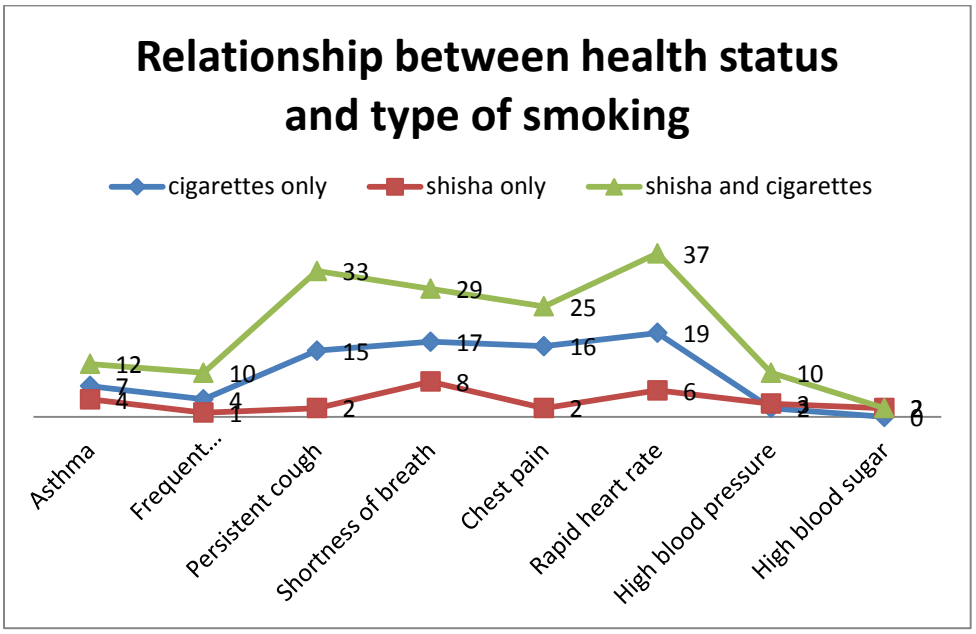

Figure 5. *Relationship between health status and type of smoking* [24].

2.2.7 Electronic cigarettes:

E-cigarettes are a form of electronic nicotine delivery system (ENDS). E-cigarettes mimic different types of smoking include cigarettes, cigars, pipes, or even pens and USB memory sticks [25]. E-cigars look like large cigars and sold as a one-

time use. In places where smoking is prohibited, many tobacco smokers tend to use e-cigarettes to get nicotine which lead to dual users and that will decrease their chance to quit. ENDS when used, it releases toxins include acetaldehyde and formaldehyde. Many studies found that e-cigarettes cause short term changes in the lungs likewise regular cigarettes. Even though ENDS do not work by burning tobacco, it provides nicotine which is an addictive substance that might lead to the use of other tobacco products [9,26-27]. The following figures show the percentage of US adults who tried an e-cigarette and who are e-cigarette smokers in 2014 [28].

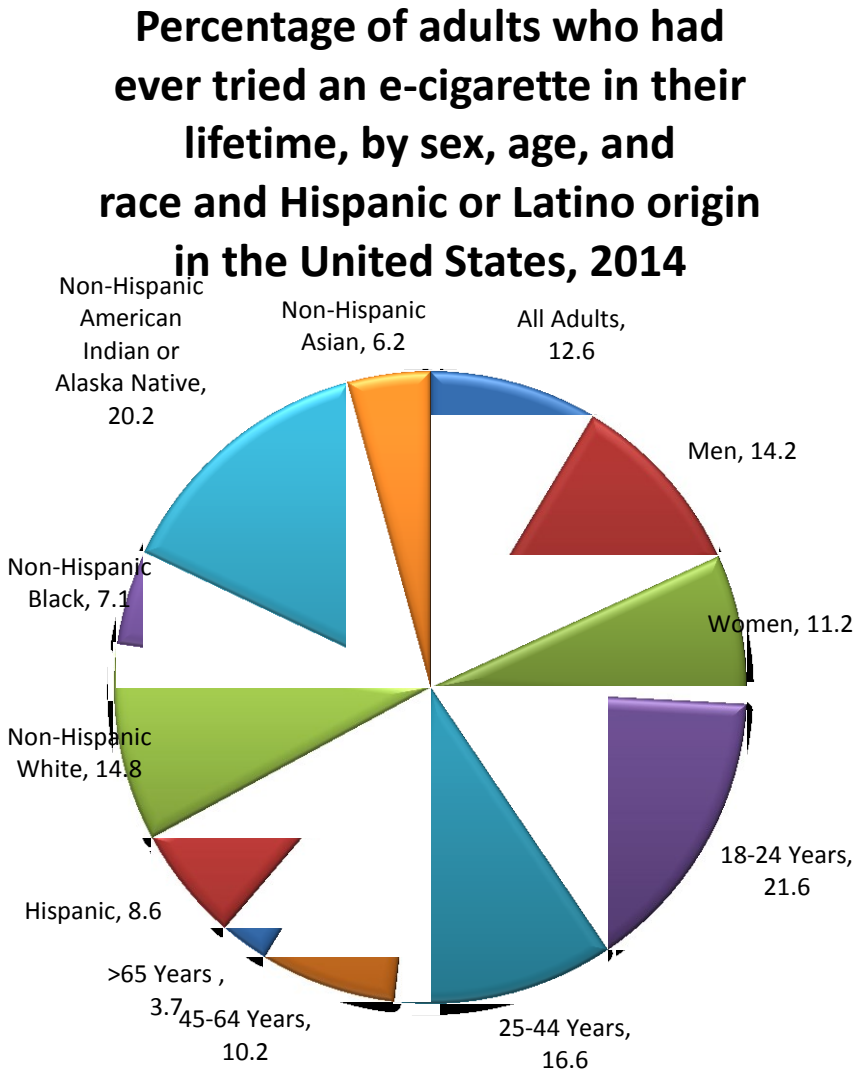

Figure 6. *Percentage of adults who had ever tried an e-cigarette in their lifetime, by sex, age, and race and Hispanic or Latino origin in the United States, 2014* [28].

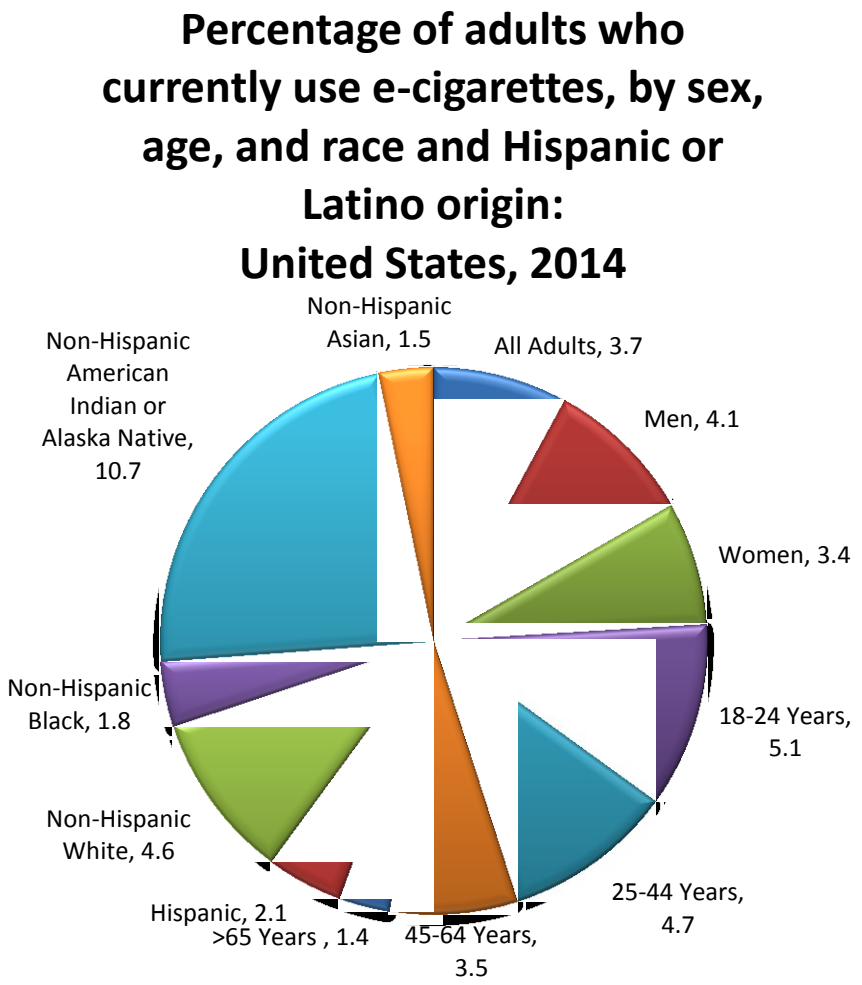

Figure 7. *Percentage of adults who currently use e-cigarettes, by sex, age, and race and Hispanic or Latino origin: United States, 2014* [28].

A recent systematic review on the available literature aimed to evaluate the health outcomes of smoking electronic cigarettes. The search covered 3 data bases which include PubMed, EMBASE and CINAHL. The study included 76 studies which examined fluids and smoke's contents, reports of harmful effects and animal testing

research. Studies identified fine/ultrafine particles, harmful metals, carcinogenic tobacco-specific nitrosamines, volatile organic compounds, carcinogenic carbonyls (some in high but most in low/trace concentrations), cytotoxicity and changed gene expression. However, also it was found some components that are not found in the regular cigarettes such as propylene glycol. Also, some studies reported increased airway resistance following short term exposure [29-30].

2.3 The effect of smoking on women:

The impact of smoking on women lives increased in the last 50 years. In fact, nowadays the risk of dying from smoking among women is the same as men's risk [31]. According to the CDC there are more than 20 million females smokers in the United States. Without doubt, women who smoke are at risk of developing one or more of these health problems such as, heart attack, strokes, emphysema and other illnesses like diabetes. It has been reported that each year there are more than 170,000 American women deaths because of smoking-related diseases [32].

After the 1964 surgeons report on smoking and its effects on health there was a drop of smoking among men. That lead tobacco companies to target women in specific by creating a thin cigarettes packed in soft colors to attract women to infer that smoking could keep women skinny; which led to the increase of smoking among them [19]. It is found that women who are less fortunate with low income, uneducated and have mental health problems are the most likely to smoke nowadays [33]. Also, women who fall into this criterion tend to continue smoking when pregnant and more likely to smoke again after delivering their babies [32-34].

Additionally, individuals with chronic obstructive pulmonary disease (COPD); which is a condition affects the airways, have a shortness of breath and suffer from lack of oxygen that gradually worsen over time and has no cure. The most common condition of COPDs is emphysema and chronic bronchitis [35]. Statistics shows that among 10 cases of COPD, 9 are caused by smoking. The likelihood of women to develop COPD is 38 times higher than non-smokers of women. Also, more deaths among women from COPD than it is in men [32-36].

Half a century ago, yet until now the proof of the relationship between smoking and cardiovascular diseases has increased [37]. In the present time, women who smoke and falls into in the group age 35 and more at increased risk to die from coronary heart disease and an abdominal aortic aneurysm, than smokers of men [32].

Pregnant women who smoke are at risk of having ectopic pregnancy, premature birth, low birth weight, placenta complications and babies with birth defects. It is mandatory for women who plans on getting pregnant to quit smoking before or early in their pregnancy [32,38-39].

2.4 Smoking and cardiovascular diseases:

The relationship between smoking and cardiovascular diseases (CVD) is proved long ago [40-41]. Among 3 deaths from CVD, 1 is caused by smoking. According to the CDC 2014 surgeons report on smoking and its health effects, in the United States CVD considered the leading single cause of death. In the United States every year more than 800,000 deaths are caused by smoking-related CVD, 16 million suffer from heart disease, 8 million had heart attacks and 7 million had strokes [40].

The possibility to develop CVD increases with increasing the number of cigarettes used every day; however, even smokers who smoke less than five cigarettes a day may develop early CVD. Moreover, the risk of developing CVD does not decrease even when using cigarettes with less tar or nicotine [40-42].

It is worth mentioning that in non-smokers the exposure to second hand smoke can cause heart disease, heart attacks and strokes [38-43]. Statistics show that in the United States more than 33,000 deaths of coronary heart disease among non-smokers are due to second hand smoke [40-42].

How through which smoking can affect the cardiovascular system, it is due to cigarette components. Smoke from cigarette releases chemicals that affect the cells of the blood vessels and thus become swollen. The inflammation of the blood vessels can lead to many CVD such as:

Atherosclerosis, which is a condition where the arteries narrow down and harden due to the accumulation of fat and cholesterol, which will form plaque. As plaque builds up in the arteries it will be hard on blood to flow as it should be to the body organs. Being a smoker can increase forming plaque in the blood vessels [40-44].

Coronary heart disease, also a condition caused by narrows blood vessels due to plaque or clots specifically blood vessels that deliver blood to the heart muscle. The chemicals from smoking cigarettes causes thickening of the blood which thus causes blood clots. A sudden death or heart attack can occur due to the formation of blood clots [40-44].

Stroke, is a condition when the body loses brain function and that is due to the disruption of blood flow to the brain. Being a smoker increase the risk of stroke. Statistics showed

that deaths caused by strokes are higher in smokers than non-smokers or former smokers [40-45].

Peripheral Arterial and vascular Disease, a condition also caused by narrow blood vessels that fail to properly deliver the blood to the arms, legs , hands and feet and the tissue in those limbs suffer for the lack of oxygen. In case if the limb is severely affected by this condition, removing it will be essential. In peripheral arterial disease (PAD) smoking is considered the most common preventable cause [40-44].

Abdominal Aortic Aneurysm, a condition caused when a portion of the aorta in the abdomen become swollen or damaged. In case of smoking, early damage to the abdominal aorta is highly possible. Most of deaths due to abdominal aorta aneurysm are caused by smoking. Between men and women, the latter are at higher risk of dying from abdominal aortic aneurysm than the other [40-46].

2.5 Smoking and Cancer:

Smoking can increase ones risk to develop cancer. According to the CDC out of 3 deaths caused by cancer, 1 is related to smoking. In the recent report of the surgeons general report, two cancers are linked to smoking which include colorectal and liver cancer. Colorectal cancer represents the second largest number of death and the fourth mostly diagnosed cancer in the US. Yearly, there are 30,000 new diagnosed cases and 20,000 deaths of liver cancer in the US [47].

According to the Surgeons General Report SGRs the following cancer were identified to be caused by smoking from 1964 to 2014 that include lungs, trachea, and

bronchus, oropharynx, esophagus, larynx, stomach, bladder; kidney and ureter, pancreas, uterine cervix, colon and rectum (colorectal cancer) and liver [47-48].

Lung cancer is one of the fatal diseases in men and women that are caused by smoking. Out of 10 lung cancer cases, 9 are related to smoking. An investigation was conducted by three studies of cancer risks in women and men whose age is over 55 in the US. The studies revealed that in early 1960 the risk of men smokers to develop lung cancer is 12.2 folds than non-smokers; yet the risk had increased to 25. Interestingly, the risk among women who smokes is 2.7 folds than non-smokers; whereas in 2010 increased to 25.7. Even though study in 2000-2010 revealed participants smoked fewer cigarettes than participants in the earlier studies, risk of cancer increased. Recent SGR found out that alterations in cigarettes design and components related to the increase risk of lung cancer in people who smokes [47].

When people smoke, every puff contains several chemical that enters the lungs to the blood stream ending to all body organs. Those chemical causes defects in the DNA which is responsible of the cells production and function. Defects in the DNA lead to mutations in the cells and defect their growth which is the begging to cancer. Approximately 70 of 7,000 chemicals present in cigarette smoke are known to cause cancer [47].

The effect of smoking is not limited to causing cancer but it also impact treatment of cancer. Diagnosed people of cancer who sustained smoking are at increased risk of developing other cancers. Cancer survivors who sustained smoking are more likely to develop cancer in another organ. Also, smoking affects the effectiveness of cancer treatment and increase the chance to treatment complications [47].

2.6 Smoking and diabetes:

People with diabetes their blood sugar is high that lead them to develop many health issues. Approximately 25 million adults are with diabetes in the United States. Diabetes is considered the seventh leading cause of death in the United States nonetheless that it is a worldwide health problem [49].

Many studies directed to prove that smoking can cause type 2 diabetes (adult-onset diabetes). The chance of having type 2 diabetes increases in smokers than non-smokers. Moreover, by increasing the number of cigarettes smoked daily, the chance of developing diabetes increases [49-50].

The process of which smoking cause's diabetes lies in causing inflammation in the body. Chemicals' in the smoke damages the cells and causes them to inflammation and affects their function. Moreover, chemicals in smoke when enters the body combines with oxygen in the blood and causes the condition called oxidative stress. Scientists believe that both of the previous health problems might be associated to increase the chance to develop diabetes. Additionally, investigations have linked between accumulation of fat in the belly (abdominal obesity) and smoking. Abdominal obesity has been known as a risk factor for diabetes since it is associated with increasing the blood sugar by increasing the cortisol hormone. It has been found that cortisol higher in smokers than non-smokers [49-50].

Many studies have been conducted to examine the danger of exposing people with diabetes to high levels of nicotine. Those studies found that this exposure affects the insulin function. For those reasons, diabetic patients needs high doses of insulin to

control their blood glucose. Diabetic patients who smoke are in an increase chance to develop many health problems such as, heart problems, damage to the kidneys, retinopathy and peripheral neuropathy [49].

2.7 Smoking and Reproduction:

Many studies revealed that smoking and exposure to cigarette smoke is harmful to reproduction of men and women. Actually in women, smoking while pregnant or being exposed to second hand smoke harmful for the baby and the mother. The number of babies whose mothers smoke while pregnant in the US is estimated by 400,000 each year. According to the CDC, an estimation of 100,000 babies have died from all kind of complications due to the exposure to cigarette smoke such as, sudden infant death syndrome, prematurity and low birth weight [37-38].

Smoking can impact reproduction and pregnancy from many aspects:

-In case of fertility many studies showed that smoking impact women fertility. Investigations showed that the hormone responsible for production is affected by smoking. Thus it will affect the ability for women who smoke to get pregnant. In case of men, the effect of smoking represented by the alterations in the sperm's DNA which will decrease fertility [37].

-Several researches showed the impact of smoking on pregnancy and being a cause to have an ectopic pregnancy. Ectopic pregnancy is a condition where the fertilized egg attaches to other organs outside the womb instead of moving to the womb. Ectopic pregnancy is a serious condition that is harmful for both the mother and the baby [51-52].

Also studies showed the possibility for miscarriage if the woman smoked during pregnancy [37-38].

-The impact of smoking is extended to affect the baby growth inside the uterus. The chance to deliver a baby with low birth weight is more potential in women who smoke. Also early delivery of the baby is more likely in women who smoke [37,38-53]. Importantly, early delivery and low birth weight are very important causes for babies' disability and death [38].

-Investigation showed that smoking affects the baby growth in the uterus such as the development of the lungs and brain. Specifically the existence of Carbone monoxide in tobacco smoke is destructive for the proper growth of the baby's central nervous system. It is worth mentioning that the effect of smoking on the baby during pregnancy is also extended throughout his life [38-54].

-The effect of smoking during pregnancy also was seen with birth defects. There are 3 out of 100 babies born with birth defects in the US yearly. Smokers of pregnant women are at higher risk to have babies with birth defects such as, cleft lip; where the top of the mouth does form properly. Although cleft lip can be treated by surgery, it affects other aspect of the baby life such as, feeding problems, dental problems and infections of the middle ear [38-55].

-Investigations have shown that the chance of babies with smoking mothers or have been exposed to second hand smoke after birth to die from sudden infant death syndrome than other babies from non-smoker mothers [38-56].

Smoking can impact male sexual function and fertility by causing erectile dysfunction (ED) [57]. ED is a condition where the male is no more able to maintain erection during intercourse, thus impact reproduction. Proper blood flow in erectile tissue is important to maintain erection, however, in smokers once tobacco smoke enters the body it alters the blood flow which leads to ED. ED affects around 18 million male over the age of 20 in the United States [38].

2.8 Health Related Quality of Life (HRQoL):

In order to encourage people who smoke and intend to quit smoking or quitted smoking to sustain quitting smoking, they should be aware of smoking effect on their HRQoL. For doing so, people should understand the factors associated with HRQoL. The description of health related quality of life cannot be limited to a specific definition, since there are different characterizations each focuses on a certain field of health status which contain HRQoL such as, physical, mental and social health. However, we can say that the concept of HRQoL covers all aspects of quality of life that impact individuals' health [58,59-60].

It is very important to measure HRQoL since it is related to both chronic diseases such as, cancer and their risk factors such as, smoking status. Also analyzing the HRQoL surveillance data is very helpful in case if people who smoke and intend to quit smoking or quitted smoking to sustain quitting smoking, because we can locate risk factors and specify the appropriate interventions in order to improve their lives and prevent any severe consequences. Measuring HRQoL according to the CDC by using several assigned questions called the "Healthy Days Measures". These questions cover the individual

general health status, physical health, mental health and activity limitations [58-59] (figure8).

Figure 8. *Radial cycle shows different factors of HRQoL*.

2.9 Smoking Cessation:

Without doubt quitting smoking is a hard thing and many smokers may have several attempts before they succeed. The reason for that is due for being smokers addicted to nicotine; which is according to researchers', addictive as heroin and cocaine. Also one of the reasons to make the quitting process very hard is that smokers once they stop smoking they will experience withdrawal symptoms such as, stress, increase appetite for food, trouble with thinking and anxiety [61].

The benefits of quitting smoking are countless. In diabetes patients the benefits of quitting smoking starts immediately. Many studies showed the increase effectiveness of insulin function of lowering blood glucose eight weeks after quitting [49]. Moreover, it is

not specifically clear which category of smokers at a higher risk of having reproduction problems, however, it is well known that smoking affect the ability to become pregnant, having a healthy pregnancy and having a healthy baby and mother. Also, it is encouraged for males and females to quit smoking in order to improve their reproductive health [38]. For cancer patients quitting smoking lower the chance for them to develop lung cancer and other types of cancer [47]. In case of cardiovascular diseases, by quitting smoking the risk to develop CV disease is reduced [40]. People with respiratory problems such as, wheezing, coughing and shortness of breath, their symptoms might not disappear, however, it will not progress compared with the people with the same symptoms but still smoking [61].

There are different ways to quit smoking; although some smokers have successfully quitted smoking without using any of these methods, researchers found that those methods are very effective. These methods are a doctor advice, group or individual counseling and behavioral therapy. Also, nowadays there are several medications that are known to help smokers to quit such as, nicotine patches, inhaler and nasal spray; which work as a nicotine replacement. There is also bupropion SR (Zyban®),6 varenicline tartrate (Chantix®), which are non-nicotine medications. Studies showed that using medication and counseling are more effective than using one of these methods only [61].

3.1 Factors associated with successful quitting:

According to the CDC, in 2010 there were nearly 7 out of every 10 (68.8%) reported the desire to quit smoking totally in the US. In 2012, there are >4 out of 10 (42.7%) of adult smokers that stopped smoking for more than 1 day in a try to quit, 5 out

of 10 (48.5%) whose age 18-24 years, >4 out of 10 (46.8 %) aged 25-44 years, 4 out of 10 (38.8%) whose age 45-64 years and >3 out of 10 (34.6.5) 65 years or older. In high school cigarette smokers in the past 12 months in 2015, there are 5 out of 10 (48%) tried to quit smoking [61-62].

It is very important to know the factors associated with a successful smoking cessation. Hence, many studies were conducted in order to pinpoint these factors and design cessation programs in order to help those who are at risk for relapse. One of the studies investigated the factors associated with successful smoking cessation is Lee and Kahende in 2000. The study came up with a conclusion that successful smoking cessation is impacted with being the individual in a home with rules against smoking, due to health concerns so didn't switch to light cigarettes, married or living with partner, non-Hispanic White, at least college educated and are 35 years or older [63].

Another study that was introduced in 2014 to investigate the factors associated with successful smoking cessation. The results of the study was concluded with the following factors, having a smoking ban either at home or at work, being unable to afford the high cost of cigarettes, due to health problems or concerns, being pregnant or breast feeding and the bad smell of cigarettes [64].

Additionally anther study was conducted in Switzerland to analyze the factors associated with successful quitting and abstinence duration. The study found that socioeconomic status affects the quitting success and duration of abstinence. In groups with lower socioeconomic status it has been found a lower quitting success and lower abstinence duration compared to the higher socioeconomic groups [65].

3.2 The impact of smoking on economy:

Advocates of the tobacco business are enforcing the importance of tobacco industry by claiming the negative effect of tobacco control on tax revenues, jobs and the economy. They claim that many jobs will be lost and the economy will suffer beside that tax revenues and the income will decrease. Certainly these claims; if true, are not going to affect the economy severely [66-67]. On the contrary, the economic costs of tobacco on the countries are greater. The cost of tobacco not only is measured on the diseases it causes but also on the health-care costs and its effect on the productivity, which both, affects the economy [68].

According to the World Health Organization (WHO) by 2030 it is expected to have 8 million deaths; 80% in low and middle income countries, caused by tobacco [68]. Moreover, the negative effect of tobacco can be seen in many ways such as, fire accidents that happens due to careless smoking, wasting land that are good for growing food and absence from work. Statistics showed that health-care costs related to tobacco 2002 approximately $76 billion in USA, $1.6 billion in Canada, $2.25 billion in UK, $14.7 billion in Germany, $3.5 billion in China, $600 million in Philippines, $6 billion in Australia and $84 million in New Zealand [66]. According to the CDC the health-care costs of tobacco in the US in 2006-2010 estimated to more than $300 billion yearly, $170 billion are for direct medical care [69-70].

In case of fire accidents attributable to smoking based on the WHO data in the US in 2005 are 82,400 with 800 deaths, 1,660 injuries and $575 million of property damages [66]. Between 2008 and 2010, around 7,600 smoking-related fires in houses in the United

States yearly that results in $326 million of property damages [107]. Also, in 2002 in Canada 7,700 accidents, 140 deaths, 470 injuries and $84 million for damaged property. In 2005 in UK there have been 3,200 accidents, 140 deaths, 1,100 injuries. Whereas in Japan, 3,300, 230 deaths and $89 million for damaged property. Worldwide fire accidents are estimated to 1.1 million in 2000, 17,300 deaths, 60,000 injuries and $27 billion for damaged property [66].

There are several studies have been conducted to investigate the effect of tobacco on the economy, society and health. An interesting study which was directed to show the effect of smoking on the individual's financial status specifically in US young baby boomers, they found that smokers tend to purchase tobacco by the money that is in non-smokers being saved (figure 9) [71].

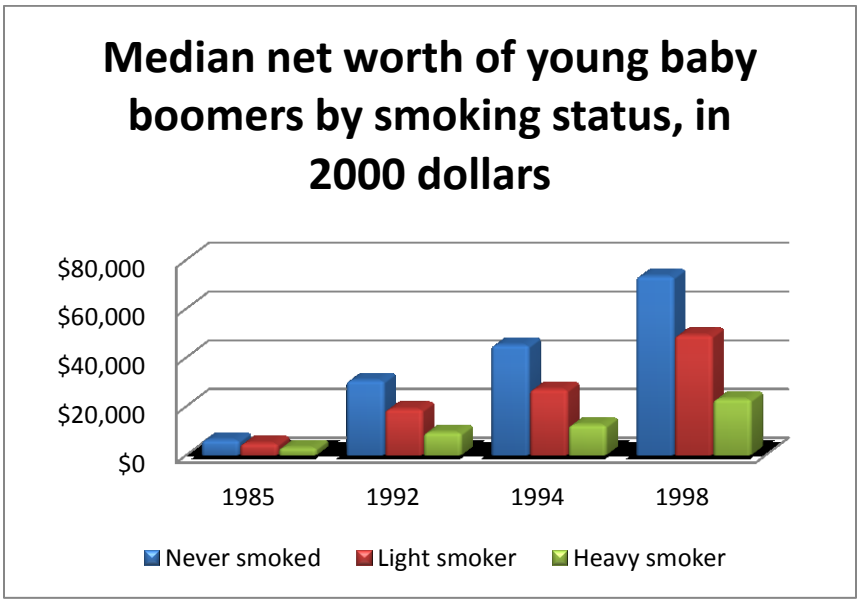

Figure 9. *Median net worth of young baby boomers by smoking status, in 2000 dollars [71].*

Another study aimed to investigate the impact of smoking on the economy and evaluate the usefulness and cost efficiency of smoking cessation measures such as, community, school and media interventions. Researchers found that %6-18 of the health care costs in the US are related to smoking. Also, after evaluating the efficacy of smoking cessation measures researchers found that these measures are clinically sufficient and cost effective [72].

Recent statistics on the impact of tobacco on the economy from The Tobacco Atlas in 2017 stated that tobacco costs to the economy are estimated to around 2 trillion dollars worldwide. Approximately, 30% of the total cost of tobacco are for direct expenses of smoking which include treatment from smoking-related diseases, hospitalization, medication, laboratory tests, etc. whereas most of tobacco costs are attributable to the indirect expenses which include, but not limited to, loss of productivity that is caused by mortality or diseases that are related to smoking [106].

3.3 Research Gap in Literature:

Even with a lot of researches and studies that analyzed the impact of smoking on human health, there are no studies that provided a clear and complete understand of the impact of smoking cessation on the health-related quality of life of adult people in the United States.

Additionally, many studies explained the impact of smoking cessation on humans' health, there is no study gave a comprehensive view of the impact of smoking cessation on health-related quality of life in adults of United States.

In this research we intend to measure with deep investigation the impact of smoking cessation duration on health-related quality of life of adults in the United States. That will be done using Behavioral Risk Factor Surveillance System (BRFSS) data.

Chapter III – Research Methodology

3.1 Research Overview:

Since that our study is based on measuring health related quality of life (HRQoL) which include activity limitations, general health, physical health and mental health, we should point out to the importance of this study on individuals health. Understanding the significant impact of smoking cessation duration on health related quality of life on peoples' lives will allow to a better understanding of the health outcomes and predict any negative effects that should be put in consideration, which based on that it will help in planning for better measures and policies.

The lack of comprehensive studies and investigations that measured the impact of smoking cessation duration on smokers HRQoL in the United States has led us to focus in this research on measuring the impact of smoking cessation on the HRQoL of people in the United States.

The objectives of this study precisely are:

- Investigating the impact of smoking cessation duration on ex-smoker people in the United States.

-Encouraging current smokers on quitting smoking and continuing abstinence duration.

The outcomes of this study will deliver the following:

-The ability to predict health outcomes of the impact of smoking cessation duration on health related quality of life in ex-smokers.

-The study will provide a better understanding of the impact of smoking cessation duration on the HRQoL on ex-smokers which will aid in providing a thorough knowledge of the unknown benefits.

-This research will help people whom about to start to smoke in the future.

3.2 Data Sources and Variables:

This study is going to use the most recent data (2014) from Behavioral Risk Factor Surveillance System (BRFSS) from Centers for Disease Control and Prevention (CDC) in order to determine the effect of smoking cessation duration on HRQoL of adult people in the United States [3].

BRFSS is the first nation system of health surveys using the telephone to get data from the United States residents asking about the conditions of their health. BRFSS data (2014) has 464,664 patients, 38,198 of them stopped smoking [3].

Even so that the information in BRFSS includes several clinical and non-clinical data about each respondent, the study will include the following variables (Table 1) [3]:

Table 1: *Data variable of the study:*

Study Variables	**Name in BRFSS Data**	**Variable Description/Question**
DEMOGRAPHICS		
Age	_AGEG5YR	Fourteen-level age category Categorical Variable. 1=Age 18 to 24 2=Age 25 to 29 3=Age 30 to 34 4=Age 35 to 39 5=Age 40 to 44 6=Age 45 to 49

		7=Age 50 to 54 8=Age 55 to 59 9=Age 60 to 64 10=Age 65 to 69 11=Age 70 to 74 12=Age 75 to 79 13=Age 80 or older
Gender	Sex	Indicate sex of respondent. Categorical Variable. 1=Male 2=Female
BEHAVIORAL FACTORS		
Current Smoking	_RFSMOK3	Are you a current smoker? Categorical Variable. 1=YES 2=NO
Frequency of days now smoking	SMOKDAY2	Do you now smoke cigarettes every day, some days, or not at all? Categorical Variable. Three-groups smoking levels. 1=Every day. 2=Some days. 3=Not at all.
Interval Since Last Smoked	LASTSMK2	How long has it been since you last smoked a cigarette, even one or two puffs? Categorical Variable. Eight-groups quitting smoking levels. 1=Within the past month. 2=Within the past 3 months. 3=Within the past 6 months. 4=Within the past year. 5=Within the past 5 years. 6=Within the past 10 years. 7=10 years or more. 8=Never smoked regularly.
General Health	GENHLTH	Would you say that in general your health is: Ordinal Variable. 1=Excellent 2=Very good 3=Good 4=Fair 5=Poor
Activity Limitations	QLACTLM2	Are you limited in any way in

		any activities because of physical, mental, or emotional problems? Categorical Variable (Binary). 1=YES 2=NO
Physical Health	PHYSHLTH	How many days during the past 30 days was your physical health not good including physical illness and injury? Numerical Variable 1 - 30 Number of days 88=None
Mental Health	MENTHLTH	How many days during the past 30 days was your mental health not good including stress, depression, and problems with emotions? Numerical Variable 1 - 30 Number of days 88=None

3.3 Hypotheses of the research:

3.3.1 First hypothesis of the research:

Table 2.

First hypothesis of the research

Hypothesis	A significant association between behavioral activity which is smoking status and HRQoL which include: activity limitations, general health, mental health and physical health on people in the United States.
Predictor Variables	_RFSMOK3
Outcome Variables	• QLACTLM2 • PHYSHLTH • MENTHLTH • GENTHLTH
Descriptive Analyses	Frequency distribution for _RFSMOK3, QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH
Inferential Analyses	Chi-square test (_RFSMOK3 vs each one of QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH).

Predictive Models	Logistic regression (_RFSMOK3 vs each one of QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH).

3.3.2 Second hypothesis of the Research:

Table 3.

Second hypothesis of the research

Hypothesis	A significant association between behavioral activity which is interval since last smoked and HRQoL which include: activity limitations, general health, mental health and physical health on people in the United States.
Predictor Variables	LASTSMK
Outcome Variables	• QLACTLM2 • PHYSHLTH • MENTHLTH • GENTHLTH
Descriptive Analyses	Frequency distribution for LASTSMK, QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH
Inferential Analyses	Chi-square test (LASTSMK vs each one of QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH).
Predictive Models	Logistic regression (LASTSMK vs each one of QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH).

3.3.3 Third hypothesis of the Research:

Table 4.

Third hypothesis of the research

Hypothesis	A significant association between behavioral activity which is frequency of days now smoking and HRQoL which include: activity limitations, general health, mental health and physical health on people in the United States.
Predictor Variables	SMOKDAY2
Outcome Variables	• QLACTLM2 • PHYSHLTH • MENTHLTH

	• GENTHLTH
Descriptive Analyses	Frequency distribution for SMOKDAY2, QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH
Inferential Analyses	Chi-square test (SMOKDAY2 vs each one of QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH).
Predictive Models	Logistic regression (SMOKDAY2 vs each one of QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH).

3.4 Research Methods:

The analysis of the study's data will include different statistical methods such as, descriptive analysis, inferential analysis and predictive analysis. The software to be used in the statistical analysis is Statistical Analysis System Software (SAS) 9.4, in order to satisfy the goal of this study. Thus, the procedures that will be used in statistical analysis are very important to be explained.

3.4.1 Descriptive Analysis:

Descriptive analysis has several methods that can be employed to describe variables such as, frequency, dispersion, position and central tendency. Yet, our study is better to be described with frequency distribution since that the variables of the study are categorical variables.

3.4.1.1 Frequency Distributions:

Frequency distribution is a good step to take in the analysis of the data since it organizes a heap of data into a compact form. It is considered the basic statistical analysis method that can be used to analyze the frequency of variables in the data. We can have frequency distributions in two ways that include absolute frequencies or relative

frequencies. In case of absolute frequencies that will provide us with a description of the rate of recurrence of a specific value in the variable. On the other hand relative frequencies give us a description of the rate of reoccurrence of a specific value in the variable in relation to the total number of values in that variable. Frequency distribution can be view in different ways that include a table or a graph. The benefits of doing frequency distribution for the researcher are numerous. One of these advantages is that frequency distribution organizes the data in tables or graphs which allow researchers to look into the data suitably. Also, by looking at frequency distribution table/graph researchers can observe the number of each value and whether a variable has a high or low distribution and if they are focused in one area or not [73,74-75-76].

3.4.1.2 Central Tendency:

Central tendency describes the data with one point that represents the whole data. There are three commonly measures in central tendency and each one of them gives a specific suggestion for the central value of the distribution, that include mode, median and mean. The mean (arithmetic mean) is considered that most used and important measure in central tendency. Basically the mean is the total number of the observations in the data divided by the number of observations. The benefit of using the mean due to being uses all the values in the data which gives a good description of the data. On the other hand, the mean is sensitive to outliers which make it unsuitable measure of central tendency in case of skewed distribution. It is worth mentioning that the mean is suitable for interval/ratio type of data [77,78-79].

The second central tendency measure is the mode. The mode is basically one value that repeated continually in the data. It is worth mentioning that one cannot find the mode in some data since each value occur since. While in some cases one can find more than a single mode in the data set. The mode is most frequently used in bimodal distribution. The benefits of using the mode that it is considered the only measure which can be used in nominal scale, and that it is calculated without any trouble. On the other hand, the mode is not a good measure for advanced analysis since it utilizes limited mathematical properties [77,78-79-80-81].

The third central tendency measure is the median. The median when used gives the middle value which in simple words it divides the distribution in half. The benefits of using the median include being easy to calculate, not affected by outliers and applicable when calculating the ratio, interval and ordinal scale. While the shortcoming in the median can be due to not put in consideration every value of the observation and it is not used in categorical variables [77,78-79-80-83].

3.4.1.3 Dispersion (Variation):

Since that central tendency is not sufficient in describing the data set, measure of dispersion can be applied. The measure of dispersion has three common measure that include range, interquartile and standard deviation [83,84].

In case of the range, it is the difference between the largest and smallest observations in the data set. The benefit of using the range as a measure of dispersion is due for its easiness. However, the shortcoming of the range is being affected by outliers. Also, the range does not include all the observations in the measurement [82,83-84-85].

For the interquartile range it gives us the difference between the first and third quartile. The benefit of using the interquartile range is not being affected by outliers. On the other hand the interquartile range cannot be mathematically manipulated which is considered its downside [83, 84,85].

The third measure of the measures of dispersion is the standard deviation. It is the most used measure of dispersion. Standard deviation measures the spread of the data from the mean of the values. The standard deviation is very useful when used with the mean to detect skewness of the data. However, it is useful in case the data is skewed [82,83-83-85].

3.4.1.4 Data visualization:

There are many ways to visualize the data and one of these ways is the use of graphs. There are different types of graphs which provide a visual distribution of the data while others provide a visual relationship within the data set's variables and they called Output Delivery System (ODS) graphics. The graphs that display the distribution of the data are bar charts, histograms and box plot. While scatter plots and series plot are for displaying the relationship between two continues variables [86-87].

3.4.2 Inferential Analysis:

After describing the data set by description analysis, comes inferential analysis in order to infer conclusions about the population. There are parametric and non-parametric methods in inferential analysis. For parametric methods we have one way analysis of variance (one-way ANOVA), linear discriminant analysis and Pearson's product moment correlation coefficient. While non-parametric methods are Chi-square test, Kruskal

Wallis test and Spearman's rank correlation coefficient. In our study Chi square test will be the methods to use since our variables are categorical.

3.4.2.1 One-Way Analysis of Variance (One-Way ANOVA):

It is used in the analysis of how the mean of a variable affected by other factors in the dataset. If we have one factorial design then one-way ANOVA will be used. Yet if there are N of factorial designs then N-way ANOVA will be used [89-90].

Many factors needs to be under consideration when using one-way ANOVA that include indicator variables are normally distributed continuous variables and predictor variables needs to be categorical [89-90].

3.4.2.2 Linear Discriminant Analysis (LDA):

LDA is basically a simple and mathematically strong classification method. Basically LDA is similar to one-way ANOVA, however, it differs that it is used in the analysis of normally distributed numerical predictor and categorical indicator variables [91-92].

3.4.2.3 Pearson's Product Moment Correlation Coefficient & Spearman's Rank Correlation Coefficient:

In order to figure the level of association between tow variables, correlation coefficient is used. The most common correlation tests are Pearson's product moment correlation coefficient and Spearman's rank correlation coefficient. Pearson's correlation figures the level of relationship between two continuous variables. While Spearman correlation figures the level of association between two ordinal variables. If the

correlation has a negative value (under 0) that specifies that there the association between the two variables is negative which means if a variable decrease the other increases and vice versa. However, if the correlation has a positive value (above 0) that means that the association between the two variables is positive which means if a variable increases the other also increase and if one decrease the other also decrease. But, if the correlation value is (0) that means that there is no association between the two variables [93,94-95].

3.4.2.3 Chi-Square Test:

It is a test that measures the association between two categorical variables. There are important factors needs to be put into consideration when using chi-square such as, the data in the cells should be frequencies, the variables categories are exclusive and the variables should be categorical [95-96].

3.4.2.4 Kruskal-Wallis Test:

It is a non-parametric test of one-way ANOVA used when comparing the median of more than two predictor variables. Also, this test is used when there is one ordinal indicator variable and predictor variable of two levels or more [97-98].

3.4.3 Predictive Analysis:

In predictive analysis there are different methods that can be used. Predictive models include simple linear regression, multiple linear regression, simple logistic regression and ordinal logistic regression. In our study the method to be used in the predictive analysis is logistic regression since that our variables are categorical.

3.4.3.1 Linear Regression:

These models measure the relationship between two or more variables. Linear regression has two major types that include simple linear regression and multiple linear regressions. In case of simple linear regression it assesses the association between an outcome (dependent) variable and one predictor (independent) variable. When using simple linear regression we have some factors needs to be put into consideration that include if there is a relationship between the two variables, the average variation are in the same line from the regression line, the points around the regression line have a normal distribution for the predictor variable values [99-100].

In case of multiple linear regressions it is similar to single linear regression in principle, while differs from it that it measures two or more predictor variable and one indicator variable. The factors that needs to be put into consideration when using multiple linear regression beside what was mention for simple linear regression that include, a relationship between two or more than two predictor variable and single indicator variable [99-100].

3.4.3.2 Logistic Regression:

This model used to predict the relationship between predictor variable and indicator variable either categorical or ordinal. Logistic regression has these subtype simple logistic regression and ordinal logistic regression. For simple logistic regression it is used with binary indicator variable. While ordinal logistic regression used with ordinal indicator variable. When using logistic regression, it is important that the relationship between the variables is not high [101-102]. When logistic regression is calculated, we can

obtain the odds ratio (OR). The OR assesses the relationship between a predictor and outcome variable [103].

3.4.4 Statistical Analysis System Software (SAS) Procedures:

After collecting the data and saved it in a SAS form researchers can obtain the results using SAS procedures. There are different procedures that are simple and ready to be used in order to do the analysis. The procedures that we will use in this study include PROC FREQ, PROC UNIVARIATE and PROC LOGISTIC [86-104].

3.5 Research Design:

In the beginning we started looking at the literature available currently on different sources such as PubMed, Rutgers University library, and other websites that has information and articles that are related to our topic. We mainly focused on the impact of smoking-related health problems, smoking related topics and smoking cessation duration on health related quality of life. After conducting the search through literature review we found that no study has given a complete examination and a broad view of the impact of smoking cessation duration on HRQoL of people in the US. For that reason, our aim is to provide knowledge of the impact of smoking cessation duration on HRQoL of people in the United States.

We are planning to use the most recent data (2014) from Behavioral Risk Factor Surveillance System (BRFSS) from Centers for Disease Control and Prevention (CDC) in order to determine the effect of smoking cessation duration on HRQoL of adult people in the United States [3].

BRFSS is the first nation system of health surveys using the telephone to get data from the United States residents asking about the conditions of their health. BRFSS data (2014) has 464,664 patients, 38,198 of them stopped smoking. BRFSS is a public data and stored in a SAS form data set [3].

When starting to use the SAS in order to analyze the data we need to be specific of the variables that would be included. For that reason we will include an IF-THEN in our PROC FORMAT and PROC FREQ statements to exclude any unwanted information.

Even so that the information in BRFSS includes several clinical and non-clinical data about each respondent, the study will include the following variables:

1- Demographic variables that include: Age, Sex and Race.
2- Behavioral variables that include: Smoking Status, Interval since last smoked, Frequency of days now smoking.
3- Health related quality of life (HRQoL) that includes: Physical Health, Mental Health, General Health and Activity Limitations.

Before choosing the appropriate procedure in order to perform all the data analysis which is descriptive, inferential and predictive, we need to know the nature of the variables. All the dependent and independent variables in our study are categorical.

In the descriptive analysis we will use frequency distribution in order to describe the variables. The procedure that will be applied is PROC FREQ.

For inferential analysis we will detect any association between the variables using Chi-square test.

Our hypotheses that will be tested are as follow:

The first hypothesis states that there is a significant association between behavioral activity which is smoking status and HRQoL which include: activity limitations, general health, mental health and physical health of people in the United States. So we will examine the association between smoking status (_RFSMOK3) and the HRQoL variables (QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH) by using CHISQ option in the PROC FREQ statement.

The second hypothesis that suggest a significant association between behavioral activity which is interval since last smoked and HRQoL which include: activity limitations, general health, mental health and physical health of people in the United States. We will examine the association between the interval since last smoked (LASTSMK) and HRQoL variables (QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH) by using CHISQ option in the PROC FREQ statement.

The third hypothesis of the research states that there is a significant association between behavioral activity which is frequency of days now smoking and HRQoL which include: activity limitations, general health, mental health and physical health of people in the United States. The association between frequency of days now smoking (SMOKDAY2) and HRQoL variables (QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH) will be tested by using CHISQ option in the PROC FREQ statement.

In the predictive analysis we will use the procedure PROC LOGISTIC (logistic regression) in order to test our first, second and third hypothesis.

Chapter V – Research Results

4.1 Introduction:

The number of patients in the BRFSS data consists of 464,664 patients, 62258 of them are smoking. Current smoking variable (_RFSMOK3) is a categorical variable: Yes or No.

Table 5: *Distribution of respondents by smoking status.*

Currently smoking?	No.	Weighted %
Yes	62258	15
No	352864	85

4.2 Descriptive Analysis:

Frequency distribution will be used since that all the variables in this research are categorical variables, rather than using other methods.

According to the distribution of adult patients by sex, female represents a higher percentage than male (58.4, the later 41.6). The sex variable is a categorical variable: Male and Female.

Table 6:

Distribution of adult respondents by Sex

Respondents Sex	No.	Weighted %
Male	172684	41.6
Female	242438	58.4

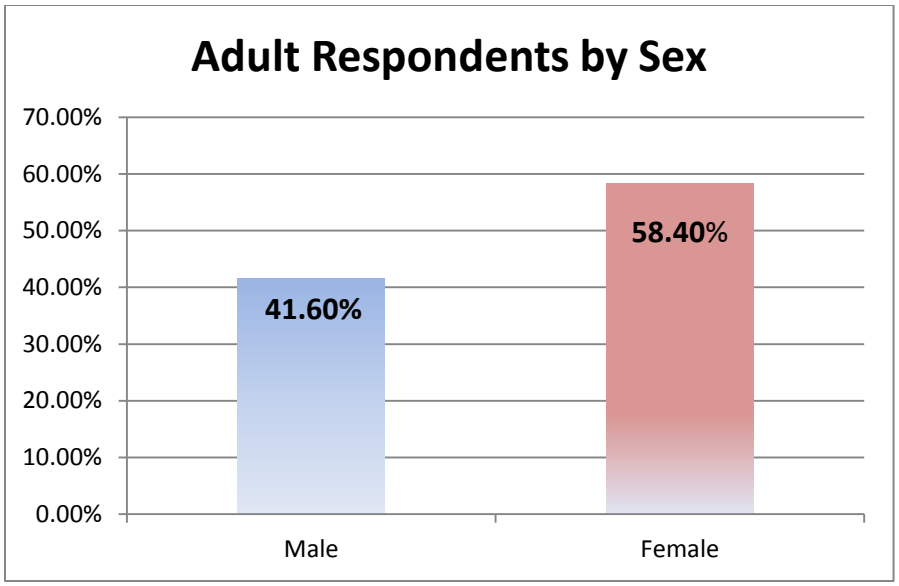

Figure10 . *Adult Respondents by Sex***.**

Table 7: *Sex-adjusted distribution for adult respondents (2011-2013).*

Respondents Sex	No.	Weighted %
Male	197274	48.63
Female	294559	51.37

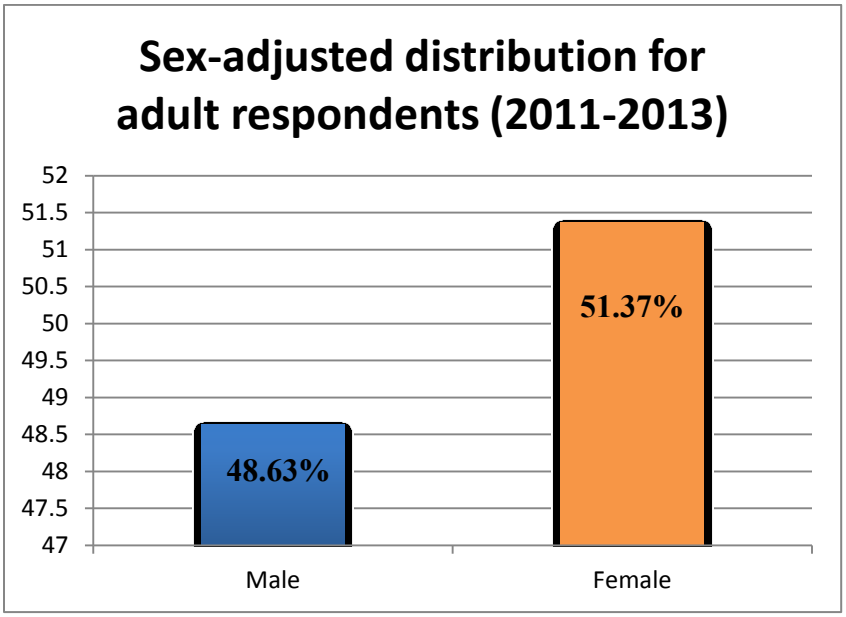

Figure 11. *Sex-adjusted distribution for adult respondents (2011-2013).*

Also the sex-adjusted distribution for adult respondents shows that females have a higher percentage than males.

The distribution of adult patients by age is represented by the variable (_AGEG5YR). the _AGEG5YR is a categorical includes fourteen age categories each represents specific age group as follow, age 18 to 24, age 25 to 29, age 30 to 34, age 35 to 39, age 40 to 44, age 45 to 49, age 50 to 54, age 55 to 59, age 60 to 64, age 65 to 69, age 70 to 74, age 75 to 79 and age 80 or older.

Table 8:

Distribution of Adult People by Age

Reported age in five-year age categories	No.	Weighted %
age 18 to 24	21997	5.3
age 25 to 29	18168	4.38
age 30 to 34	21624	5.21
age 35 to 39	23408	5.64
age 40 to 44	26251	6.32
age 45 to 49	30044	7.24
age 50 to 54	39756	9.58
age 55 to 59	45222	10.89
age 60 to 64	48020	11.57
age 65 to 69	46141	11.12
age 70 to 74	36008	8.67
age 75 to 79	25739	6.2
age 80 or older	32744	7.89

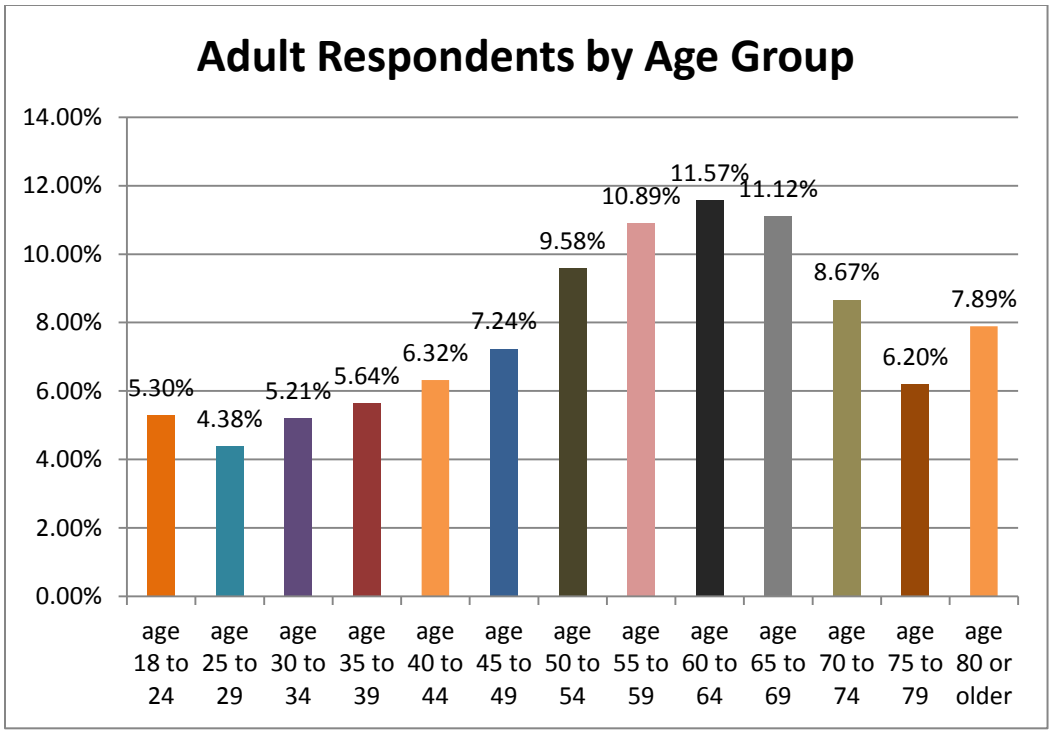

Figure 12. *Adult Respondents by Age Group.*

Table 9:*Age-adjusted distribution for adult respondents (2011-2013)*

Reported age in five-year age categories	No.	Weighted %
age 18 to 24	25049	12.99
age 25 to 29	22129	8.23
age 30 to 34	18745	9.09
age 35 to 39	28544	7.75
age 40 to 44	32890	9.08
age 45 to 49	37881	8.26
age 50 to 54	48211	10.34
age 55 to 59	52670	8.01
age 60 to 64	52226	7.63
age 65 to 69	48298	5.71
age 70 to 74	38804	4.32
age 75 to 79	30115	3.68
age 80 or older	40704	4.35

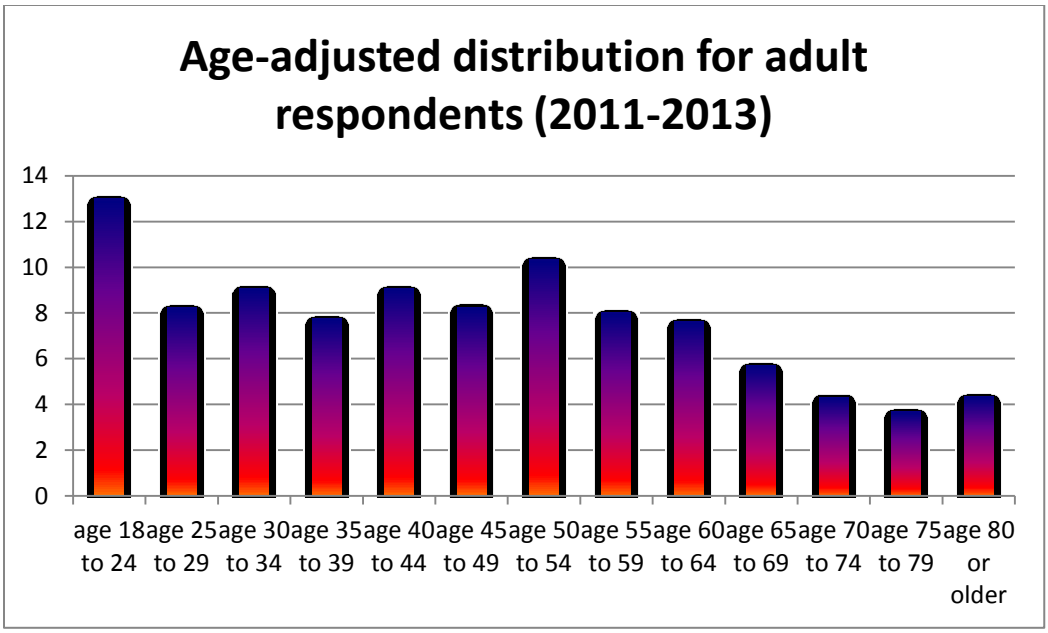

Figure 13.*Distribution of adult respondents by age*.

The variable (_RACE) represents the ethnicity of adult people. The (_RACE) variable have 8 categories that includes, White, Black or African American, Hispanic or Latino, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, don't know or not sure and some other group.

Table 10:

Distribution of Adult Respondents by Race

Race-Ethnicity Grouping	No.	Weighted %
White	326913	78.76
Black or African American	30732	7.4
Hispanic or Latino	6227	1.5
Asian	8131	1.96
Native Hawaiian or other Pacific Islander	1542	0.37
American Indian or Alaska Native	1746	0.42
don't know or not sure	8077	1.95
some other group	31687	7.63

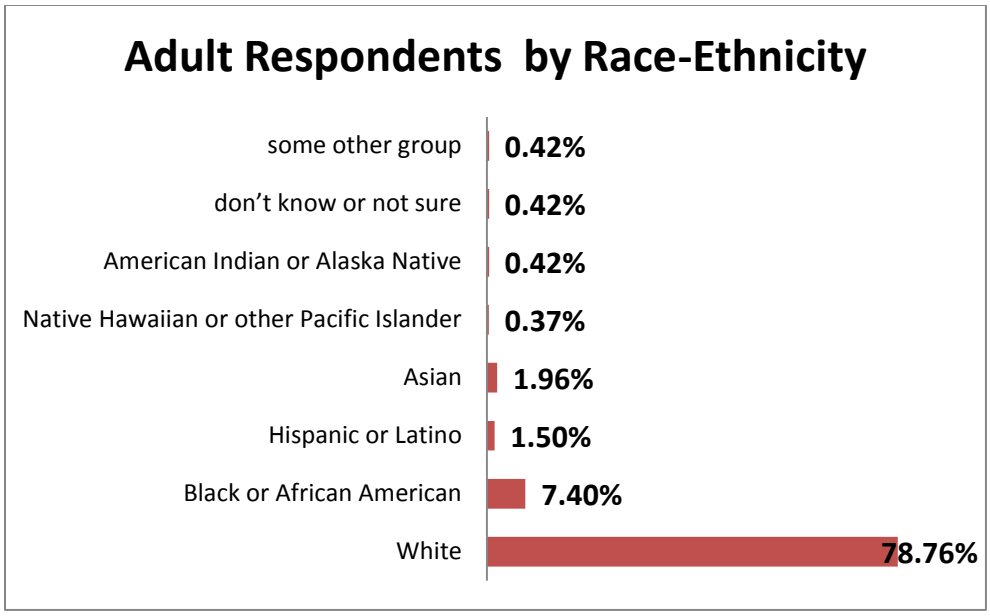

Figure 14. *Adult Respondents by Race-Ethnicity.*

Table 11: *Race-adjusted distribution for adult respondents (2011-2013)*

Race-Ethnicity Grouping	No.	Weighted %
White	140111	67.62
Black or African American	13883	6.75
Hispanic or Latino	13471	17.73
Asian	3224	2.90
Native Hawaiian or other Pacific Islander	969	0.33
American Indian or Alaska Native	2535	1.92

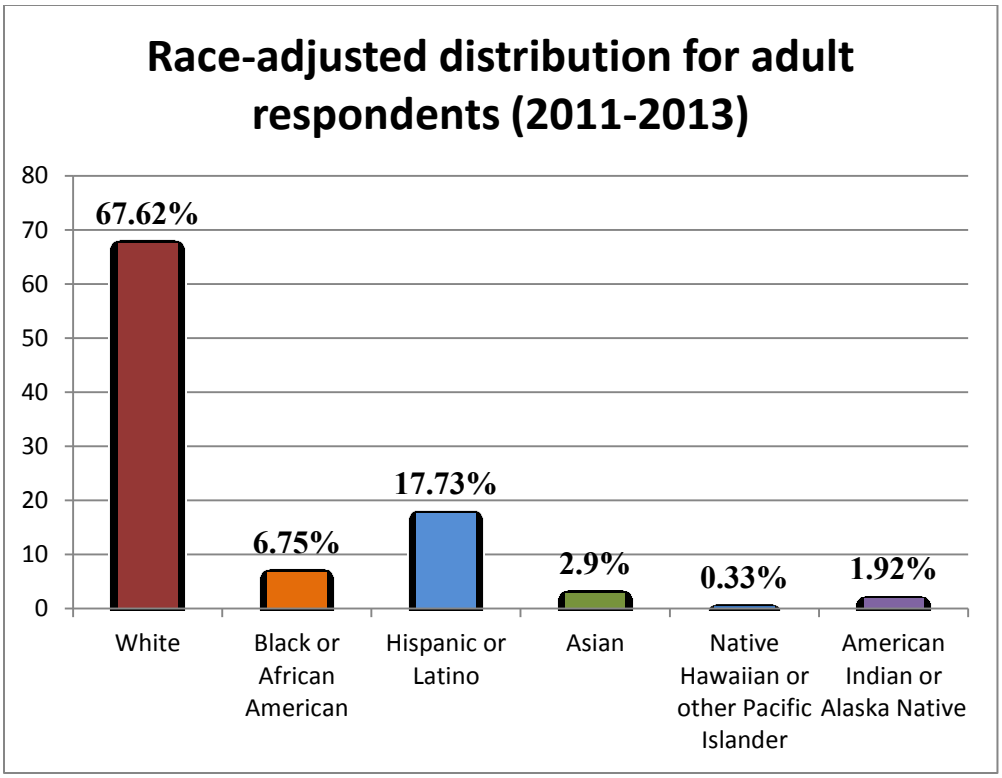

Figure 15. *Race-adjusted distribution for adult respondents (2011-2013).*

4.2.1 Descriptive Analysis of Behavioral Predictor Variables:

Current smoking variable (_RFSMOK3) is a categorical variable: Yes or No.

Table 12:

Distribution of Adult Respondents by Current Smoking Status

Currently smoking?	No.	Weighted %
Yes	62258	15
No	352864	85

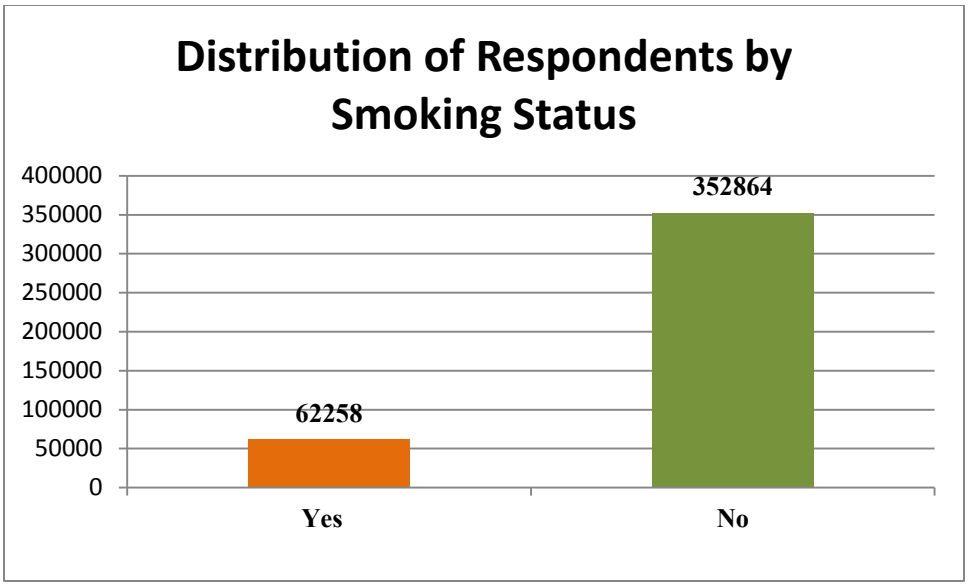

Figure 16. *Distribution of Adult Respondents by Smoking Status*.

The variable SMOKDAY2 is a behavioral categorical predictor variable. It represents the frequency of days now smoking. It has 3 categories that include every day, some days and not at all.

Table 13: *Distribution of Adult Respondents by Frequency of Days Now Smoking*

Frequency of Days Now Smoking		
Category:	No.	No. (Weighted %)
Every day	34775	24.24%
Some days	13869	9.67%
Not at all	94791	66.09%

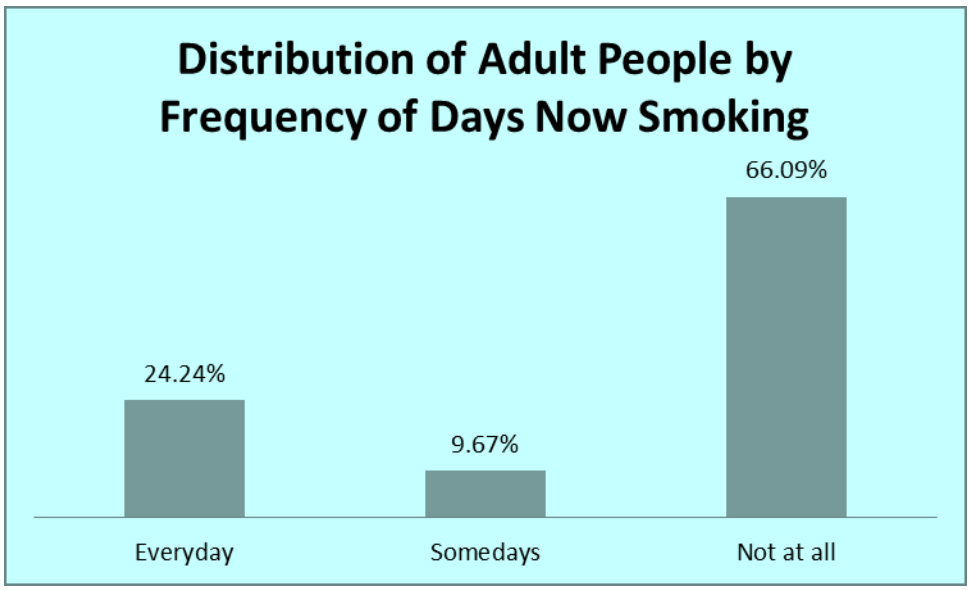

Figure 17.*Distribution of Adult Respondents by Frequency of Days Now Smoking*.

The variable (LASTSMK2) represents the interval since last smoked. It has eight groups (as in the following table). The variable (LASTSMK2) is a categorical variable.

Table 14:

Distribution of Adult People by Interval Since Last Smoked

INTERVAL SINCE LAST SMOKED	No.	Weighted %
within the past month	2584	2.16
within the past three months	2319	1.94
within the past six months	2506	2.1
within the past year	4029	3.37
within the past five years	14908	12.47
within the past ten years	12166	10.18
ten years and more	80242	67.12
never smoked regularly	804	0.67

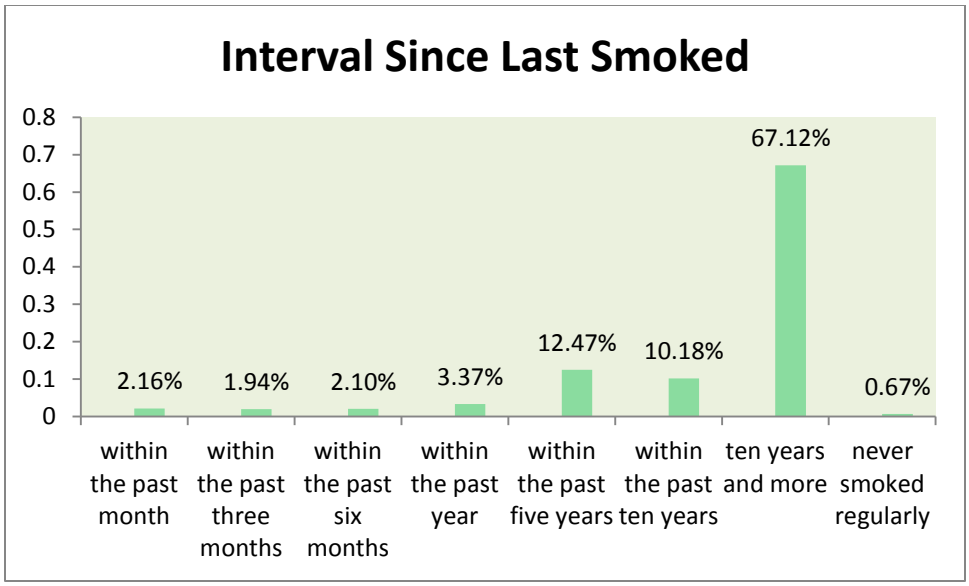

Figure 18. *Distribution of adult respondents by interval since last smoked.*

4.2.2 Descriptive Analysis of Indicator Variables:

Health related quality of life (HRQoL) variable are the indicator variables. Those include General Health (GENHLTH), Activity Limitation (QLACTLM2), Physical Health (PHYSHLTH) and Mental Health (MENTHLTH).

The indicator variable (GENHLTH) is a categorical variable. It represents the reported general health status of adult patients. The following table indicates number of days during the past 30 days was the respondents' physical health not good including physical illness and injury, whereas 88 represents none.

Table 15:

Distribution of Adult People by General Health Status

Indicator variables of health related quality of life (HRQoL)		GENERAL HEALTH STATUS	
Variable	Category	No.	Weighted %

General Health (GENHLTH)	Excellent	74889	18.04
	Very good	139337	33.57
	Good	126615	30.5
	Fair	53067	12.78
	Poor	21212	5.11

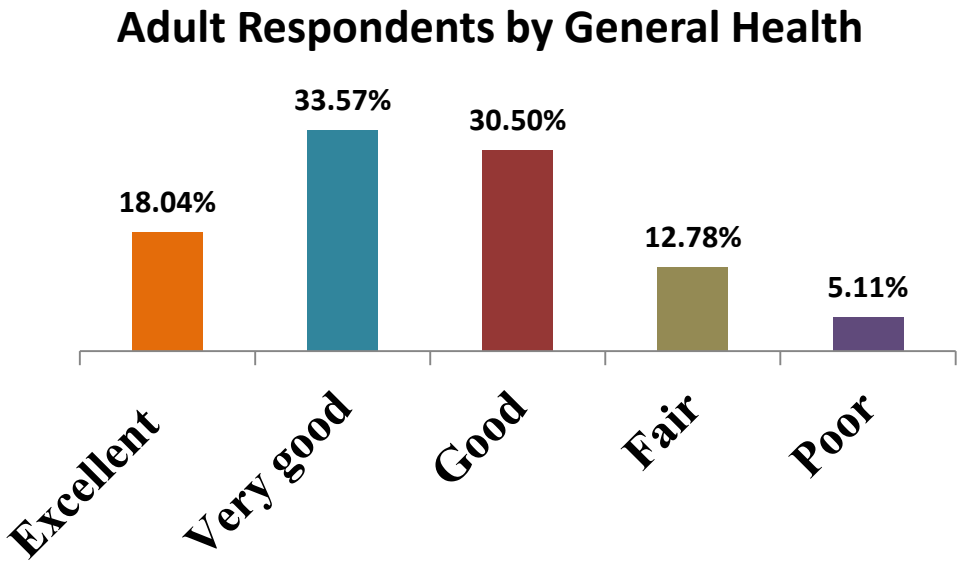

Figure 19. *Distribution of adult respondents by general health status*.

Activity limitation (QLACTLM2) is an indicator variable of (HRQoL). It is a categorical variable: Yes and No. This table shows if the respondents reported any limitation in any way in any activity because of physical, mental or emotional problems.

Table 16:

Distribution of Adult People by Activity Limitation Due to Health Problems

Indicator variables of health related quality of life (HRQoL)		ACTIVITY LIMITATION DUE TO HEALTH PROBLEMS	
Variable	Category	No.	No. (Weighted %)

Activity limitations (QLACTLM 2)	Yes	101408	24.43
	No	313703	75.57

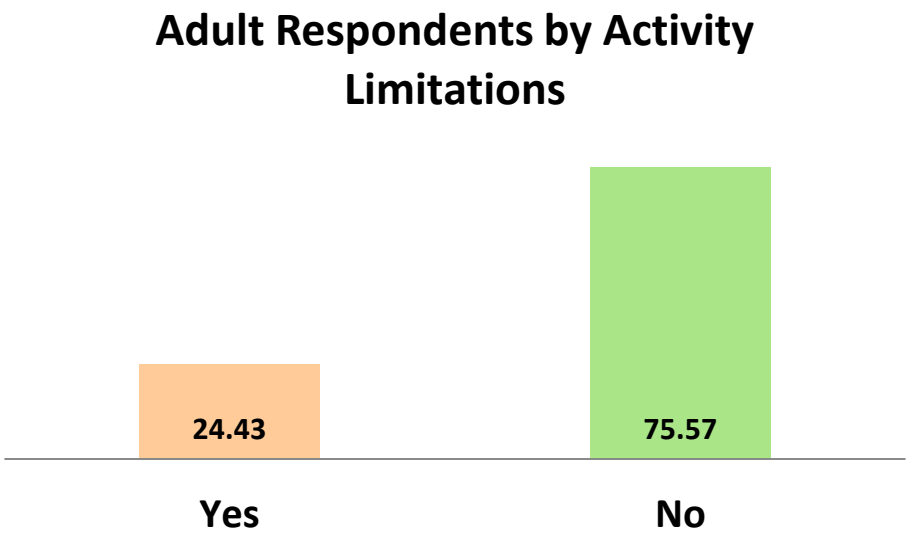

Figure 20.*Distribution of adult respondents by activity limitations due to health problems.*

Also, physical health (PHYSHLTH) is an indicator variable of HRQoL. The table indicates number of days during the past 30 days was the respondents' physical health not good including physical illness and injury and 88 represents none. It is a categorical variable.

Table 17: *Distribution of Adult People by Number of Days Physical Health Not Good*

Indicator variables of health related quality of life	NUMBER OF DAYS PHYSICAL HEALTH NOT GOOD

(HRQoL)			
Variable	Category (Number of days)	No.	(Weighted%)
Physical Health (PHYSHLTH)	Some or all	148655	(35.79%)
	None	266466	(64.19%)

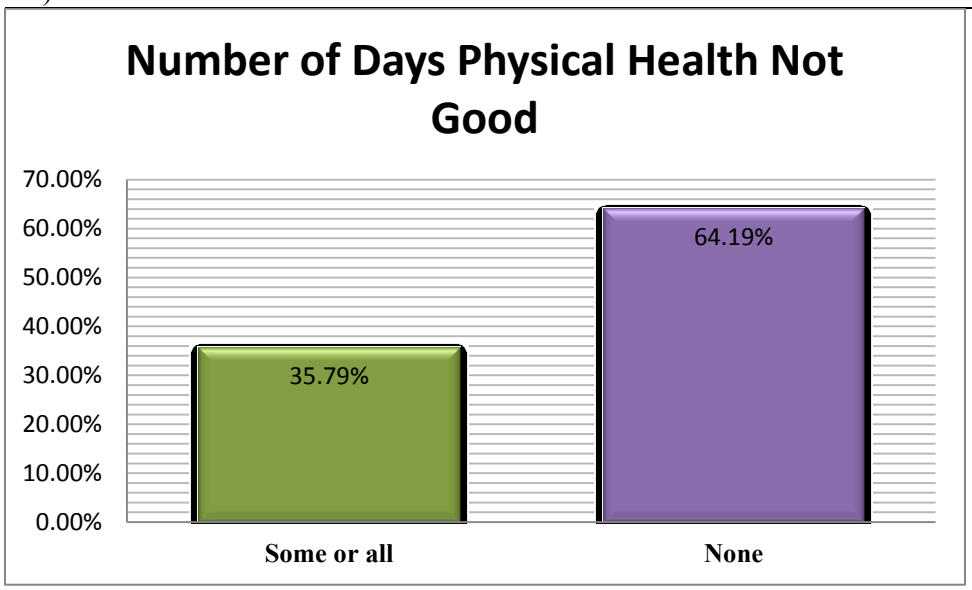

Figure 21: *Distribution of Adult People by Number of Days Physical Health Not Good*

Mental health (MENTHLTH) an indicator variable of health-related quality of life (HRQoL). It indicates number of days during the past 30 days was the respondents' mental health not good including stress, depression and problems with emotions. It is a categorical variable and include number of days from 1 to 30 and 88 represents none.

Table 18: *Distribution of Adult Respondents by Number of Days Mental Health Not Good*

Indicator variables of health related quality of life (HRQoL)		NUMBER OF DAYS MENTAL HEALTH NOT GOOD	
Variable	Category	No.	No. (Weighted %)
Mental health problems	Some or all	126112	30.37%

(MENTHLTH)	None	289010	69.62%

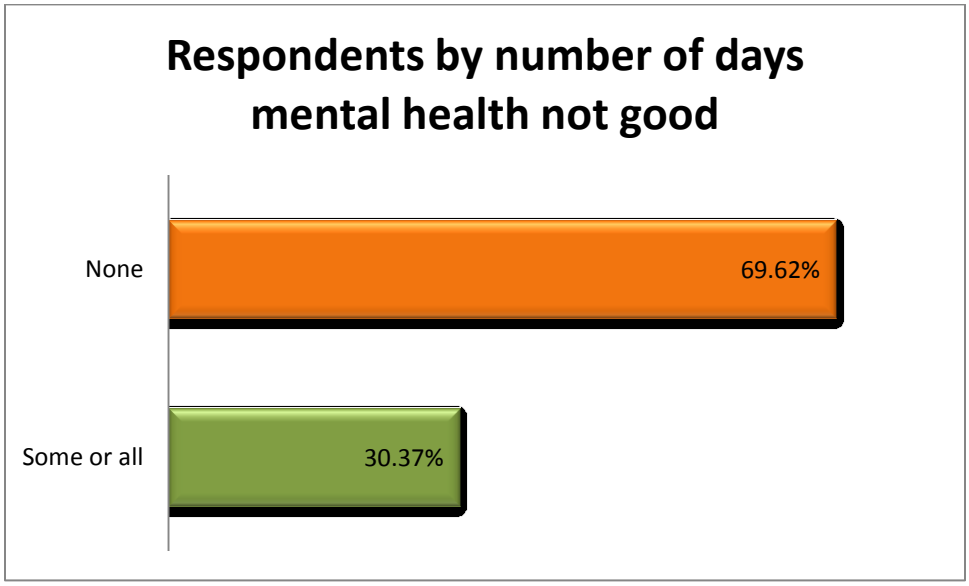

Figure 22 . *Distribution of Adult Respondents by Number of Days Mental Health Not Good*

4.3 Inferential analysis:

In order to identify the association between the variables in this research we will perform Chi-Square test since all the variables are categorical.

4.3.1 Inferential analysis of the research hypotheses:

The research hypothesis proposes that smoking cessation duration have statistically significant effect on health-related quality of life (HRQoL) (involving: general health, activity limitations, physical health, mental health) of adult people in the United States.

In order to detect the association between smoking status(_RFSMOK3) and the health quality of life indicators that include general health (GENHLTH), physical health(PHYSHLTH), mental health(MENTHLTH) and activity limitations (QLACTLM2), Chi-Square will be performed.

Basically the Chi-Square detects the presence of an association between two variables. In order to conclude that there is an association between two chosen variables the P-value needs to be less than or equal to our alpha-level (significance level) which is in this research 0.05. In case the P-value is greater than the alpha-value (0.05) then we can conclude that there is no association between those two variables. In other words, the null hypothesis is rejected if the P-value is equal or less than 0.05. However the null hypothesis is accepted if the P-value is greater than 0.05 (8).

Table 19: *Association between smoking status and each one of the HRQoL*

P-value of Chi-Square test to indicate the association between smoking status and HRQoL variables	
Indicator variables of health related quality of life (HRQoL)	Predictor variable
	Currently smoking?
General health	< .0001
Activity limitations	<.0001
Physical health	< .0001
Mental health	< .0001

In order to detect the association between interval since last smoked (LASTSMK) and the health quality of life indicators that include general health (GENHLTH), physical health (PHYSHLTH), mental health (MENTHLTH) and activity limitations (QLACTLM2), Chi-Square will be performed. The null hypothesis is rejected if the P-value is equal or less than 0.05. However the null hypothesis is accepted if the P-value is

greater than 0.05. From the tables below we can conclude that there is a significant association between interval since last smoked and general health, mental health, physical health and activity limitations since the P-value is less than 0.05.

Table 20: *Association between interval since last smoked and each one of the HRQoL*

P-value of Chi-Square test to indicate the association between interval since last smoked and HRQoL variables	
Indicator variables of health related quality of life (HRQoL)	Predictor variable
	How long has it been since you last smoked a cigarette?
General health	< .0001
Activity limitations	< .0001
Physical health	< .0001
Mental health	< .0001

Now, to detect the association between frequency of days now smoking (SMOKDAY2) and the health quality of life indicators which include general health (GENHLTH), physical health (PHYSHLTH), mental health (MENTHLTH) and activity limitations (QLACTLM2), Chi-Square will be performed. The null hypothesis is rejected if the P-value is equal or less than 0.05. However the null hypothesis is accepted if the P-value is greater than 0.05

Table 21: *Association between Frequency of days now smoking and each one of the HRQoL*

P-value of Chi-Square test to indicate the association between interval since last smoked and HRQoL variables	
Indicator variables of health related quality of life (HRQoL)	Predictor variable
	How often do you smoke?
General health	< .0001
Activity limitations	<.0001
Physical health	< .0001

Mental health	< .0001

4.4 Predictive Analysis:

In order to predict the association between the study variables we will use the logistic regression in the statistical analysis system software (SAS).

4.4.1 Predictive analysis of the first hypothesis:

The first hypothesis states that there is a significant association between behavioral activity which is smoking status and HRQoL which include: activity limitations, general health, mental health and physical health on people in the United States.

In order to proceed with the predictive analysis we should review the results of the inferential analysis so we can disregard any predictor and indicator variable that does not have any associations and resume the predictive analysis with the indicator variables that has statically significant association with predictor variables of the study (table 19).

In order to predict the association between smoking status (_RFSMOK3) which is a predictor variable and the health quality of life indicators that include general health (GENHLTH), physical health (PHYSHLTH), mental health (MENTHLTH) and activity limitations (QLACTLM2), we will perform logistic regression. The P-value (alpha level) was set to be 0.05. Then, if the results comes with a P-value equal to 0.05 or less we will reject the null hypothesis and indicate that there is a statistically significant association between smoking status and each one of the HRQoL which include: mental health, physical health, general health and activity limitations (table 22).

Table 22.

Predictive analysis to predict association between predictor variable represented by smoking status and HRQoL as indicator variables in adult in the United States.

P-value of Logistic regression to indicate the predictive relation between smoking status and HRQoL variables					
Indicator variables of health related quality of life (HRQoL)	Predictor variable				
	Current smoking status				
	WCS	Pr > chi-Sq	OR	95% CI	Std. Err.
General Health	3053.2613	<.0001	1.181	1.152-1.210	0.00513
Activity limitations	2642.2274	<.0001	4.329	4.033- 4.646	0.0130
Physical health	945.7538	<.0001	1.470	1.425- 1.517	0.00695
Mental health	2192.0865	<.0001	1.770	1.712- 1.830	0.00725

4.4.2 Predictive analysis of the second hypothesis:

The second hypothesis that suggest a significant association between behavioral activity which is interval since last smoked and HRQoL which include: activity limitations, general health, mental health and physical health on people in the United States.

In order to proceed with the predictive analysis we should review the results of the inferential analysis so we can disregard any predictor and indicator variable that does not have any associations and resume the predictive analysis with the indicator variables that has statically significant association with predictor variables of the study (table 20).

We will examine the association between the interval since last smoked (LASTSMK) and HRQoL variables (QLACTLM2, PHYSHLTH, MENTHLTH and

GENTHLTH) by using logistic regression. The P-value (alpha level) was set to be 0.05. Then, if the results comes with a P-value equal to 0.05 or less we will reject the null hypothesis and indicate that there is a statistically significant association between interval since last smoked and each one of the HRQoL which include: mental health, physical health, general health and activity limitations (table 23).

Table 23.

Predictive analysis to predict association between predictor variable represented by interval since last smoked and HRQoL as indicator variables in adult in the United

P-value of Logistic regression to indicate the predictive relation between last smoked and HRQoL variables		
Indicator variables of health related quality of life (HRQoL)	Predictor variable	
	Last smoked	
	WCS	Pr > chi-Sq
General Health	149.6701	< .0001
Activity limitations	910.1456	< .0001
Physical health	15331.5623	< .0001
Mental health	1759.8676	< .0001

We used logistic regression in order to get odds ratio (OR) so we can study the significance of differences between last smoked levels (table 24).

Table 24.

Odds ratio of each level of last smoked and associated HRQoL indicator variables in adults in the United States.

Odds ratio of levels of last smoked and associated HRQoL variables					
Predictor variable		Indicator variables of health related quality of life (HRQoL)			
Last smoked		General Health	Activity limitations	Physical health	Mental health
Within the past month	OR	1.288	1.245	1.292	3.266
	95% CI	1.124-1.476	0.813-1.906	0.891-1.873	2.049-5.205
	Std.Err.	0.0696	0.0448	0.0394	0.0423

Within the past 3 months	OR	1.176	1.234	1.184	2.889
	95% CI	1.098-1.259	0.811-1.879	0.816-1.719	1.811-4.609
	Std.Err.	0.0348	0.0299	0.0412	0.0442
Within the past 6 months	OR	1.148	1.224	1.140	2.844
	95% CI	0.817-1.615	0.805-1.861	0.785-1.653	1.784-4.535
	Std.Err.	0.1740	0.0264	0.0403	0.0432
Within the past year	OR	1.063	1.216	1.105	2.547
	95% CI	0.976-1.159	0.799-1.852	0.763-1.598	1.601-4.053
	Std.Err.	0.0439	0.0307	0.0348	0.0383
Within the past 5 years	OR	1.049	1.171	1.072	2.261
	95% CI	0.974-1.130	0.764-1.796	0.744-1.547	1.425-3.587
	Std.Err.	0.0377	0.0468	0.0265	0.0306
Within the past 10 years	OR	1.036	1.137	1.047	2.037
	95% CI	0.963-1.114	0.725-1.782	0.726-1.510	1.283-3.233
	Std.Err.	0.0371	0.0792	0.0273	0.0315
Within the past 10 years or more	OR	1.025	1.023	0.934	1.436
	95% CI	0.931-1.128	0.656-1.595	0.649-1.346	0.906-2.277
	Std.Err.	0.0488	0.0722	0.0233	0.0278
Never	OR	0.979	0.913	0.888	0.554
	95% CI	0.888-1.079	0.761-1.097	0.603-1.310	0.473-0.648
	Std.Err.	0.0348	0.0933	0.0644	0.0803

4.4.3 Predictive analysis of the third hypothesis:

The third hypothesis that suggest a significant association between behavioral activity which is interval since last smoked and HRQoL which include: activity limitations, general health, mental health and physical health on people in the United States.

In order to proceed with the predictive analysis we should review the results of the inferential analysis so we can disregard any predictor and indicator variable that does not have any associations and resume the predictive analysis with the indicator variables that has statically significant association with predictor variables of the study (table 21).

We will examine the association between frequency of smoking (SMOKDAY2) and HRQoL variables (QLACTLM2, PHYSHLTH, MENTHLTH and GENTHLTH) by using logistic regression. The P-value (alpha level) was set to be 0.05. Then, if the results comes with a P-value equal to 0.05 or less we will reject the null hypothesis and indicate that there is a statistically significant association between frequency of smoking and each one of the HRQoL which include: mental health, physical health, general health and activity limitations (table 25).

Table 25.

Predictive analysis to predict association between predictor variable represented by frequency of smoking and HRQoL as indicator variables in adult in the United

P-value of Logistic regression to indicate the predictive relation between frequency of smoking and HRQoL variables		
Indicator variables of health related quality of life (HRQoL)	Predictor variable	
	Frequency of smoking	
	WCS	Pr > chi-Sq
General Health	2228.7940	< .0001
Activity limitations	385.6358	< .0001
Physical health	393.1892	< .0001
Mental health	2604.0935	< .0001

We used logistic regression in order to get odds ratio (OR) so we can study the significance of differences between the frequency of smoking levels (table 26).

Table 26.

Odds ratio of each level of frequency of smoking and associated HRQoL indicator variables in adults in the United States.

Odds ratio of levels of frequency of smoking and associated HRQoL variables				
Predictor variable	Indicator variables of health related quality of life (HRQoL)			
Frequency of smoking	General Health	Activity limitations	Physical health	Mental health

Every day	OR	1.228	1.031	1.386	2.108
	95% CI	0.970-1.555	0.783-1.357	1.065-1.805	1.569-2.831
	Std.Err.	0.0404	0.0464	0.0445	0.0467
Some days	OR	1.169	0.920	1.355	2.025
	95% CI	1.134-1.205	0.698- 1.212	1.042-1.763	1.508-2.718
	Std.Err.	0.0153	0.0473	0.0437	0.0459
Not at all	OR	0.940	0.827	1.138	0.917
	95% CI	0.694-1.272	0.629-1.089	0.875-1.479	0.658-1.280
	Std.Err.	0.1545	0.0461	0.0434	0.1698

Chapter VI:

DISCUSSION AND CONCLUSION

5.1 Discussion:

Even with a lot of researches and studies that analyzed the impact of smoking on human health, there are no studies that provided a clear and complete understand of the impact of smoking cessation on the health-related quality of life of adult people in the United States.

Additionally, many studies explained the impact of smoking cessation on humans' health, there is no study gave a comprehensive view of the impact of smoking cessation on health-related quality of life of adults of United States.

In this research we intend to measure with deep investigation the impact of smoking cessation duration on health-related quality of life of adults in the United States. That will be done using Behavioral Risk Factor Surveillance System (BRFSS) data.

So our hypotheses that will be tested are as follow:

- The first hypothesis states that there is a significant association between behavioral activity which is smoking status and HRQoL which include: activity limitations, general health, mental health and physical health of people in the United States.
- The second hypothesis that suggest a significant association between behavioral activity which is interval since last smoked and HRQoL which

include: activity limitations, general health, mental health and physical health of people in the United States.

- The third hypothesis of the research states that there is a significant association between behavioral activity which is frequency of days now smoking and HRQoL which include: activity limitations, general health, mental health and physical health of people in the United States.

We used BRFSS 2014 data to test our hypotheses. BRFSS data (2014) has 464,664 participants, 38,198 of them stopped smoking. The data was analyzed using statistical Analysis System Software (SAS) 9.4. There were three analytical steps in order to achieve the aim of the study. The first step is the descriptive analysis where we describe the distributions of our independent and dependent variables. The second step is the inferential analysis where we infer the association between dependent and independent variables of the study. The last step is the predictive analysis where we predict the association between the independent and dependent variables of the study. The distribution of the data by sex showed 41.6% male and 58.4% female. Also distribution of data by race we found that whites non-Hispanic are more prevalent, they represent 78.76%. The distribution of the data's participants by age showed different age groups with the highest of age 60 to 64 (11.57%).

Moreover after processing descriptive analysis we have seen some poor health related quality of life in the participants; that include physical health, general health, mental health and activity limitations, which encouraged us to assume that there might be an association between HRQoL variables and our predictor variables. Having said that it takes us to the next step in the analysis, which is inferential analysis. In inferential

analysis we ran Chi-square test in order to determine if there is an association between the variables. The results of the Chi-square test; where we determined the alpha level to be 0.05, are <.0001 which mean that the null hypothesis is rejected and infer that there is an association between our indicator variables that include physical health, mental health, general health and activity limitations, and our predictor variables which include current smoking status, last smoked and frequency of smoking (table 27).

Table 27.

Association between predictor variables and each one of HRQoL indicator variables in adult in the United States.

P-value of Chi-Square test to indicate the association between predictor variables and each one of HRQoL indicator variables				
Predictor variable	Indicator variables of health related quality of life (HRQoL)			
	Activity limitations	Physical health	Mental health	General health
Current smoking status	< .0001	< .0001	< .0001	<.0001
Frequency of smoking	< .0001	< .0001	< .0001	<.0001
Last smoked	< .0001	< .0001	< .0001	<.0001

The next step after inferential analysis is predictive analysis where we can calculate the odds ratio (OR) and measure the predictive relationship between the variables. In this step, we ran logistic regression. In logistic regression the alpha level (P-value) has to be 0.05 or less in order to determine that there is a significant association between the variables.

After running logistic regression all the p-values are Pr > chi-Sq is < 0.0001 which indicate that the null hypothesis is rejected and that there is a significant association between HRQoL indicator variables that include general health, mental health, physical health and activity limitations, and our predictor variables that include current smoking status, frequency of smoking and last smoked (table 28).

Table 28.

Predictive association between our predictor variables and each one of HRQoL indicator variables in adult in the United States.

P-value of Logistic regression to indicate the association between predictor variables and each one of HRQoL indicator variables				
Predictor variable	Indicator variables of health related quality of life (HRQoL)			
	Activity limitations	Physical health	Mental health	General health
Current smoking status	< .0001	< .0001	< .0001	<.0001
Frequency of smoking	< .0001	< .0001	< .0001	<.0001
Last smoked	< .0001	< .0001	< .0001	<.0001

As we mentioned before in order to calculate the effect of the predictive variables as well as the effect of the different levels of the predictor variables on the HRQoL indicator variables, when need to obtain the odds ratio (OR) for every one of the predictor variables and the 95% confidence interval (95%) in order to know the true population of the overall population. The following formula was used to calculate the percentage of effect differences [105].

Percent difference =

$$\frac{N1 - N2}{\frac{N1 + N2}{2}} * 100\%$$

N1= number of exposed cases.

N2=number of non-exposed cases.

Current smoking status has a significant association and predictive relationship with our indicator variables of the HRQoL that include general health, mental health, physical health and activity limitations of adults in the United States (table 27&28). The odds ratio of general health for smoking status is 1.181, odds ratio of activity limitations for smoking status is 4.329, odds ratio of physical health for smoking status is 1.470, and odds ratio of mental health for smoking status is 1.770 (table 22).

Smoking in adults has a statistically significant association and affects general health by 16.59% more than in adults who does not smoke. Smoking in adults has a statistically significant association and increases activity limitations by 124.93% more than in adults who does not smoke. Smoking in adults has a statistically significant association and increases physical health problems by 38.05% more than in adults who does not smoke. Also, smoking in adults has a statistically significant association and increases mental health problems by 55.59% more than in adults who does not smoke (table22).

Additionally, quitting smoking (Last smoked) has a significant relationship and predictive association with general health, mental health, physical health and activity limitations in adults (table 27&28). Importantly last smoked as a predictor variable has eight levels which include within past month, within past 3 months, with past 6 months, within past year, within past 5 years, within past 10 years, within past 10 years or more, and never smoked. Each level has its own odds ratio which reflects different impact

levels on HRQoL in adults which is general health, physical health, mental health and activity limitations.

The odds ratio of general health for last smoked within past month in adults is 1.288, the odds ratio of general health for last smoked within past year in adults is 1.063, and the odds ratio of general health for last smoked within past 10 years in adults is 1.036. The odds ratio of activity limitations for last smoked within past month in adults is 1.245, the odds ratio of activity limitations for last smoked within past year in adults is 1.216, and the odds ratio of activity limitations for last smoked within past 10 years in adults is 1.137. The odds ratio of physical health for last smoked within past month in adults is 1.292, the odds ratio of physical health for last smoked within past year in adults is 1.105, and the odds ratio of physical activity for last smoked within past 10 years in adults is 1.047. The odds ratio of mental health for last smoked within past month in adults is 3.266, the odds ratio of mental health for last smoked within past year in adults is 2.547, and the odds ratio of mental health for last smoked within past 10 years in adults is 2.037 (table 24).

Last smoked within past month in adults increases general health problems by 25.17 % more than last smoked within past year in adults by 6.107% more than last smoked within past year in adults by 3.536% and have a statically significant relationship. Also, last smoked within past month in adults increases activity limitations by 21.826% more than last smoked within past year in adults by 19.494% more than last smoked within past 10 years in adults by 12.821% and have a statically significant relationship. Last smoked within past month in adults increases physical health problems by 25.479% more than last smoked within past year in adults by 9.976% more than last

smoked within 10 years in adults by 4.592% and have a statically significant relationship. Moreover, last smoked within past month in adults increases mental health problems by 106.235% more than last smoked within past year in adults by 87.228% more than last smoked within past 10 years in adults by 68.291% and have a statically significant relationship (table 23&24).

Frequency of smoking has a predictive association and statically significant relationship with HRQoL factors that include general health, mental health, physical health, and activity limitations in adults of the United States (table 25&26). Importantly, frequency of smoking as a predictor variable has three levels which include everyday smoking, someday smoking, and not at all smoking. Every level of frequency of smoking reflects different impact on the HRQoL in adults which include general health, mental health, physical health and activity limitations.

The odds ratio of general health for everyday smoking in adults is 1.228, the odds ratio of general health for some days smoking in adults is 1.169, and the odds ratio of general health for not at all smoking in adults is 0.940. While the odds ratio of activity limitations for everyday smoking in adults is 1.031, the odds ratio of activity limitations for some days smoking in adults is 0.920; the odds ratio of activity limitations for not at all smoking in adults is 0.827. The odds ratio of physical health for everyday smoking in adults is 1.386, the odds ratio of physical for some days smoking in adults is 1.355, and the odds ratio for not at all smoking in adults is 1.138. Whereas the odds ratio of mental health for everyday smoking in adults is 2.108, the odds ratio of mental health for some days smoking in adults is 2.025, and the odds ratio of mental health for not at all smoking in adults is 0.917 (table 26).

Everyday smoking in adults increases general health problems by 20.466% more than in some days smoking in adults by 15.583% more than not at all smoking in adults by 6.185% and has a statically significant association. Every day smoking in adults increases activity limitations by 3.052% more than some day smoking in adults by 8.333% more than not at all smoking in adults by 18.938% and have a statically significant association. Everyday smoking in adults increases physical health problems by 32.355% more than some days smoking in adults by 30.148% more than not at all smoking in adults by 12.909% and has a statically significant association. Everyday smoking in adults increases mental health problems by 71.299% more than some days smoking in adults by 67.768% more than not at all smoking in adults by 8.659% and has a statically significant association (table 25&26).

5.2 Conclusion:

With the availability of different studies that analyzed the effect of smoking cessation on the health aspect in this research we used the most recent BRFSS database (2014) to examine the impact of smoking cessation on the HRQoL. The indicator variables of this study include these behavioral factors, smoking status, frequency of smoking and quitting smoking. The indicator variables of this study include HRQoL factors which are general health, physical health, mental health and activity limitations.

BRFSS is the first nation system of health surveys using the telephone to get data from the United States residents asking about the conditions of their health. BRFSS data (2014) has 464,664 patients, 38,198 of them stopped smoking. We used the Statistical Analysis System Software (SAS) 9.4 in order to analyze the data. Different analysis

methods were used. We started with descriptive analysis, inferential analysis and predictive analysis.

After running descriptive analysis of the study variables, we have seen some poor health outcomes in the participants that include physical health, mental health, general health and activity limitations.

In the inferential analysis of the research hypotheses' the results met the alpha level (p-value) which is <.0001 which means that the null hypothesis is rejected and emphasize that there is a significant association between our indicator variables of the HRQoL and our predictor variables.

As for the predictive analysis for the research hypotheses the p-value was Pr > chi-Sq is < 0.0001 which means that the null hypotheses is rejected and emphasize that there is a significant predictive association between our indicator variables of the HRQoL and each one of the predictor variables.

Generally, smoking, last smoked and frequency of smoking as predictor variables has a statically significant relationship and predictive association with HRQoL that include general health, mental health, physical health and activity limitations. Those predictor variables have a negative effect on HRQoL of adults.

Smoking in adults increases general health problems more than adults who do not smoke by 16.59%, activity limitations by 124.93%, physical health problems by 38.05%, and mental health problems by 55.59%.

Also, quitting smoking within past month in adults increases general health problems by 25.17%, activity limitations by 21.826%, physical health problems by

25.479%, and mental health problems by 106.235% more than in quitting smoking within past 19 years in adults.

Additionally, everyday smoking in adults increases general health problems by 20.466%, activity limitations by 3.052%, physical health problems by 32.355%, and mental health problems by 71.299% more than in not at all smoking in adults.

To conclude, we can approve that our behavioral factors which include smoking status, quitting smoking and frequency of smoking affects HRQoL of adults of the United States. More importantly with increased smoking cessation duration, HRQoL in adults of the United States clearly improve.

5.3 Future Research Recommendations:

In this study we aimed at measuring with deep investigation the impact of smoking cessation duration on health-related quality of life in adults in the United States. This study will give a throughout knowledge of the impact of smoking cessation duration on the peoples' health. It is worth noting that this research used the 2014 database Behavioral Risk Factor Surveillance System (RFSS) which is the first nation system of health surveys using the telephone to get data from the United States residents. So, the information in the database is not a collection of medical diagnoses that is been made by physicians. It is also important to know that this study is established on a U.S. population, which emphasizes that applying the results of the study to other countries should be done carefully. Although that using data that is based on surveys provide important results, clinical diagnosis is also important to draw a complete image.

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