THE EFFECT OF COMORBIDITIES AND SMOKING CESSATION DURATION ON THE HEALTH-RELATED QUALITY OF LIFE OF ADULT PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN THE UNITED STATES

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The Effect Of Comorbidities And Smoking Cessation Duration On The Health-Related Quality Of Life Of Adult Patients With Chronic Obstructive Pulmonary Disease In The United States

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is one of the diseases that causes a huge burden to the health status of patients. Inflammation cause progressive obstruction to the airflow in the lung. Therefore, COPD patients may have poor health-related quality of life (HRQoL) because of their disease. HRQoL is defined as the discernments of mental health and physical health of the patient including the functional status, socioeconomic status, social support, health risks and conditions. This study aims to undergo an integrated analysis to strengthen our understanding of the effects of COPD, comorbidities, and smoking cessation duration on the HRQoL of COPD patients in the United States.

Methods: This study uses the Behavioral Risk Factor Surveillance System (BRFSS) 2014 database as well as different statistical methods and predictive models to accomplish the goals of this research.

Results: The logistic regression models showed that COPD patients who have stopped smoking within the past month have mostly higher risks of having activity limitations (15.61 %), poor mental health (44.00%), and poor physical health (25.44%) when compared to the cessation of 10 years. Furthermore, obese COPD patients have mostly higher risks of having difficulties in walking or climbing stairs (101.23%), activity limitations (73.27%), and poor physical health (37.51%) when compared to patients who have normal weight.

Moreover, diabetic COPD patients have increased risks of having activity limitations (114.48%) with relatively similar results for the other HRQoL indicator when compared to COPD alone. Moreover, patients with COPD and coronary heart disease have more

risks of having difficulties in doing errands alone (73.92%) with similar results for the other indicators when compared to COPD alone. In addition, patients with COPD and stroke have increased risks of having activity limitations (40.71%) with also similar results for the other HRQoL factors when compared to the patients with COPD alone.

Conclusion: Therefore, this study shows the importance of early smoking cessation and the effect of different comorbidities on the HRQoL for adult COPD patients. It suggests that the disease of those patients should be assessed and monitored for getting better disease outcomes and improved management of the disease.

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ABBREVIATIONS

Abbreviation	Description
COPD	Chronic obstructive pulmonary disease
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
SAS	Statistical Analysis System
HRQoL	Health-related quality of life
FEV_{1s}	Forced expiratory volume in 1 second
FVC	Forced vital capacity
GOLD	Global Initiative of Obstructive Lung Disease
CB	Chronic bronchitis
SOB	Shortness of breath
WHO	World health organization
ANOVA	Analysis of variance
BMI	Body Mass Index

CHAPTER I

INTRODUCTION

1. 1. Background:

Chronic obstructive pulmonary disease (COPD) is one of the most common inflammatory lung diseases in the world [(1)]. Progressive obstruction to the airflow in the lung is caused by the inflammations. It has been suggested that COPD cases represent 95% among all cases of chronic lower lung diseases [(2)]. COPD is usually represented as several lung diseases, including emphysema, chronic bronchitis (CB), and refractory asthma [(3)]. In the United States, COPD is described as a progressive lung disease as well as the third disease causing death for Americans. According to the Centers for Disease Control and Prevention (CDC), in 2010, the death rate of COPD was 47.6 per 100,000 for male individuals, while it was 36.4 per 100,000 for female individuals [(4)]. In 2011, it was reported by the CDC that about 15 million individuals with COPD were living in the United States. In addition, there are approximately 210 million individuals living with COPD worldwide [(5)]. Nevertheless, the incidence rates may actually be higher than those numbers since many cases of COPD are misdiagnosed or not detected [(3)].

There are several risk factors for people to develop COPD. First, exposure to tobacco smoking is the main risk factor for developing COPD. People who smoke or smoked tobacco for a long period of time are at higher risk of developing the disease. [(6)] Mostly, Tobacco smoking is the primary cause of mortality for chronic lower lung diseases patients [(7)]. Second, exposure to air pollutants, dusts, and chemical fumes at workplace for a long time increases the chance of acquiring COPD [(6)]. Third, people who

genetically carry the alpha -1-antitypsin deficiency are rarely at risk of the disease. Finally, since the disease develops very slowly, individuals who are 35-40 years and older are at higher risk of reporting the disease. [6]

In emphysema, the alveoli in the lung are damaged because of progressive destruction of air pollutants and particles [1]. On the other, in chronic bronchitis, the lining of the bronchial tubes in the lungs are affected by inflammations. This condition is usually described by the production of sputum and daily cough [1]. People with COPD may also show other symptoms, which include shortness of breath, wheezing, lack of energy, chest tightness, blueness of lips or fingernail beds, weight loss, and frequent respiratory infections [9]. However, individuals with COPD may show severe symptoms that differ from other people in relation to the severity of their disease [10].

COPD is a preventable and treatable disease [5]. The symptoms can be managed and controlled by several treatment options. However, COPD is not a curable disease yet because of the damage in the lungs is not reversible [11]. Individuals with severe COPD may suffer in their lives. The burden of COPD increases when the severity of the symptoms increases [10]. So, patients may have poor health-related quality of life (HRQoL) because of their disease [12]. COPD affects the general health, physical health, and mental health of the patients [10].

1. 2. Goals and Objectives:

In this study, I aim to examine the effect of chronic obstructive pulmonary disease and other comorbidities on the health-related quality of life in adult COPD patients in the United States. In addition, I will investigate the beneficial impact of smoking cessation duration on the HRQoL in adult patients with COPD.

❖ This study will be conducted to determine the following objectives:

- Determine the associations between COPD and the health-related quality of life including physical health, and mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone in adult COPD patients.

- Identify the benefits of quitting cigarette smoking and smoking cessation duration on the HRQoL in adult COPD patients in the United States.

-Define any correlations between comorbid conditions such as high body mass index (BMI), diabetes, coronary heart disease, and stroke on the HRQoL in adult COPD patients in the United States.

1. 3. Research Hypotheses of This Study:

1- There are statistically significant associations between COPD and health-related quality of life including physical health, and mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone in adult COPD patients in the United States. The null hypothesis is that there are no statistically significant associations between COPD and each one of the HRQoL indicators in adult patients with COPD.

2- There are statistically significant associations between smoking cessation duration and HRQoL factors including physical health, and mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone in adult patients with COPD. The null hypothesis is that there are no statistically significant associations between smoking cessation duration and each one of the HRQoL indicators in adult COPD patients.

3- There are statistically significant associations between comorbid conditions such as high BMI, diabetes, coronary heart disease, and stroke and the HRQoL including physical health, and mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone in adult COPD patients The null hypothesis is that there are no statistically significant associations between the comorbidities and each one of the HRQoL indicators in adult patients with COPD.

1. 4. Data and Methods:

This study will use datasets obtained from Behavioral Risk Factor Surveillance System (BRFSS), which was established by CDC in 1984 [(13)]. Since its establishment, BRFSS is considered as a cross-sectional survey that collects data about the respondent's health status. Currently, it is performed in all states and territories of the United States [(13)]. Each year, the survey is conducted by standardized questionnaires asked by state health departments randomly on adult residents (>18) in the US over landline telephones or cellular telephones [(13-14)]. In fact, more than 460,000 interviews were performed on adult residents in the year of 2014 in all states and territories of the United States [(15)]. In addition, in each year, the survey assesses the impact of risk behaviors and preventive health measures on the respondents' health status. After collecting the data, the surveys are returned to the CDC for analyzing and then reporting the prevalence and new trends of health conditions [(13)].

BRFSS questionnaires are divided into several parts including the core component of the survey, optional modules, and state added questions [(16)]. Some of the modules that included in BRFSS are related to demographics (including age, gender, and

race/ethnicity), socioeconomic such as stress, education level, health care access, and household income level, chronic health conditions, health-related quality of life, immunization, and behavioral questions such as tobacco use and alcohol consumption. BRFSS consists of other modules but they are not be discussed in this research.

This study is using BRFSS datasets from the year 2014 to meet its goals. The datasets are used to investigate the effect of COPD and other comorbidities on the health-related quality of life in adult COPD patients in the United States. Also, they are used to examine the impact of smoking cessation duration on the HRQoL in adult COPD patients. Finally, by employing Statistical Analysis System (SAS) software, different analysis methods and models including: descriptive statistics, inferential statistics, and predictive analytics would be used to accomplish the goals of this research.

CHAPTER II

LITERATURE REVIEW

2.1. Introduction:

Chronic obstructive pulmonary disease (COPD) is one of the diseases that causes a huge burden to the health status of patients. It is considered to play an important role in the mortality and morbidity rates in COPD patients at all types of income levels in different countries [(17)]. In 2015, the Global Initiative of Obstructive Lung disease (GOLD) updated the definition of COPD as "a common preventable and treatable disease, is characterized by persistent airflow limitation that usually is progressive and associated with enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients" [(18)]. In 2001, COPD was known to be the fifth leading cause of death in major developed countries [(17)]. In addition, it was estimated that the disease would emerge to be the third leading cause of death worldwide in 2020 [(19)]. Thus, since 2008, COPD has emerged to be the third leading cause of death in the United States [(2)]. The emerging of COPD is mostly linked to the increase of life expectancy as well as the increase of toxic gases exposure such as tobacco smoking [(17)].

Life-long exposure to toxic particulates such as dusts in workplaces and tobacco smoking could eventually damage the lung [(20)]. When individuals acquire COPD, some pathological changes are identified in their lungs. These changes include losing extracellular matrix in alveoli, elevated thickening of airway walls, hyper-secreting of mucus in the lung, and damaging of alveolar septae. Because of these pathological

changes, the airway diameters are narrowed, the function of lung parenchyma is reduced, and the elastic tethering forces to maintain the airway patency is decreased [20].

In the case of chronic bronchitis, the air passage is obstructed and the airway diameter is narrowed because of different reactions including: thickening of the walls, hyper-secretion, and elevated mucus alongside with epithelial debris in the airway [20]. Theses reactions can lead to hyperplasia of the epithelium, which causes the emergence of inflammatory cells to the bronchial tubes. In contrast, in case of emphysema, the alveolar septae is destructed. As a result, the elastic recoil of the alveolar is decreased, the traction support of the small airway lumens is decreased, and the exhalation is impaired [20]. In addition, other organs of the body can be affected by severe status of COPD leading to more comorbidities including: cardiovascular disease, heart enlargement, osteoporosis, weight loss and muscle weakness, chronic infections, lung cancer, and metabolic syndrome [18, 20]. So, patients with severe COPD would have also more comorbidities than patients with mild COPD, which leads severe COPD adult patients to have more life difficulties including: social isolation, immobility, and poor health-related quality of life [20].

The onset of chronic obstructive pulmonary disease starts at mid-life [17]. Because COPD is characterized as a slowly progressive disease, some patients don't show symptoms in the early time of their disease and may go undiagnosed [18]. Some individuals show symptoms that are different from other people with the same disease [18]. COPD can be diagnosed by symptoms and a clinical test [17, 18]. The symptoms of COPD include shortness of breath, wheezing, lack of energy, chest tightness, blueness of lips or fingernail beds, weight loss, and frequent respiratory infections. The clinical

diagnosis of COPD can be performed by breathing capacity test called spirometry [17, 18]. It is identified by existences of post bronchodilator forced expiratory volume in 1second (FEV_1) / forced vital capacity (FVC) ratio of less than 70%, which indicates the persistent of airflow limitation in the lung [17].

The GOLD has classified COPD to four different stages regarding to the airflow limitation severity in COPD, table 1 [18]. The first stage (GOLD 1), which is the mild stage, is characterized with $FEV_1/FVC < 0.70$ and $FEV_1 \geq 80\%$ of the predicted value [17, 18]. The second stage (GOLD 2), which is the moderate stage, can be confirmed with $50\% \leq FEV_1 < 80\%$ of the predicted value [17]. In addition, the third stage (GOLD 3), which is the severe stage is described with $30\% \leq FEV_1 < 50\%$ of the predicted value[1]. Finally, the fourth stage (GOLD 4), which is the very severe stage, is characterized with $FEV_1 < 50\%$ of the predicted value [17, 18]. However, the clinical diagnosis of the patient's symptoms by healthcare providers play an important role for the classification of the disease [18].

Table 1. GOLD classification of COPD based on post-bronchodilator FEV_1 [17, 18]

Stages	COPD Classification	Severity of airflow limitation
GOLD 1	Mild	$FEV_1 \geq 80\%$ predicted
GOLD 2	Moderate	$50\% \leq FEV_1 < 80\%$ predicted
GOLD 3	Severe	$30\% \leq FEV_1 < 50\%$ predicted
GOLD 4	Very Sever	$FEV_1 < 50\%$ predicted

Fortunately, there are many ways and options to treat COPD and prevent the severe complications that usually associated with it [17]. For the treatment of COPD, it is important to control and manage the symptoms [18]. One treatment option is that patients are strongly recommended to stop and avoid exposure to tobacco smoking [3]. Another way to treat COPD is that air pollutants at living areas of COPD patients should be eliminated. In addition, some medications can be used to treat the symptoms such as wheezing and persistent cough. Some healthcare providers may consider recruiting COPD patients in pulmonary rehabilitation programs that are designed for each individual specifically. These programs concentrate on helping the patients to adapt breathing strategies and use energy-conversing techniques and nutritional counseling [3]. Similarly, the prevention of COPD starts from the recommendation of smoke cessation to the early identification of the disease and alteration of risk factor exposure and finally to the avoidance of the possible development of severe complications [17].

2. 2. Behavioral Risk Factors for COPD:

There are several behavioral risk factors that are associated with chronic obstructive pulmonary disease. These risk factors include tobacco smoking, daily activity and exercise, alcohol consumption, and routine checkup. The following sections will describe how each one of these behavioral risk factors contribute to the health status of COPD patients.

2. 2. 1. Tobacco Smoking:

The idea that tobacco smoking is the most leading cause of preventable mortality globally is well established. Although, the fact that tobacco smoking is well known to be the cause of lung cancer and cardiovascular disease, it is also considered the major risk

factor for developing chronic obstructive pulmonary disease. [22] It also contributes to the progression of the patients' disease [23]. Despite the way of exposure to tobacco, either by firsthand smoking or secondhand exposure, it is still the main risk factor for acquiring COPD [24]. Unfortunately, it was suggested that tobacco smoking is associated with at least 75% of deaths caused by COPD [25].

Patient smoking behavior is an important aspect in controlling and managing COPD. Although cigarette smoking is the main cause of COPD development and progression, majority of COPD patients tend to continue smoking [25]. In 2014, it was estimated that just about 50% of COPD patients reported trying to quit smoking in the previous year [23]. A recent study by Schauer et al, 2014, has compared the smoking behavior of COPD patients to the behavior of patients with other illnesses such as asthma, chronic conditions, and no chronic conditions by using Behavioral Risk Factor Surveillance System (BRFSS) 2011 database of just 5 states in the United States [25]. Schauer et al. found that among COPD patients, there were 47.3 % current smokers, whereas there were 23.1% current smokers among asthma patients, 28.8% current smokers among other chronic conditions patients, and 20.0% current smokers among patients with no chronic conditions. In addition, the findings of age-adjusted prevalence of tobacco smoking in the five states did not significantly differ from the findings of all states. Surprisingly, almost the majority of current smokers with COPD and asthma were females when compared to the other studied conditions. On the other hand, the age of current smokers of COPD and other chronic disease patients was much higher than the age of patients of the other studied conditions [25].

In addition, the findings of *Schaure et al* study indicated that COPD patients did

not differ significantly in regard to the number of quitting smoking attempts in the previous year. However, they suggested that COPD patients were significantly more expected to try several cessation treatment options than other patient groups. Despite that, the study showed that 40% of current smokers of COPD patients did not do any attempts for quitting smoking.

Another study on the BRFSS 2011 database by Cunningham et al, 2014, found that the prevalence of COPD among current smokers was 14.1%, while they found that the prevalence of COPD among former smokers was 7.1% and among never smokers was 2.9% [(26)]. They also suggested that the prevalence of comorbid diseases such as diabetes, cancer, coronary heart disease, stroke, and kidney disease is high in current smokers COPD patients [(26)].

Furthermore, a study conducted on the BRFSS 2012 database of South Carolina state by Liu et al, 2015, to investigate the relationship between history of COPD and respiratory symptoms with tobacco smoking duration [(27)]. The researchers studied the smoking duration history of 4,135 American adults (≥ 45) in relationship to frequent productive cough, frequent shortness of breath (SOB), affected physical activity because of SOB, and COPD diagnosis. Liu et al. found that among the respondents there were about 1, 454 people who smoked for ≥30 years, and among them the were 25.6% COPD patients. They indicated that among the respondents with ≥30 years of smoking history there were 58.3% current smokers, 26.0% had productive cough symptom, 11.2% had SOB, and 16.7% had limited physical activity because of SOB [(27)]. In addition, they found that people who quit smoking in the previous 10 years or more had a significantly lower prevalence of COPD when compared to current smokers [(27)]. Moreover, after

adjusting for smoking status, the findings showed that COPD and the other respiratory symptoms had linear relationship with smoking duration. The researchers found that women had much greater age-adjusted prevalence of COPD in all of the smoking durations when compared to the age-adjusted prevalence for men [27]. Liu et al. concluded that long exposure to tobacco smoking increases the risk of developing COPD and frequent respiratory symptoms [27].

Furthermore, Mirabelli et al, 2014, found that patients with active asthma with smoking history had significant prevalence of COPD [28]. They found that active asthma respondents who were current smokers had 26.7% prevalence of COPD. In contrast, they found that active asthma patients who were former smokers and lifetime nonsmokers had 20.6% and 8.3% prevalence of COPD, respectively [28].

In terms of investigating the regulation of smoking behavior, Hahn et al, 2014, conducted a study to confirm the benefits of smoke-free laws on the hospitalization of COPD patients in regions of Kentucky State from 2003 to 2011 [24]. The researchers found that hospitalization for COPD was 20% less likely to happen to individuals who are living in comprehensive smoke-free laws regions compared to people living in moderate-weak smoke-free laws or no smoke-free laws regions [24]. Hahn et al. indicated that individuals living in well-established smoke-free laws regions were 21% less likely to be hospitalized for COPD compared to people living in regions with very recent laws or no smoke-free laws. They concluded that strict smoke-free laws are important to lower the hospitalization rates for COPD patients, which eventually could save many people's lives and cut healthcare costs [24].

2. 2. 2. Alcohol Consumption:

It is important to investigate the risk factors that contribute to the development of exacerbation to COPD patients. A recent study conducted by Wetherbee et al, 2015, to determine the relationship between alcohol intake and the risk of developing acute exacerbation of COPD [29]. They found that among 1,082 self-reported alcohol consumption individuals there were only 74 heavy drinkers, while there were 645 light drinkers, and 363 moderate drinkers. Wetherbee et al. found that the median time of first acute exacerbation of COPD had no significant differences for all alcohol intake groups [29]. They found that all self-reported alcohol intake groups did not have significant differences in the mean crude rate of acute exacerbation of COPD. Wetherbee et al. concluded that there was no significant relationship between the acute exacerbations of COPD and the self-reported alcohol consumption of COPD patients with risk of developing exacerbation [29]. However, they indicated the number of heavy drinkers is a little bit low to determine the relationship between alcohol intake and the risk of acute exacerbation of COPD, and studies with larger samples are needed [29].

2. 2. 3. Physical Activity:

It is well established that physical activity has beneficial effects on primary and secondary preventions of chronic conditions [30]. For COPD, physical activity is suggested by several studies to benefit patients' quality of life, reduce mortality and morbidity rates, and decrease hospitalization admissions [30, 31]. Since managing COPD includes the utilization of respiratory rehabilitation programs, it has been shown that physical activity leads to lower loss of lung function and fewer exacerbations. In addition, more beneficial effects such as reduced pulmonary symptoms, increased

exercise capacity, reduced utilization of health care resources, increased strength of muscles, and reduced depression and anxiety are results of respiratory rehabilitation programs [31]. Also, these programs improve the health-related quality of life (HRQoL), sleep quality, and exercise tolerance in COPD patients [32,33]. However, physical inactivity and reduced daily exercise are usually found in COPD patients, especially in patients with severe COPD [30]. The reason behind the increased inactivity among COPD patients may be because either respiratory or non-respiratory demonstrations of the disease [34]. For example, weakness and loss of skeletal muscles induces exercise intolerance in COPD patients [31]. On the other hand, the dynamic hyperinflation is the main cause of limited exercise in individuals with COPD [34].

In 2011, Marin Royo et al. stated that although programs for pulmonary rehabilitation can benefit exercise capacity of patient with COPD, it is important to investigate the daily physical activity of COPD patients and its association to the disease severity [30]. So, they conducted a study on 132 COPD patients who were not currently enrolled in respiratory rehabilitation programs to determine the relationship between daily physical activity and severity of the disease. The study design differentiated the study population into three groups based on energy expenditure which included; inactive group with less than 100 kcal/week, moderate group with 1000 to 3000 kcal/week, active group with greater than 3000 kcal/week [30]. Marin Royo et al. found that the measurement of physical activity was 32.6% for the inactive group, 38.6% for the moderate group, and 28.8% for the active group. They concluded that high severity of disease, high bronchial obstruction, high dyspnea, and fewer walking meters were more likely to be seen in inactive COPD patients [30]. Marin Royo et al. also indicated that

inactivity is linked to poor health status in COPD patients. Finally, using motivational cues can enhance the physical activity behavior of COPD patients [35]. It can be implemented as a telemedicine intervention to encourage COPD patients to include more physical activity in their daily lives [35].

2. 2. 4. Routine Follow-up for COPD:

In COPD cases, it is very important for patients to do routine checkup to help managing their disease. There are several tests such as lung function test, pharmacotherapy, comorbidities, smoking status, and exacerbation history that can be assessed by the routine follow-up for CODP patients [36]. For instance, the annual routine check-up for the assessment of COPD is spirometry. In addition, frequent tests and other assessments such as discussion of treatment and symptoms tracking are involved in the routine check-up for COPD patients [36].

2. 3. Socioeconomic risk factors for COPD:

In general, socioeconomic status is well studied by many researchers in relationship to the individual's health status [37]. It has been linked to the contribution of health behavior changes. Many studies indicated that differences in socioeconomic status might be associated to increased mortality and morbidity rates [37]. Socioeconomic status is usually measured by education level, income level, occupation, condition of the housing, and residency location [38]. In case of COPD, Low socioeconomic status and mostly low education levels are always linked to high prevalence of the disease [38]. Several studies indicated that low socioeconomic status is associated with fewer FEV_1 or FVC, which indicates impairments in lung function of COPD patients [39]. In addition, a previous study found that COPD patients who are characterized having primary or

secondary education levels had larger spirometric airflow limitations when compared to COPD patients with university education level [39].

A study by Vozoris, N.T. and Stanbrook, M.B, 2011, found that low income level, education level, and social support were significantly associated in Canadian current smokers with COPD who had personal doctors and coverage for prescription medications [40]. Furthermore, according to the CDC analysis on BRFSS 2013 database, individuals with higher education level reported low prevalence to COPD [41].

Another study conducted by Katarzyna Bąk-Drabik and Dariusz Ziora was aimed to measure the effect on quality of life of COPD patients by their socioeconomic status [42]. They found that high education level was significantly associated with high quality of life in COPD patients. Also, the researchers indicated that people with low monthly income had significantly low quality of life. Moreover, they found that patients who had lower employment status had lower quality of life than of those with higher employment status [42]. Similarly, CDC reported from the BRFSS 2013 database that the employment status of patients is affected by the disease, that there were 24.3% of COPD patients who could not work [41]. In addition, low income and low education levels are associated with COPD severity, and COPD patients at risk of developing severe exacerbations [43]. The low level of education and income of COPD patient are associated with low lung function by lowering the FEV_1 % predicted [43]. The factors of socioeconomic work in a complex way to affect the health status of COPD patients [42].

2. 4. Clinical Risk Factors for COPD:

2. 4. 1. Depression and Anxiety:

Many people worldwide suffer from the disability and impaired quality of life because of several disorders related to mental health [44]. In the case of COPD, mood disorders such as major depression and minor depression are commonly seen. In addition, anxiety disorders such as panic, phobias, and generalized anxiety disorder are also common in patients with COPD [44]. It has been suggested by many studies that anxiety and depression could worsen the health outcomes of COPD patients by reducing the HRQoL, increasing the deaths rates, and increasing hospitalization admissions and healthcare costs [45, 46]. In addition, it is indicated that in terms of the etiology COPD and depression increase the morbidity of each other [47]. A Previous study suggested that patients with severe COPD were about two times more likely to be depressed than mild COPD patients [44]. Another study by Eisner et al. found that about 80% of COPD patients had anxiety when compared to healthy individuals [44]. They should also those COPD patients who reported having anxiety had significantly reduced exercise tolerance, increased COPD exacerbations, and reduced functional limitations when compared to COPD patients without anxiety [44].

Moreover, a study by Marco et al. investigated the prevalence of depression and anxiety in a group of COPD patients and healthy people based on their gender and disease severity [48]. They found that COPD patients had a prevalence of 18.8% depression and 28.2%, anxiety, when compared to healthy individuals who had only 3.5% depression and 6.1% anxiety. They indicated that majority of the patients with depression and anxiety were women who also had a poorer quality of life than men [48].

Unfortunately, COPD patients who are having depression commonly report noncompliance to medical treatments [46]. Hence, pulmonary rehabilitation programs and cognitive behavioral therapies for COPD patients are essential for the management and assessment of the impact of depression and anxiety, and therefore improved the health status of the patients. Finally, screening for depression and anxiety in COPD patients regardless of the severity of the disease is very important for better healthcare practice of COPD [49,50].

2. 4. 2. Other Comorbid Conditions

Although the chronic obstructive pulmonary disease is associated with depression and anxiety as comorbidities, it has been linked with other comorbid conditions such as diabetes, coronary heart disease, obesity, arthritis, high blood pressure, and stroke [51]. A previous study by Pleasants et al. was conducted to investigate the association of COPD alone, asthma alone, overlap syndrome (COPD and asthma), and no-disease status with comorbid conditions in patients from the North Carolina state BRFSS 2007 and 2009 databases. They found that patients with overlap syndrome had a higher prevalence of having comorbid diseases than the no disease group [51]. The overlap syndrome group had significantly higher prevalence of diabetes, stroke, and arthritis than the other groups [51]. In the case of COPD alone, patients had a higher prevalence of coronary heart disease (16.6%), stroke (4.4%), and high blood pressure (38.4%) than in the cases of asthma alone, former asthma alone, and no-disease. Pleasants et al. concluded that patients with COPD and asthma were more prevalent to report more comorbidities [51].

2. 5. Health-Related Quality of Life (HRQoL):

Health-related quality of life is an important aspect of the total quality of life for patients with many diseases, especially for chronic diseases such as COPD [52]. HRQoL is an essential outcome for the assessment of patients' diseases because it represents the mental health, physical health, and the general health of the patients [52]. HRQoL is defined as the discernments of mental health and physical health of the patient including: the functional status, socioeconomic status, social support, health risks and conditions. In fact, measuring HRQoL is important to determine the impact of health on the overall quality of life [53]. It is recommended that HRQoL should be utilized in the clinical practice to give a better evaluation of the severity and progression of the disease since it can help in the assessment of improvement and deterioration of the patient's health status [52]. COPD is linked to high morbidity and mortality rates, and that the severity of the disease is associated with reduced quality of life [54]. In addition, patients with COPD also suffer from fatigue and decreased sleep quality [55]. It is suggested that about 58% of COPD patients may report fatigue and that because they suffer from declined oxygen saturation and loss of sleep [55]. This fatigue may lead COPD patients to have reduced working area productivity, reduced ability to concentrate, higher state of unwillingness, low performance, and reduced social activities. However, a study conducted by Sahin and Dayapoglu, 2015, suggested that progressive relaxation exercise programs could benefit COPD patients by increasing the sleep quality and therefore decreasing their fatigue suffering [55]. COPD is also associated with other health impairments such as disability in walking and standing [55-57].

Several studies indicated that patients with COPD have reported health impairments such as mental and physical disability, use of a special equipment, and mental distress. Pleasants et al. have investigated the associations between healthy people, COPD patients, asthma patients, overlap syndrome patients with their health impairments by using BRFSS database for North Carolina state [51]. They found that COPD patients and overlap syndrome patients were more likely to have frequent physical distress, frequent mental distress, use of a special equipment, and disability than healthy people. In addition, they found that overlap syndrome patients had more reported disabilities resulting in higher use of special equipment than the other groups in the study [51]. Pleasants et al. found that shortness of breath impacted the quality of life of COPD patients as well as overlap syndrome patients [51].

In addition, according to Wheaton et al study, 2015, that investigated the prevalence of COPD in the United States, there were around 24.3 % of COPD patients with disability of work, whereas the patient without COPD had about 5.3% [41]. Also, they found that COPD significantly causes activity limitations (49.6%), difficulty walking or climbing stairs (38.4%), and using of a special equipment (22.1%), while participants without COPD had less percentages in activity limitations (16.9%,), difficulty walking or climbing stairs (11.3%) and using of a special equipment (6.7%) [41].

Moreover, Katajisto et al. suggested that dyspnea was strongly correlated with HRQoL, daily exercise, and physical activity in COPD patients [58]. They indicated a significant association between increased perception of dyspnea and high inactivity in COPD adult patients. They concluded that exercise programs are important in improving the physical activity in COPD patients [58].

In addition, Antwi et al. have investigated the association between prevalence of COPD and HRQoL in the United States by using BRFSS database for South Carolina [1]. They have found that patients of COPD had statistically significant fair or poor general health. Also, they found that COPD patients had unhealthy mental and physical days more than the general population [1]. Finally, a study Abu Hassan et al, 2014, indicated that long duration of smoking quitting could significantly benefit the HRQoL of patients with COPD [59]. They found that COPD patients who quit smoking in a long time had less risk of developing respiratory symptoms such as cough, dyspnea, and phlegm than the current smokers COPD patients [59]. The studies on HRQoL of patients with COPD indicated that pulmonary rehabilitation programs, exercise training programs, early smoking cessation can be in a great interest.

2. 6. Research Gap in The Literature

The previous studies have examined the effect of chronic obstructive pulmonary disease on the health status of COPD patients. Several of these studies found that this disease could increase the poor health status of COPD patients. Some of the recent papers have found that the high severity of COPD can significantly affect the health of the patients more than the mild cases of COPD. Also, they have suggested that exacerbations are more likely to occur in patients with advanced stages of COPD. However, the previous studies have not thoroughly focused on investigating the effect of COPD on the health-related quality of life of COPD patients. It is still important of interest to investigate how the HRQoL is statistically significant by the disease itself.

In addition, many studies examined the effect of tobacco smoking as a primary risk factor in the severity of COPD. Many of which suggested that current smoking status

affects COPD patients and leads to a progressive status of the disease to develop exacerbations. Nevertheless, limited studies have focused on the association between the tobacco smoking duration of patients with COPD and HRQoL of the patients. Furthermore, a thorough investigation on the association between quitting smoking and HRQoL of patients with COPD in the United States is in a great need.

Moreover, previous studies examined the associations between comorbid conditions and COPD in patients in the United States. These studies have found that comorbidities contribute significantly to the severity of the disease. However, since literature has not investigated the relationships between the comorbid conditions and the HRQoL of COPD patients, more studies are in need to address this aspect.

This study aims to investigate the addressed issues in terms of associations between COPD and the HRQoL in adult patients with COPD in the United States by using BRFSS 2014 database. In addition, the outcomes of this study would give a thorough understanding of the associations between the smoking status, quitting smoking duration, or other comorbid conditions, and the HRQoL of patient with COPD patients, which therefore would lead to the improvement of the healthcare practice for chronic obstructive pulmonary disease in the United States

CHAPTER III

RESEARCH METHODS

3.1 Research Overview:

It is very important to study the effect of chronic obstructive pulmonary disease on HRQoL in adult COPD patients. The HRQoL includes the physical activity, mental health, physical activity limitations, and other daily life difficulties such as difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in performing errands alone. These factors could be significantly impacted by the disease itself. In addition, investigating the effect of smoking cessation duration on the HRQoL in COPD patients is essential to support the knowledge of the beneficial effect of smoking cessation for COPD patients. On the other hand, determining the associations between HRQoL and other health conditions in COPD patients is critical for helping the patients have a healthy social life. The outcome of investigating the impact of COPD and patients' behaviors on the HRQoL in COPD patients could generate improved assessment, management, and better healthcare services for adults with COPD in the United States.

Although during the previous years there has been a great research on the COPD relationship with the health status of adult patients, this study aims to conduct a thorough descriptive analysis for the behavioral risk factors, socioeconomic risk factors, and clinical risk factors of COPD patients to determine the associations between the HRQoL

in adult COPD patients and their COPD, smoking status, smoking cessation duration, and specific comorbidities.

Furthermore, this study examines the relationships between the health-related quality of life of COPD patients and several risk factors including: 1) behavioral risk factors (such as tobacco smoking status, alcohol consumption, physical activity, and routine follow up), 2) socioeconomic risk factors (such as education level, income level, stress and health care coverage), and 3) clinical risk factors (such as obesity, coronary heart disease, stroke and diabetes).

The objectives of this study are the following:

- Determine the associations between the COPD disease and health-related quality of life in adult COPD patients.
- Identify the benefits of quitting cigarette smoking on the HRQoL of COPD patients in the US.
- Identify any associations between comorbidities such as obesity, diabetes, coronary heart disease, and stroke in COPD patients and each one of HRQoL factors in COPD patients in the United States.

The outcomes of this study will develop a better understanding of the effect of COPD and the other investigated factors on the health-related quality of life in adult patients with COPD in the United States. Thus, this knowledge would lead to the improvement of the assessment and management of the disease in adult patients. Also, it would significantly enhance the performance of healthcare practice for COPD, increase

the necessity of smoking cessation and pulmonary rehabilitation programs for COPD patients in the United States.

3.2 Data Sources and Data Elements:

This study is using the Behavioral Risk Factor Surveillance System 2014 database of adults with COPD in the United States. The behavioral, socioeconomic, clinical risk factors of COPD patients will be investigated in relationship to the HRQoL of those patients. The outcome of this study will show how these risk factors are associated with HRQoL in adult COPD patients.

BRFSS is considered as a cross-sectional survey that collects data about the respondent's health status and is performed in all states and territories of the United States. Each year, the survey is conducted by standardized questionnaires asked by state health departments on randomly selected adults (18 years and older).

Finally, this study includes several data elements to determine the effects of COPD and other risk factors on the HRQoL in adult patients with COPD in the United States. These data elements include; 1) a chronic health condition (COPD), 2) demographics elements (including: age, gender, and race of the individuals), 3) socioeconomic elements (including: education level, income level, healthcare coverage, and stress), 4) behavioral elements (including: tobacco smoking status, alcohol consumption, physical activity, and routine follow-up), 5) clinical elements (including depressive disorder, obesity, diabetes, coronary heart disease, and stroke), and 6) HRQoL elements (including: physical health, mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and

difficulties in doing errands alone). The study variables are shown in table 2. The hypotheses of this study are shown in table 3.

Table 2. Lists of the variables used in the current study.

Research Variables	Variables Names from BRFSS Data 2014	Variable Description Or Variable Questions
Have COPD?	CHCCOPD1	"(Ever told) you have Chronic Obstructive Pulmonary Disease or COPD, emphysema or chronic bronchitis?" Type: Num. Categorical Variable (Binary). 1. YES 2. NO 7.
Gender	SEX	Respondents Sex Type: Num. Categorical Variable (Binary). 1. Male 2. Female
Age	_AGEG5YR	Age of respondents from five-year age categories divide into. Type: Num. Fourteen-level age category. 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 50 to 54 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
Race	_RACE	Race/ethnicity categories Type: Num. Categorical Variable. Nine groups Race-Ethnicity categories: 1. White non-Hispanic 2=Black non-Hispanic 3. American Indian or Alaskan Native Non-Hispanic 4. Asian non-Hispanic 5. Native Hawaiian or other Pacific Islander Non-Hispanic. 6. Other race non-Hispanic 7.Multiracial non-Hispanic 8. Hispanic.
Education Level	EDUCA	"What is the highest grade or year of school you completed?" Type: Num. Ordinal Variable. Six-groups education level category. 1. Never attended school. 2. Grades 1 through 8. 3. Grades 9 through 11. 4. Grades 12 or GED. 5. College 1 year to 3 years. 6. College 4 years or more.
Employment Status	EMPLOY1	Are you currently…? Type: Num. Ordinal Variable. Nine employment groups: 1. Employed for wages 2. Self-employed 3. Out of work for 1 year or more 4. Out of work for less than 1 year

		5. A homemaker 6. A student 7. Retired 8. Unable to work.
Income Level	INCOME2	"Is your annual household income from all sources: Type: Num. Ordinal Variable. Tin-groups income level category. 1. Less than $10,000 2. Less than $15,000 3. Less than $20,000 4. Less than $25,000 5. Less than $35,000 6. Less than $50,000 7. Less than $75,000 8. $75,000 or more
Could Not See Doctor Because of Cost	MEDCOST	"Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?" Type: Num. Categorical Variable (Binary). 1. YES / 2. NO.
Could Not Get Medicine Due To Cost	MEDSCOST	"Was there a time in the past 12 months when you did not take your medication as prescribed because of cost? Do not include over-the-counter (OTC) medication." Type: Num. Categorical Variable (Binary). 1. YES / 2. NO.
Health Care Coverage	HLTHPLN1	"Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?" Type: Num. Categorical Variable (Binary). 1. YES / 2. NO
Exercise	EXERANY2	"During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" Type Num. Categorical Variable (Binary). 1. YES / 2. NO
Health Routine Checkup	CHECKUP1	"About how long has it been since you last visited a doctor for a routine checkup?" Type: Num. Ordinal Variable. 1. Within past year. 2. Within past 2 years. 3. Within past 5 years 4. Within 5 years or more. 8. Never.
Current Smoking	_RFSMOK3	"Adults who are current smokers" Type: Num. Categorical Variable (Binary) 1. NO / 2. YES
Frequency Of Days Now Smoking	SMOKDAY2	"Do you now smoke cigarettes every day, some days, or not at all?" Type: Num. Ordinal Variable. 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?" Type: Num. Ordinal Variable. 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.
Alcohol Usage	AVEDRNK2	"During the past 30 days, on the days when you drank, about how many drinks did you drink on the average?" Type: Num. Numerical Variable 1 – 76 Number of drinks.
Stress	1. SCNTMNY1 2. SCNTMEL1	1. "How often in the past 12 months would you say you were worried or stressed about having enough money to pay your rent/mortgage? Would you say." 2. "How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals? Would you say" Type: Num. Ordinal Variable. 1. Always. 2.Usually. 3. Sometimes. 4.Rarely. 5. Never.
Ever told you had a depressive disorder	ADDEPEV2	"(Ever told) you that you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?" Type: Num. Categorical Variable (Binary). 1. YES / 2. NO.
Body mass index	_BMI5CAT	Body Mass Index (BMI). Type: Num. Ordinal Variable. 1. Underweight. / 2. Normal Weight. / 3. Overweight. 4.Obese.
Diabetes	DIABETE3	"(Ever told) you have diabetes?" Type: Num. Categorical Variable (Binary). 1. YES. / 2. Yes, but female told only during pregnancy 3. NO / 4. No, pre-diabetes or borderline diabetes
Coronary heart disease	CVDCRHD4	"(Ever told) you had angina or coronary heart disease?" Type: Num. Categorical Variable (Binary). 1. YES 2. NO.
Stroke	CVDSTRK3	"(Ever told) you had a stroke." Type: Num. Categorical Variable (Binary). 1. YES 2. NO.
General Health	GENHLTH	"Would you say that in general your health is:" Type: Num. Ordinal Variable. 1.Excellent. 2. Very good. 3. Good. 4. Fair. 5. Poor.
Number of Days Physical Health Not Good	PHYSHLTH	"Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?" Type: Num. Numerical Variable 1 - 30 Number of days 88. None.
Number of Days Mental	MENTHLTH	"Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days

Health Not Good		during the past 30 days was your mental health not good?" Type: Num. Numerical Variable. 1 - 30 Number of days 88. None
Activity Limitations	QLACTLM2	"Are you limited in any way in any activities because of physical, mental, or emotional problems" Type: Num. Categorical Variable (Binary). 1. YES 2. NO.
Difficulty Walking or Climbing Stairs	DIFFWALK	"Do you have serious difficulty walking or climbing stairs?" Type: Num. Categorical Variable (Binary). 1. YES 2. NO.
Difficulty Dressing or Bathing .	DIFFDRES	"Do you have difficulty dressing or bathing?" Type: Num. Categorical Variable (Binary). 1. YES 2. NO.
Difficulty Doing Errands Alone.	DIFFALON	"Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?" Type: Num. Categorical Variable (Binary). 1. YES 2. NO.

Table 3. The Research Questions of the Current Study

Research Questions	Hypothesis	Independent variables	Outcomes variables	Inferential analyses	Descriptive analyses & Predictive models
Does COPD significantly affect the HRQoL of COPD patients?	Hypothesis 1	CHCCOPD1	GENHLTH, PHYSHLTH, MENTHLTH, QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON,	Correlation between (CHCCOPD1 vs. Each of the outcomes variables)	- Frequency Distribution for the outcomes variables & - Logistic regression for CHCCOPD1 Vs. outcomes variables
Do quitting smoking and quitting duration significantly benefit the HRQoL of COPD patients?	Hypothesis 2	SMOKE100, SMOKEDAY2, LASTSMK2, _RFSMOK3	GENHLTH, PHYSHLTH, MENTHLTH, QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON,	Correlation between (each of SMOKE100, SMOKEDAY2, , LASTSMK2, , _RFSMOK3 Vs. Each of HRQoL outcomes variables.)	- Logistic regression for HRQoL Variables (outcomes) in regard to SMOKE100, SMOKEDAY2, , LASTSMK2, , _RFSMOK3
Do comorbid conditions affect the HRQoL of COPD patients significantly?	Hypothesis 3	_BMI5CAT DIABETE3 CVDCRHD4 CVDSTRK3	GENHLTH, PHYSHLTH, MENTHLTH, QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON,	Correlation between (each of CHCCOPD1 _BMI5CAT DIABETE3 CVDCRHD4 CVDSTRK3 Vs. Each of outcomes variables.)	- Logistic regression for HRQoL Variables (outcomes) in regard to _BMI5CAT DIABETE3 CVDCRHD4 CVDSTRK3

3. 3. Research Design and Methods:

In the beginning of this study, a literature review was performed on several subjects of this research. Many of scientific databases such as Rutgers University Libraries, PubMed databases, and ScienceDirect databases were used to accomplish the search for the topics of interest. The research engine Google was also used for the search for important websites related to COPD and the other element of this study. In the search, there were no limits on the articles' publication year. However, I aimed to limit the search in all the databases for only articles that have full access to full text (as downloadable PDFs). The lists of researched topics in all the databases are as follows; "COPD and BRFSS", "BRFSS" "COPD patients' health-related quality of life", "effect of COPD on health-related quality of life", "Behavioral risk factors for COPD patients", "Socioeconomic risk factors for COPD patients", "Smoking status for COPD patients", "Quitting smoking for COPD patients", "Smoking and health-related quality of life", "Comorbidities and COPD", "Comorbidities and health-related quality of life". A separate search was conducted for any statistical tests that would be used in this study for understating the theoretical concepts of each test and its use.

Then, I obtained the data from the Behavioral Risk Factors Surveillance System (BRFSS) 2014 database in order to conduct the analysis on the effects of COPD, smoking cessation duration, and specific comorbidities on the health-related quality of life in adult COPD patients in the United States. The BRFSS is considered the largest surveillance survey of health status in the world. It is performed by health departments in all 50 states of the US in addition to the District of Columbia and the other US territories. Since 2011, BRFSS has conducted cellular phone interviews in addition to the original method that is

landline phone interviews. Each year, around 500,000 interviews are collected from all states by health departments and returned to the CDC for data storage and analysis.

The BRFSS datasets contain different types of data, which include clinical data and non-clinical data. Examples of data that are included in BRFSS:

- Demographics data (including: age, gender, race, and marital status),
- Behavioral risk factors data (including tobacco smoking status, exercise, and alcohol consumption),
- Clinical data that include chronic health conditions data (including diabetes, COPD, coronary heart disease, stroke, and many other conditions)
- Socioeconomic risk factors data which include income level, education level, and healthcare coverage,
- Health-related quality of life data (including physical health, mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone).

In addition, BRFSS data contain other data from optional modules that are decided by health departments in each state. Screening modules such as breast and cervical cancer screening, alcohol screening, and prostate cancer screenings are examples of the optional modules found in the BRFSS 2014 database. These modules are developed and evaluated by the CDC. In contrast, BRFSS databases contain other data from modules that are developed by each state's health department without any review by the CDC.

In this research, I aim to obtain the BRFSS 2014 dataset and extract them by using the statistical analysis software (SAS) release 9.4. According to BRFSS, the data

file of the year 2014 consists of around 464,664 records. Then, new SAS datasets will be generated from the original datasets, which will only consist of data of adult COPD patients in the United States. The SAS software will be employed to perfume the analysis of this research. The following figure demonstrates the conceptual model generated for this study.

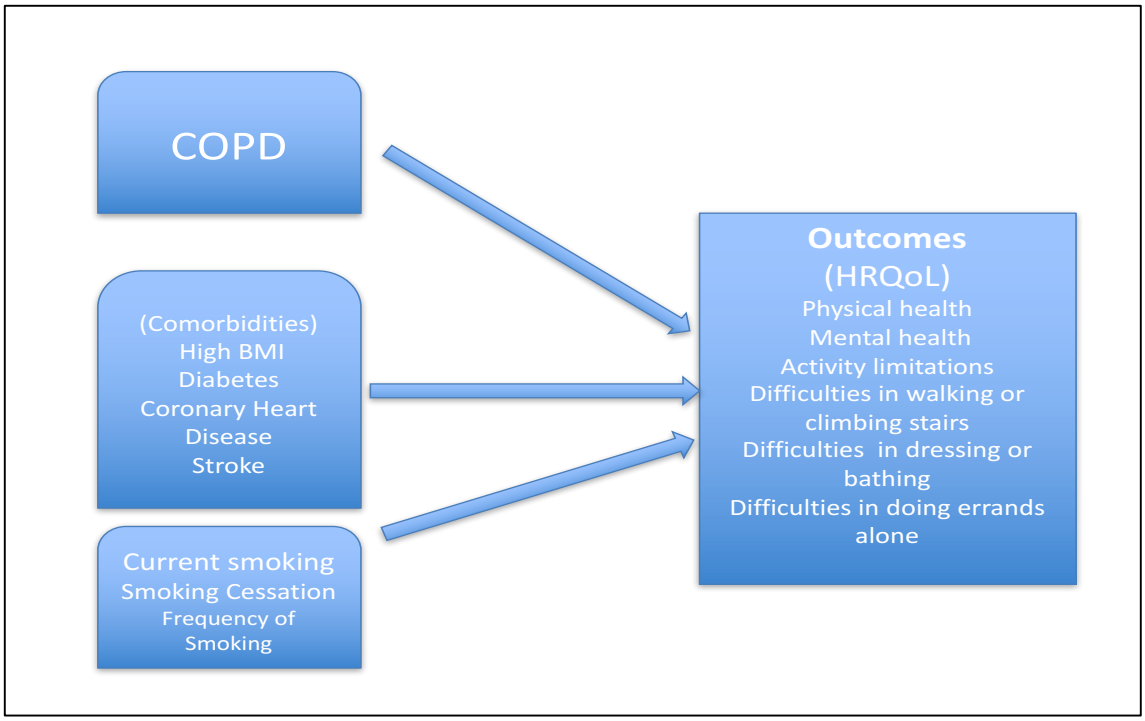

Figure 1:
A Conceptual model for determining the factors that affect the HRQoL in adult COPD patients.

In this study, several descriptive statistics will be used to describe and demonstrate the data that obtained from the BRFSS 2014 database. The data of this study contain quantitative variables such as alcohol consumption, physical health, and mental health, which will be described by measuring the central tendency such as mean, median and mode for estimating the center of distribution for each of these variables. The mean of data is measured by summing the observed values from the dataset and then divided by the number of the values [60]. The median of data is identified by the value that divides the

observations in the dataset in half. It represents the midpoint of the distribution of the data [60]. On the other hand, the class that consists of the highest values in the dataset represents the mode of the data [60]. Dispersion measures such as range, standard deviation, and variance to describe the variability of measurements of these variables will be performed. In brief, the range of data is measured by identifying the difference between the lowest and highest value in a distribution of records. On the other hand, the standard deviation and the variance of the observation in a data are the squared deviations of the data means. These measures are helpful in comparing the results of different datasets that have similar units. [60]

In addition, the data of this study also consist of qualitative variables that will be described by using frequency distribution method. This method represents the illustration of how the different values of the dataset are distributed in the measurement scale [61]. Frequency distribution can be displayed in graphical (such as histogram graphs) or tabulation formats. The qualitative variables of this study include ever-told have COPD, gender, age, race, education level, income level, exercise, routine checkup, current smoking, frequency of days now smoking, interval since last smoked, could not see doctor because of cost, could not get medicine due to cost, healthcare coverage, diabetes, coronary heart disease, stroke, body mass index, stress, depressive disorder, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone.

Moreover, inferential statistics such as chi-square test, Kruskal-Wallis test, one–way analysis of variance (ANOVA), two-way ANOVA, Pearson correlation, and Spearman correlation may be performed when appropriate. Finally, predictive models

such as simple linear regression, logistic regression models will be conducted when needed to define the risk and ratios for different factors such as comorbidities and smoking status that affects the health-related quality of life of COPD patients in the United States.

3. 3. 1. Statistical Methodologies:

When appropriate, the following statistical tests will be used to analyze the data obtained from the BRFSS 2014 database:

For parametric data, the parametric tests for normally distributed variables such as:

- Descriptive analyses such as mean, and standard deviation
- Pearson correlation (correlation analysis)
- One-way ANOVA
- Paired or unpaired t-test

For non-parametric data, the following tests will be used for the not normally distributed variables such as:

- Descriptive analyses such as range, and median
- Spearman correlation (correlation analysis)
- Chi-square test.
- Kruskal-Wallis test

Several other tests will be used for the categorical and binary outcome variables such as:

- Descriptive analyses such as proportion
- Chi-square test
- Fisher exact test
- Logistic regression models

3. 3. 2. Statistical Analysis:

The BRFSS datasets are previously transferred to SAS files and are ready to use for analysis. However, I aim to generate different datasets that contain only records of COPD patients in the United States. The datasets will also include records of comorbidities in COPD patients to accomplish the third hypothesis of this study. In addition, a SAS software Release 9.4 running on a Windows operating system will be used to perform all the computations of this study. This study will report all the invalid data such as missing values with explained reasons. Also, outlying data will be included to study if they increase the power of the statistical tests, but if otherwise they will be excluded.

Descriptive analysis methods will be performed for all of the quantitative and qualitative variables. Then, they will be demonstrated with the appropriate display methods such as tables, bar charts, or histogram graphs. In addition, a normality assessment will be performed for all continuous variables. If the studied variables are normally distributed, a parametric method will be conducted. In contrast, if the studied variables are not normally distributed, a non-parametric method will be conducted.

After that, inferential statistics methods such as chi-square test will be used for analyzing the relationships between independent categorical variables and dependent categorical variables. Also, the chi-square test will be used for determining the associations between independent ordinal variables and dependent categorical variables. In addition, a Kruskal-Wallis test will be conducted for analyzing the relationships between the dependent not normally distributed quantitative variables and the independent categorical variables and dependent ordinal variables. On the other hand, a

one-way ANOVA test will be used for determining the relationships between the dependent normally distributed quantitative variables and the independent categorical and ordinal variables.

Moreover, linear discriminant analysis test will be used for determining the relationship between the independent normally distributed quantitative variables and the dependent categorical variables. On the other hand, the Spearman correlation test will be used for determining the associations between the independent ordinal variables with the dependent ordinal or not normally distributed quantitative variables. Also, it will be used for determining the associations between the independent normally distributed quantitative variables with the dependent ordinal or not normally distributed quantitative variables. In addition, the Spearman correlation test will be conducted for determining the associations between the independent not normally distributed quantitative variables and the dependent categorical, ordinal, or not normally distributed quantitative variables.

Furthermore, the Pearson correlation test will be conducted to determine the associations between the independent normally distributed quantitative variables and the dependent normally distributed quantitative variables. However, it can be used for determining the associations between the independent not normally distributed quantitative variables and the dependent normally distributed quantitative variables. Finally, the following sections will give a brief summary of the theoretical concepts of each of the statistical test including: chi-square test, Kruskal-Wallis test, one-way ANOVA test, Spearman correlation test, and the Pearson correlation test.

3. 3. 2. 1. Chi-square Test:

Chi-square test is one of the widely used statistics in the biomedical field. This test can be used for two different applications [60]. First, it can be used for the assessment if an observed proportion follows a specific expectation. Second, it can be used for determining if two variables have a statistically significant association. It is used for determining the associations between categorical variables. It is important in the chi-square test to set the level of significance, which can be indicated as a *p*-value [60]. Usually, the *p*-value is set as < 0.05, 0.01, or 0.0001. When using the chi-square for independence, the expected frequency of the outcome variable is not known. In addition, the two variables tested in the chi-square test should be first presented in cross-tabulation or contingency tables. These tables illustrate the frequencies observed for those variables. [60]

In this study, the chi-square test would be used to determine the associations between categorical variables. For the first hypothesis, the chi-square would be used to test the associations between the variables "Ever told have COPD" (CHCCOPD1) with each of the HRQoL variables (including QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON, PHYSHLTH, and MENTHLTH). On the other hand, this test would be used for the second hypothesis to test the associations between each of the smoking status variables such as (SMOKE100, SMOKEDAY2, STOPSMK2, LASTSMK2, USENOW3, _RFSMOK3) and each one of the HRQoL variables (including QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON, PHYSHLTH, and MENTHLTH).

In addition, for the third hypothesis, the chi-square test would be used to determine the associations between each of the comorbidities variables including the

BMI (_BMI5CAT), diabetes (DIABETE3), coronary heart disease (CVDCRHD4), and stroke (CVDSTRK3) and each one of the HRQoL variables (including QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON, PHYSHLTH, and MENTHLTH). The results will report all the statistically significant associations between the predictor and indicator variables with explained interpretations.

3. 3. 2. 2. One-way Analysis of Variance (ANOVA):

In general, all studies that test different conditions use analysis of variance (ANOVA) for comparing different populations [(60)]. It investigates the different means for the studied populations. However, one-way ANOVA is used to investigate a single factor that discriminates different groups. The main goal of this method is to determine if the several groups, which are two or more, have similar mean. Compared to the t-test, ANOVA determines that the means are different for the groups but does not give which one is having the larger mean. [(60)] ANOVA requires three assumptions including; each value in all groups is normally distributed and independents have the same mean and variance, two groups may have different means but they should have similar variance, and all groups should have similar means in the null hypothesis. Finally, in the evaluation of the association significance between an independent variable and a dependent variable, one-way ANOVA uses the *F* distribution. [(60)] Two- way ANOVA is used when there are two categorical independent variables and one continuous dependent variable for determining their associations.

3. 3. 2. 3. Kruskal-Wallis Test:

In relation to the one-way ANOVA test, Kruskal-Wallis test is considered the nonparametric analog for it [(60)]. The main goal of this test is to determine if the studied

groups, which should be three or more, have similar central tendency measures. The fundamental idea of this test is that rank transformation is applied to the pooled data. Each group should have similar rank sum to accept the null hypothesis. In contrast, if one of the groups has different measures, it should have different rank sum. [60]

3. 3. 2. 4. Linear Discriminant Analysis:

This statistical test is used to classify observations into previously known two groups [62]. The concept of this method requires the independent variables to be quantitative and be normally distributed, which are called predictors. It requires one or more independent variables. In addition, it requires that the dependent variables to be categorical, which are called classes. [62]

3. 3. 2. 5. Pearson Correlation:

Pearson correlation method is a statistical technique used to determine if two different variables are associated [60]. It identifies the degree of a linear relationship between these variables. The variables are all the time representing ratio or interval-level measurements. Thus, the independent and dependent variables that used for this method are quantitative variables. [60] This method gives a linear association between the two variables. For Pearson correlation, (r) referees to the sample correlation coefficient, which means that if two variables are perfectly correlated, it means that r is equal to 1. In addition, if the variables are negatively correlated, r would be as -1 ($-1 \leq r$), whereas if the variables are positively correlated, r would be as +1 ($r \geq +1$). [60]

In this study, the Pearson correlation would be used for determining the relationships between the independent and dependent quantitative variables. In the beginning, a scatter plot would be performed to test for normal distribution of the

variables. Finally, the results will give comprehensive explanations of the relationships between the variables.

3. 3. 2. 6. Spearman Correlation:

In contrast to the Pearson correlation, Spearman correlation is a non-parametric statistical method that is used to determine the association between two variables. Although the independent and dependent variables used in this method are quantitative variables, this test does not require that the variables be normally distributed. In addition, Spearman correlation is also used for ordinal data.

In this study, the Spearman correlation test would be used for determining the associations between independent ordinal variables and dependent ordinal variables. Moreover, it would be used for the independent and dependent variables if they are not normally distributed.

3. 3. 3. Predictive Models:

There are many predictive analytics that are used in statistical studies in the biomedical field. These models may include, but not limited to, simple linear regression, simple logistic regression, and ordinal logistic regression. The following sections will give brief summaries of the fundamental concepts of the linear regression and simple logistic regression models, and an overview of how they would be used towards the research hypotheses.

3. 3. 3. 1. Linear Regression:

For modeling the relationship between several predictors (or called independent variables) and dependent variables, researchers have been using regression models. Ultimately, regression models use the *p*-value for measuring their sufficiency [(63)]. Linear

regression is defined as a statistical model that determines the relationship between two variables in a straight-line manner [64]. There are two different techniques of linear regression models including simple linear regression and multiple linear regression. For the first technique, from its name, simple linear regression determines the relationship between one independent (predictor) variable and a dependent (response) variable. The equation of the relationship line in simple linear regression is (z=kx+c), which z refers to the dependent variable, x refers to the independent variable, k refers to the coefficient of the slope of the linear relationship, and c refers to the constant. [64] Simple linear regression has several necessary assumptions including; 1) the two variables are assumed to have linear relationship, 2) the regression line is assumed to have a constant variation, 3) independent variables are assumed to have a variation with a normal distribution at the regression line, and finally, all the data at the regression line are assumed to have independent deviation points from other data. [64]

In contrast, multiple linear regression is a technique used for determining the relationship between multiple independent (predictor) variables and a dependent (response) variable [65]. The importance of this method is that researchers can create one model to investigate essential factors in the biomedical field. That is, this technique gives better understating of the associations between each of the predictor variables and the indicator variable, and between all of the independent variables and the response variable. It also gives a great understating of the associations between the independent variables themselves [65]. Stepwise regression method is used to choose the best independent variables for overcoming the overfitting problem when many variables are introduced to the model [60].

In this study, the simple linear regression technique would be used for determining the relationships between a predictor variable (such as a categorical, ordinal, or quantitative variable) and an indicator variable (such as a quantitative variable).

3. 3. 3. 2. Logistic Regression:

Logistic regression is a predictive method that is used in the biomedical field to determine the relationship between two variables [60]. It determines the relationship between one or more predictor variables and one outcome (indicator) variable. This technique is used to find the probability of the occurrence of an event. However, compared to the linear regression model, this method finds the relationship between one or more independent variables and a binary indicator variable [60, 66]. In addition, it depends on the coefficients to form the linear model. [59] Logistic regression determines the relationship between the log odds of the indicator variable and the predictor variables [67]. The odds ratio is the concept that stresses the logistic regression technique. Therefore, the changes that occur in the indicator variable's log odds as combated to the variable itself are calculated by this model. Generally, the ratio of two odds is defined as the log odds ratio. The indicator variable in the logistic regression model is a binary categorical variable, while one or more predictor variables can be categorical or quantitative [67]. In contrast, if the indicator variable has many values, then another type of logistic regression is used, which called multinomial logistic regression. Although the simple model of logistic regression would be used for almost all of the indicator variables which are binary, the ordinal logistic regression would be used for the other indicator variables that have more than one case.

In this study, the logistic regression model would be used for determining the probability of the binary categorical health-related quality of life variables. Simple logistic regression would be used to determine the relationship between each one of categorical and quantitative of the predictor variables and each one of the binary HRQoL indicator variables. In details, simple logistic regression would be used for the first hypothesis to find the probabilities of each of the indicator variables (including QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON, PHYSHLTH, and MENTHLTH) in relationship to the COPD predictor variable (CHCCOPD1). For the second hypothesis, this model would be used to determine the relationship between each one of the predictor variables (including SMOKE100, SMOKEDAY2, STOPSMK2, LASTSMK2, USENOW3, and _RFSMOK3) and each one of the HRQoL indicator variables (including QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON, PHYSHLTH, and MENTHLTH).

In addition, the simple logistic regression model would be used for the third hypothesis for finding the probabilities of each of the HRQoL indicator variables (including QLACTLM2, DIFFWALK, DIFFDRES, DIFFALON, PHYSHLTH, and MENTHLTH) in relationship to the predictor variables (including BMI5CAT, DIABETE3, CVDCRHD4, and CVDSTRK3).

In contrast, ordinal logistic regression model is used for determining the probabilities of the health-related quality of life indicator variables that have more than two cases. Finally, the results will include detailed interpretations whenever a specific model is performed.

3. 4. SAS Procedures for The Project:

There are several SAS procedures that would be used in this study in order to perform each of the statistical analysis tests. These procedures include PROC UNIVARIATE and PROC FREQ which would be used in the descriptive analysis of the data. However, the procedure PROC FREQ with the CHISQ option would be used for the Chi-square test in the inferential analysis. In addition, PROC CORR procedure with the options (OUTP and OUTS) may be used for the Pearson correlation and Spearman correlation tests in the inferential analysis of the data. On the other hand, the inferential analysis may use the PROC GLM and PROC NPAR1WAY procedures for the one-way ANOVA and Kruskal-Wallis tests, respectively. Moreover, the predictive analysis may use the PROC REG procedure for the linear regression models. Finally, PROC LOGISTIC procedure would be used for the logistic regression models in the predictive analysis. All of these procedures are commonly used in many statistical types in the SAS software.

CHAPTER IV

RESULTS

4. 1. Introduction:

After obtaining the Behavioral Risk Factors Surveillance System 2014 dataset, I have created a new dataset that only contains data about respondents who answered the COPD questions. The dataset was excluded from data about respondents who answered other questions that are related to other modules in the BRFSS database. The BRFSS 2014 database contained approximately 464,664 records, out of them 38191respondents who have reported that they have been told that they had chronic obstructive pulmonary, emphysema, or chronic bronchitis, table 4 and figure 11. All statistical tests in this study were generated by using the SAS 9.4 ran on a Windows machine. The following sections will include the results of the descriptive analysis, inferential analysis, and predictive analysis for each hypothesis of this study.

Table 4:
The distribution of COPD in BRFSS database of the year 2014.

Chronic Obstructive Pulmonary Disease	Frequency	Percent
Yes	38191	8.26%
No	423997	91.74%

Note: *Data were obtained from BRFSS 2014 database.*

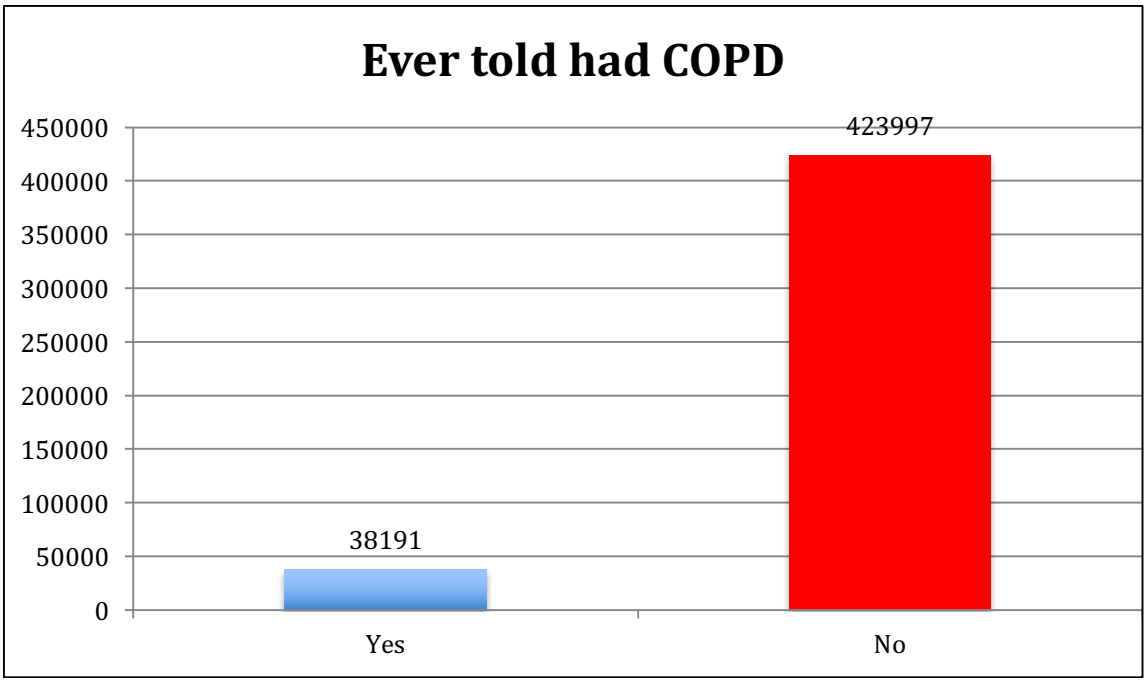

Figure 2: *Distribution of COPD in the BRFSS 2014 database.*

4. 2. Results of Hypothesis One:

The distribution of COPD by the demographic variables including age, gender, race, education level, and income level has been conducted. It shows that older respondents are more likely to report having been told to have COPD than younger people, figure **3**. The analysis of the age-adjusted of the distribution of COPD by age groups in the years 2011 to 2013 showed similar results for the year of 2014, figure **4**. In addition, the results showed that American women are more likely to have COPD (64.07%) than American men, figure **5**. The analysis of the sex-adjusted of the distribution of COPD by gender in the years 2011 to 2013 indicated parallel findings for the year of 2014, figure **6**.

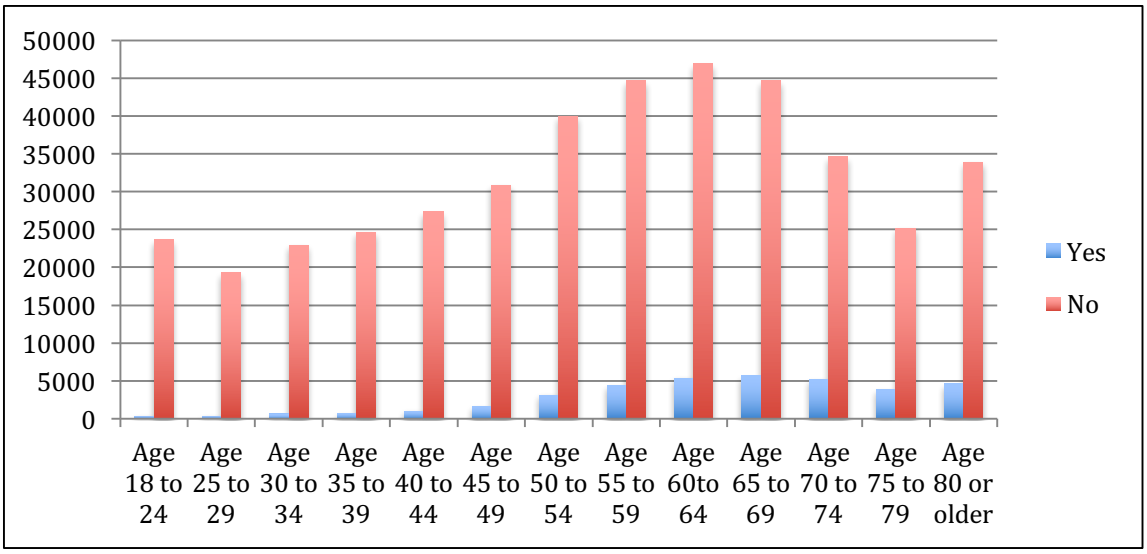

Figure 3. *Distribution of COPD by Age groups.*

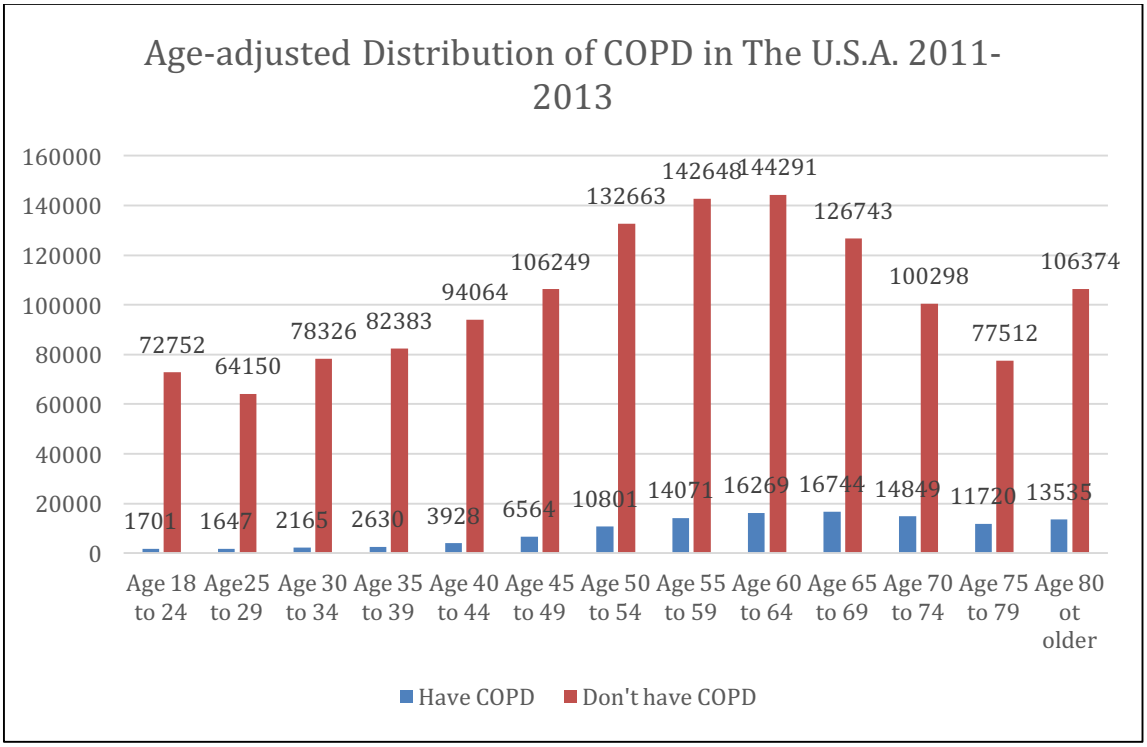

Figure 4. *Age-adjusted distribution of COPD in the United States for 2011-2013.*

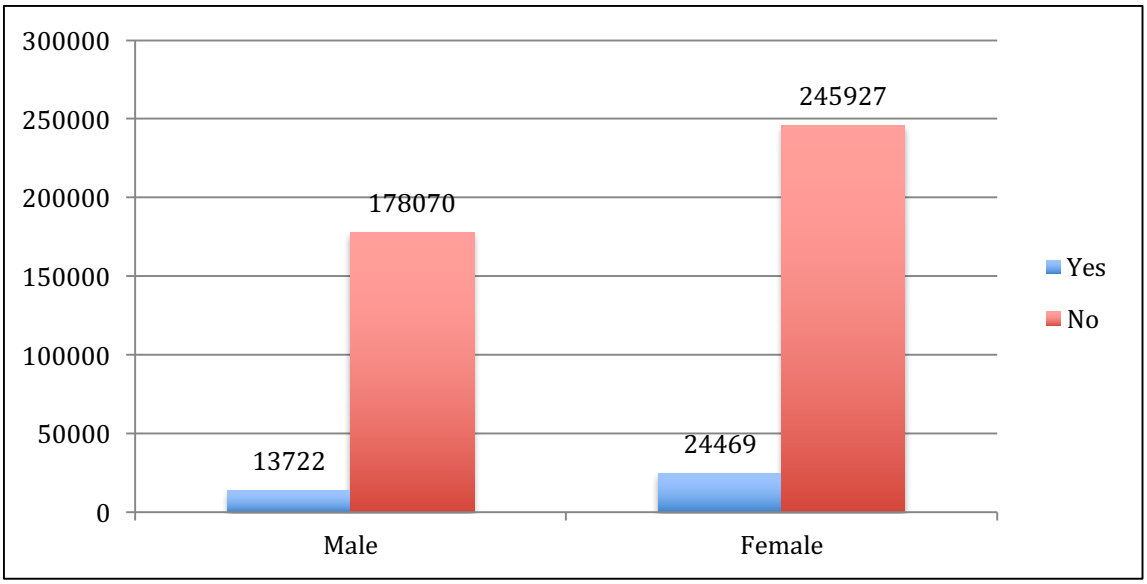

Figure 5. *Distribution of COPD by Gender.*

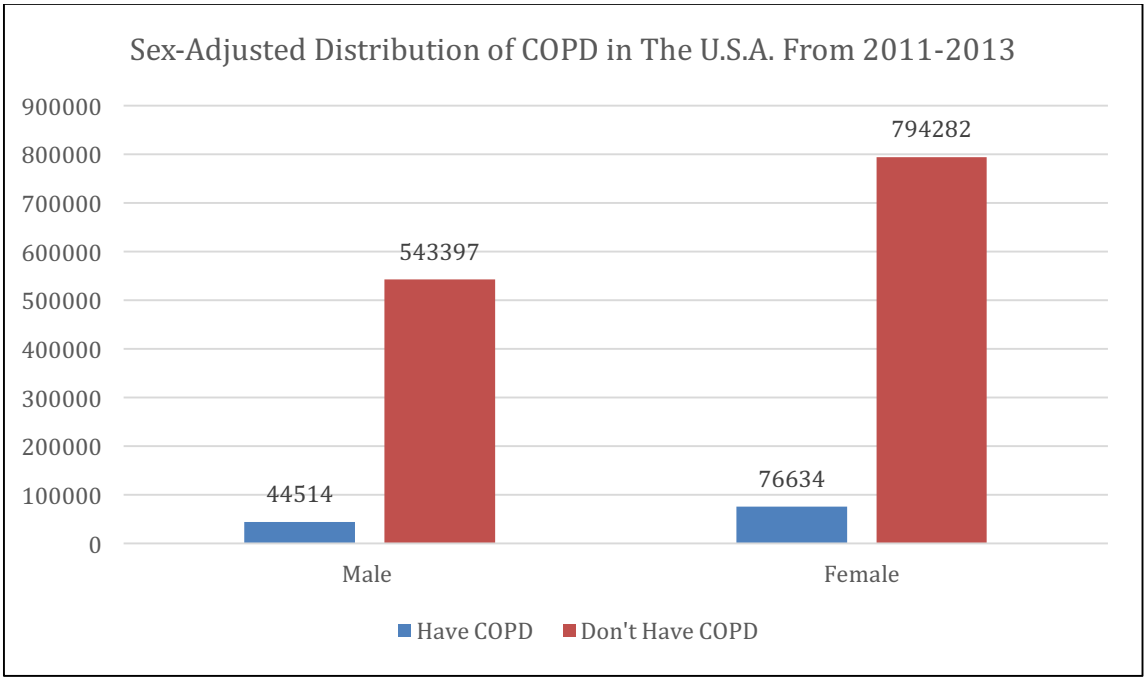

Figure 6. *Sex-Adjusted distribution of COPD in The United States from 2011-2013.*

On the other hand, the results showed that non-Hispanic whites (81.74%) are more likely to report having been told to have COPD than the other race groups of this study, figure 7. The analysis of the race-adjusted of the distribution of COPD by race groups in the years 2011 to 2013 indicated similar results for the year of 2014, figure 8.

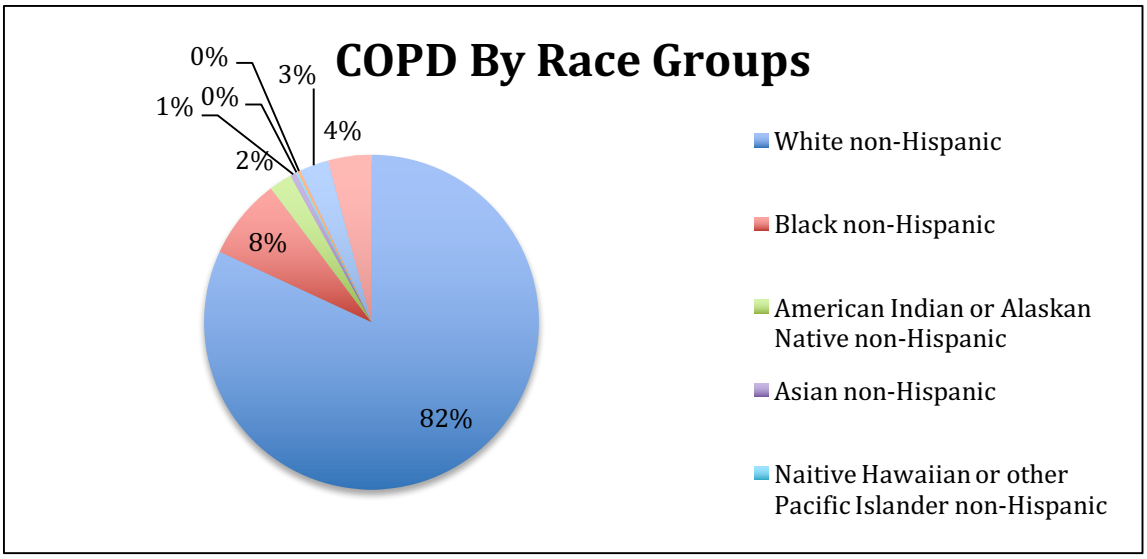

Figure 7. *Distribution of COPD by Race.*

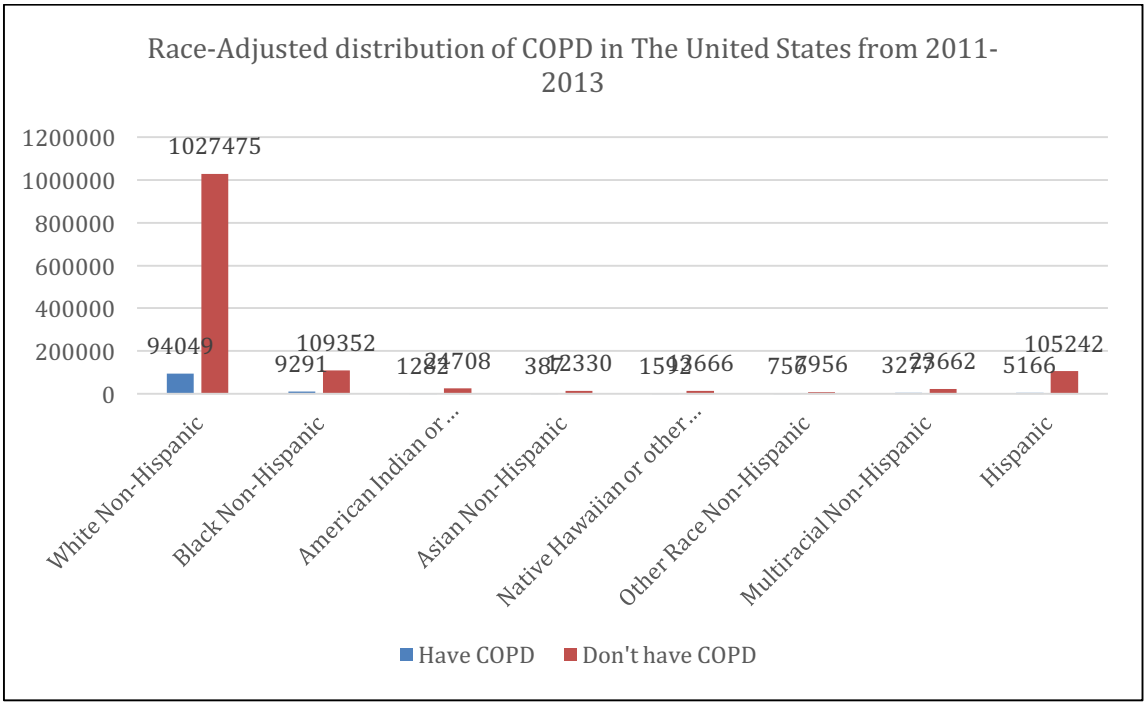

Figure 8. *Race-Adjusted distribution of COPD in The United States from 2011-2013.*

Moreover, the results showed that the respondents who have grades 12 or GED (36.23%), college 1 year to 3 years (29.15%), and college 4 years and more education levels (18.89%) are more likely to have COPD than the people with lower education levels, figure 9.

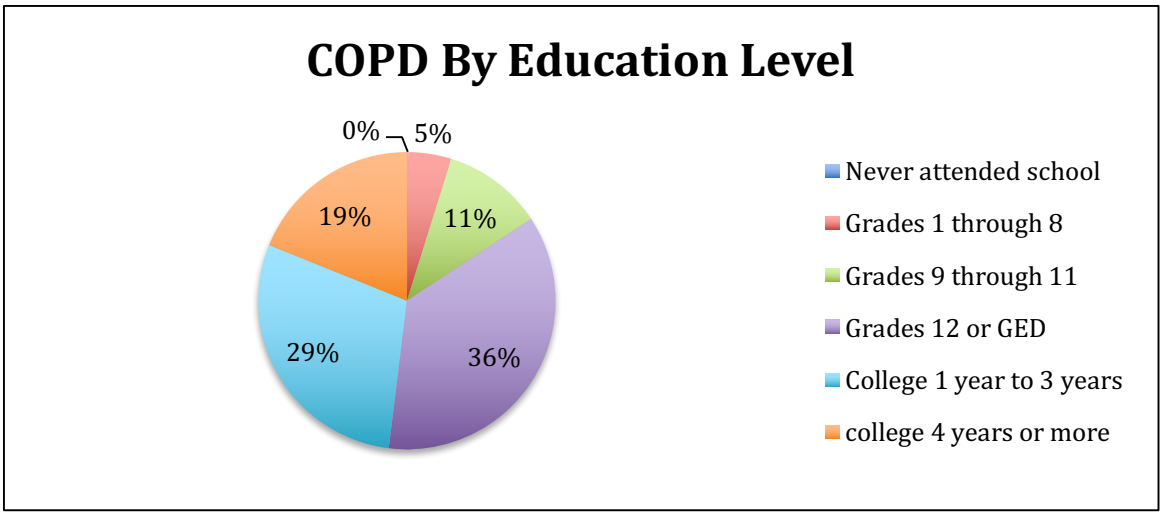

Figure 9. *Distribution of COPD by Education Level.*

In addition, the results showed that people with high-income level (31.56%) are more likely to report COPD than people with low-income level, figure 10.

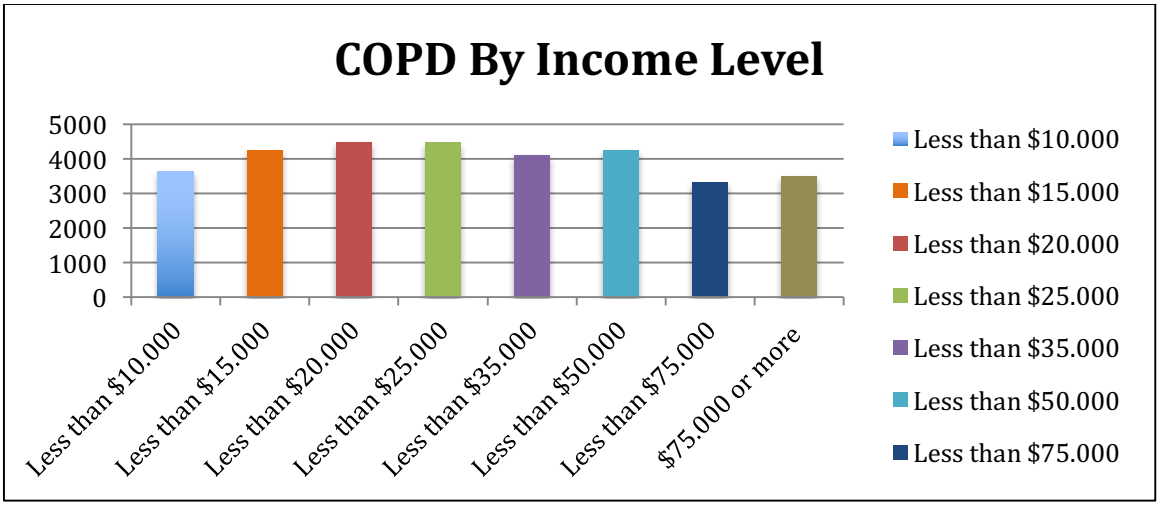

Figure 10. *Distribution of COPD by Income Level.*

In addition, the descriptive results showed that retied patients are more likely to report having COPD (43%) than other patients of different employment levels, figure 11.

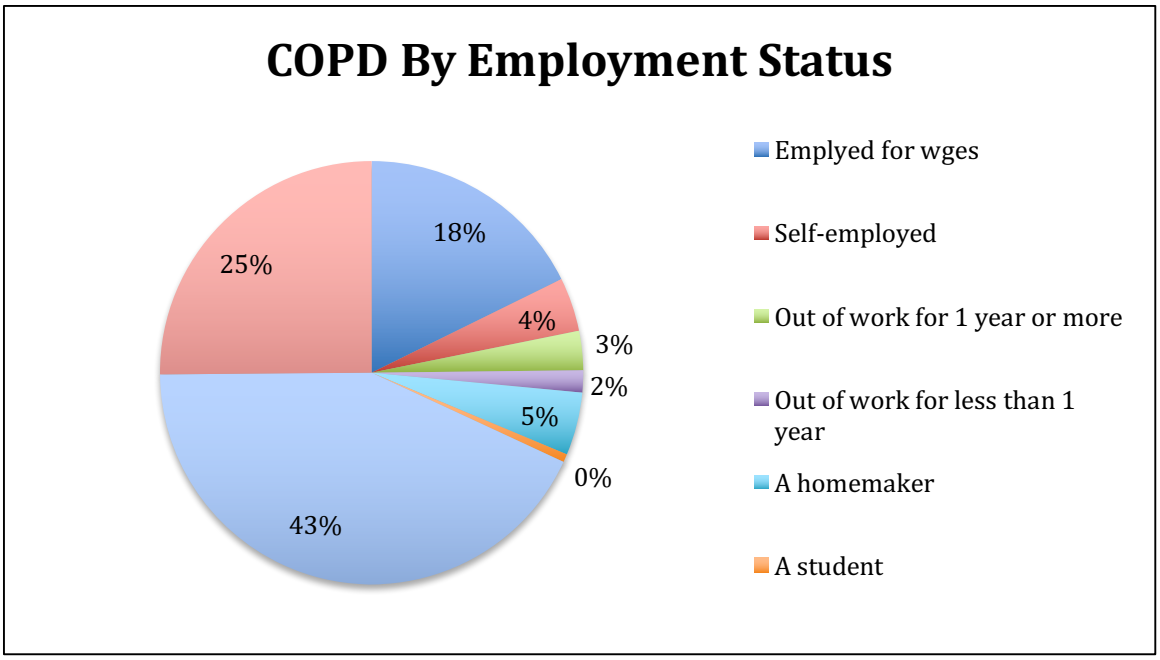

Figure 11. *Distribution of COPD by employment status.*

Furthermore, the findings showed that about (56%) of COPD patients have reported that they exercised in the past 30 days, while about (44%) of COPD patient reported that they didn't not exercise, figure 12. One the other hand, the results showed that about (82%) of COPD had health routine checkup in the past year, figure 13.

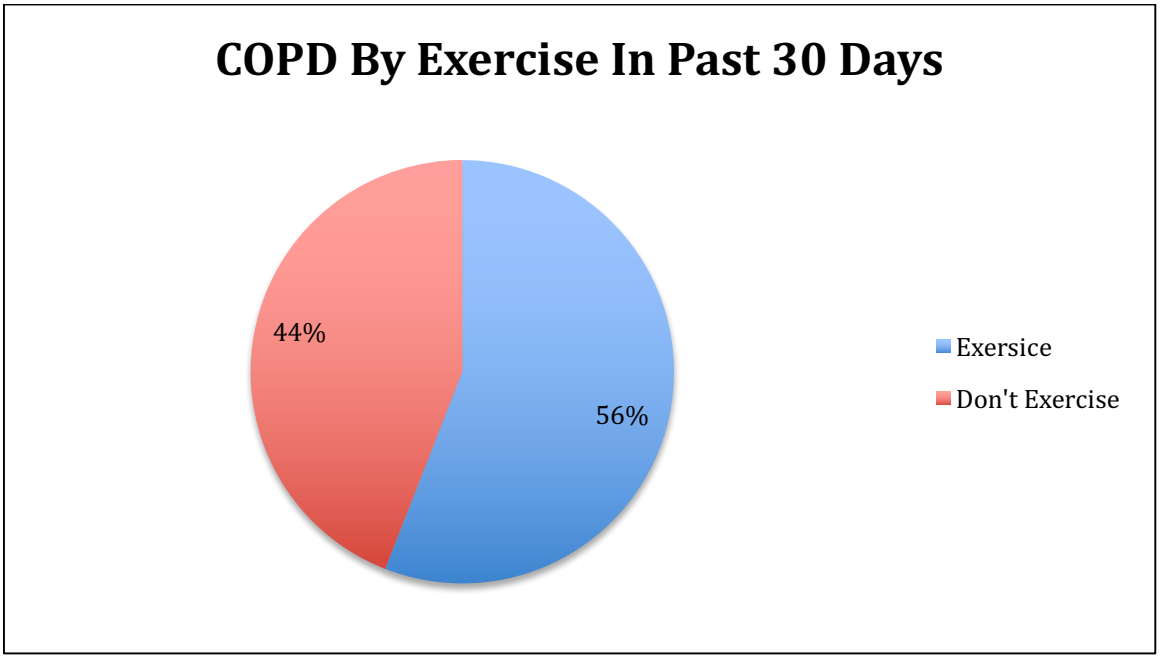

Figure 12. *Distribution of COPD by exercise in the past 30 days.*

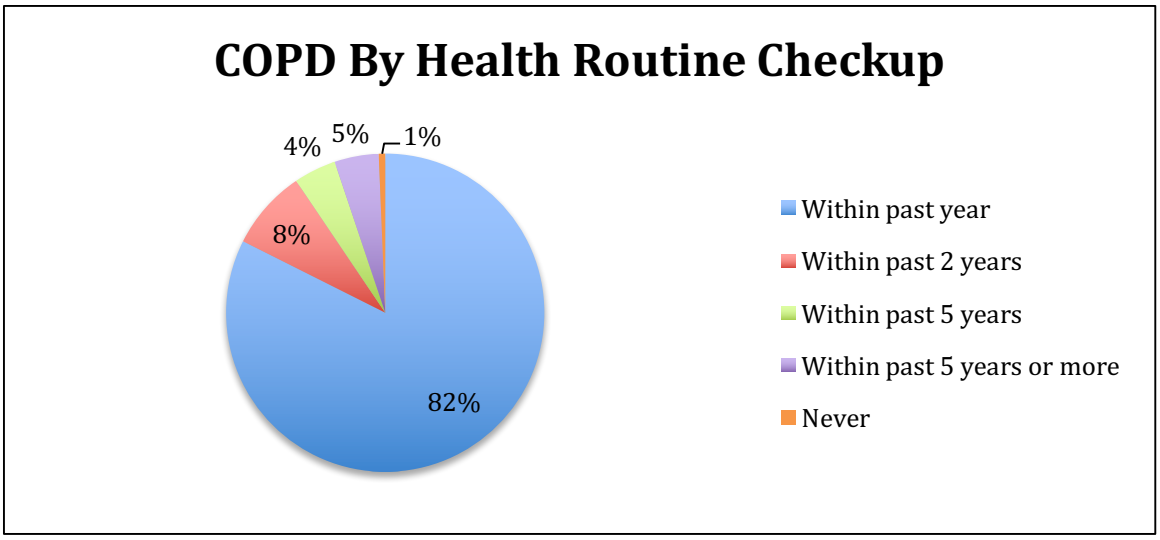

Figure 13. *Distribution of COPD by health routine checkup.*

Moreover, the descriptive results showed that about (93%) of COPD patients reported that they have health care coverage, figure 14. The findings showed that about (82%) of COPD patients have reported that they couldn't see their doctor because of costs, figure 15. On the other hand, the results showed that about (81%) of COPD patients have reported that they couldn't get medicine because of costs, figure 16. In addition, the findings showed that many of COPD patients have reported having about 3 or more alcoholic drinks in the past 30 days, figure 17.

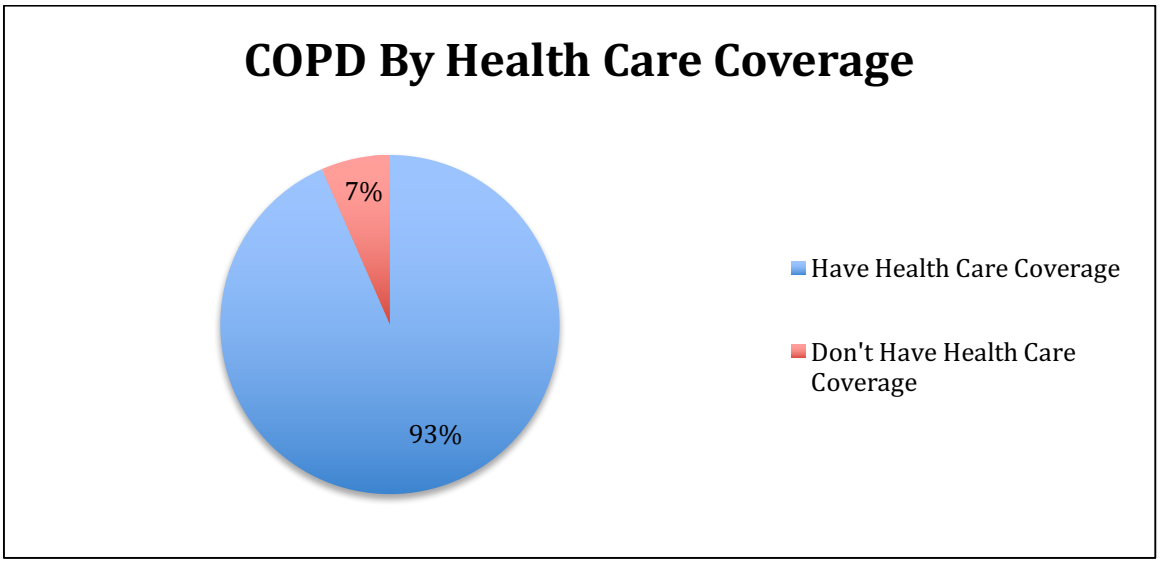

Figure 14. *Distribution of COPD by healthcare coverage.*

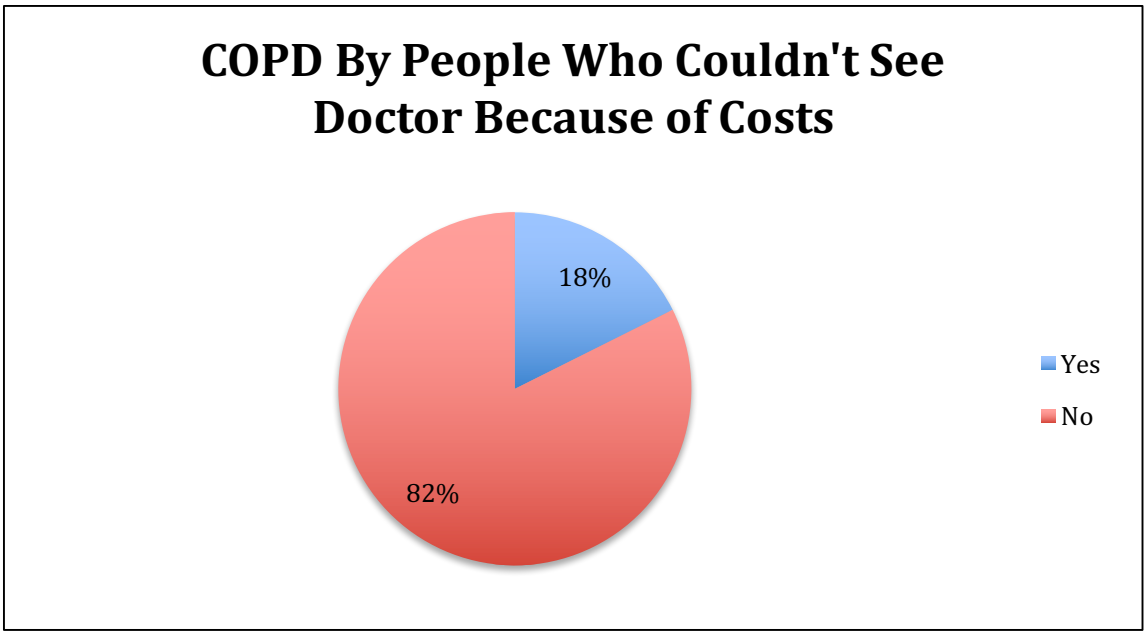

Figure 15. *Distribution of COPD by people who couldn't see doctor because of costs.*

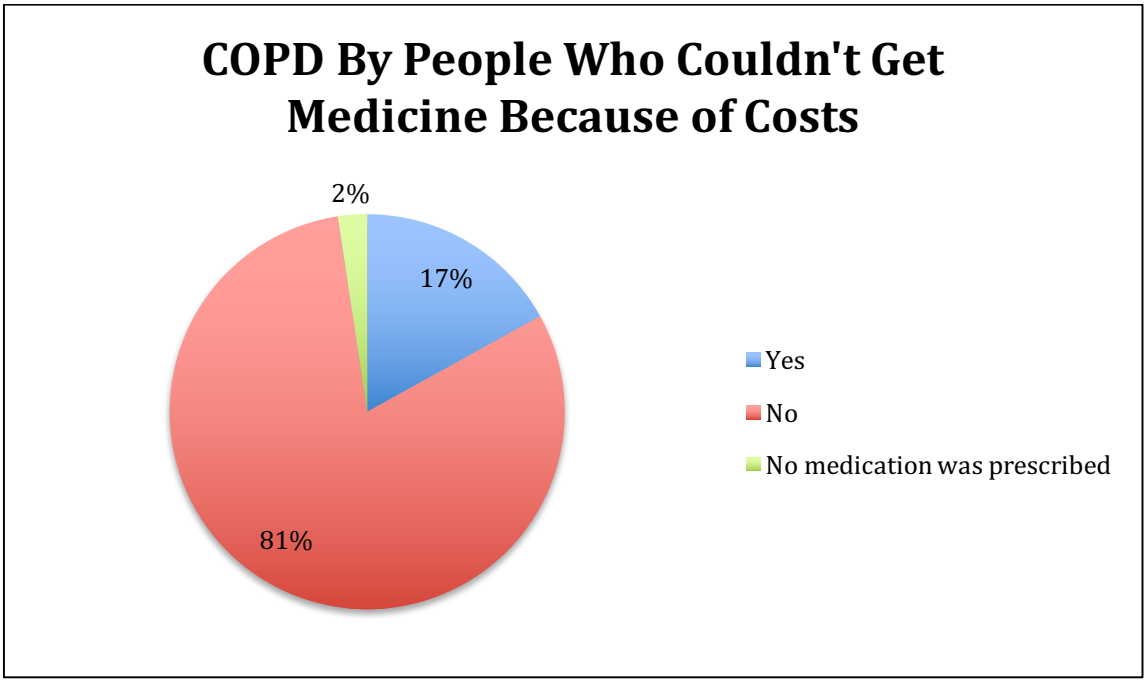

Figure 16. *Distribution of COPD by people who couldn't get medicine because of costs.*

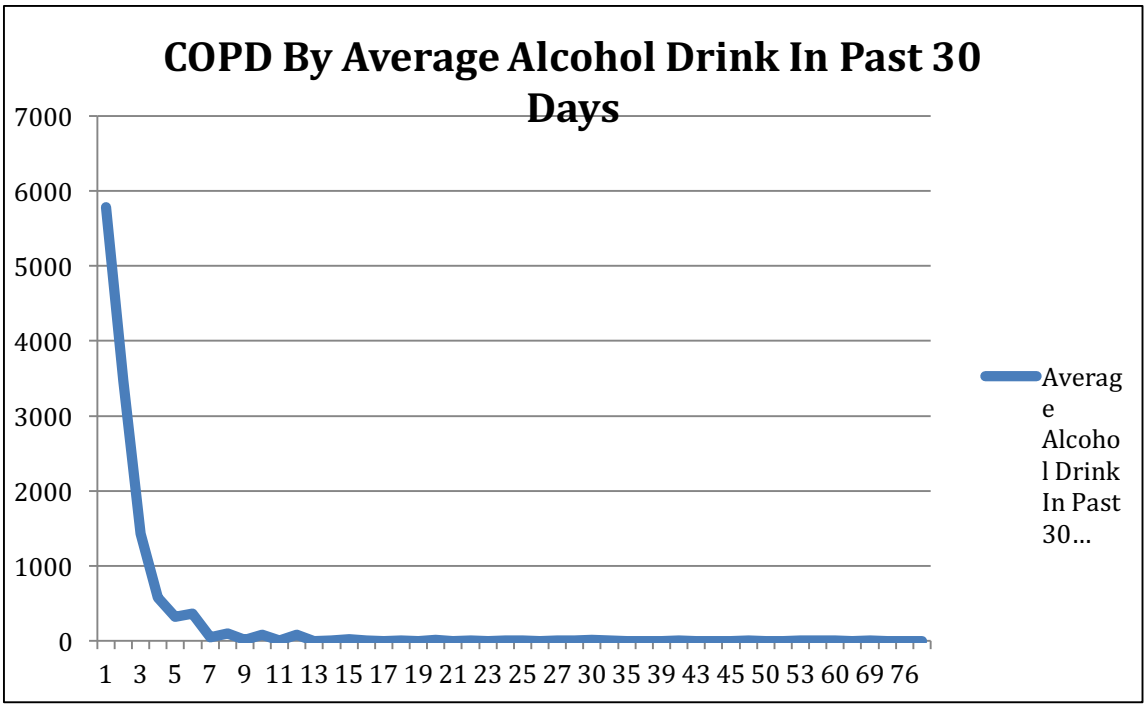

Figure 17. *Distribution of COPD by Average of alcohol drinks in past 30 days.*

Furthermore, the descriptive analysis showed that about (39%) of COPD patients have reported having depressive disorder, figure 18. The results indicated that about (23%) of COPD patient reported always having stress of having enough money to pay their rent or mortgage, figure 19. On the other hand, the findings showed that about (16%) of COPD patients reported always having stress of having enough money to buy nutrition meals, figure 20.

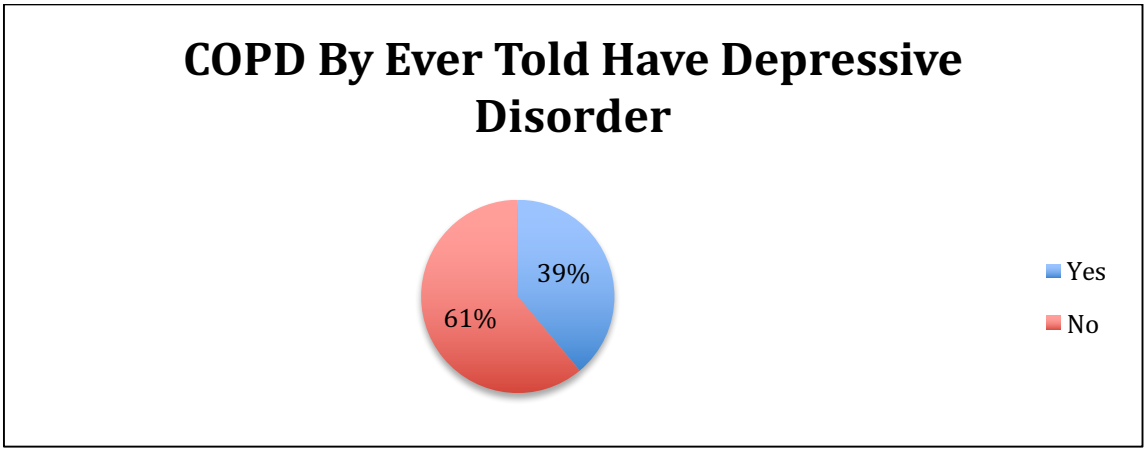

Figure 18. *Distribution of COPD by ever told have depressive disorder.*

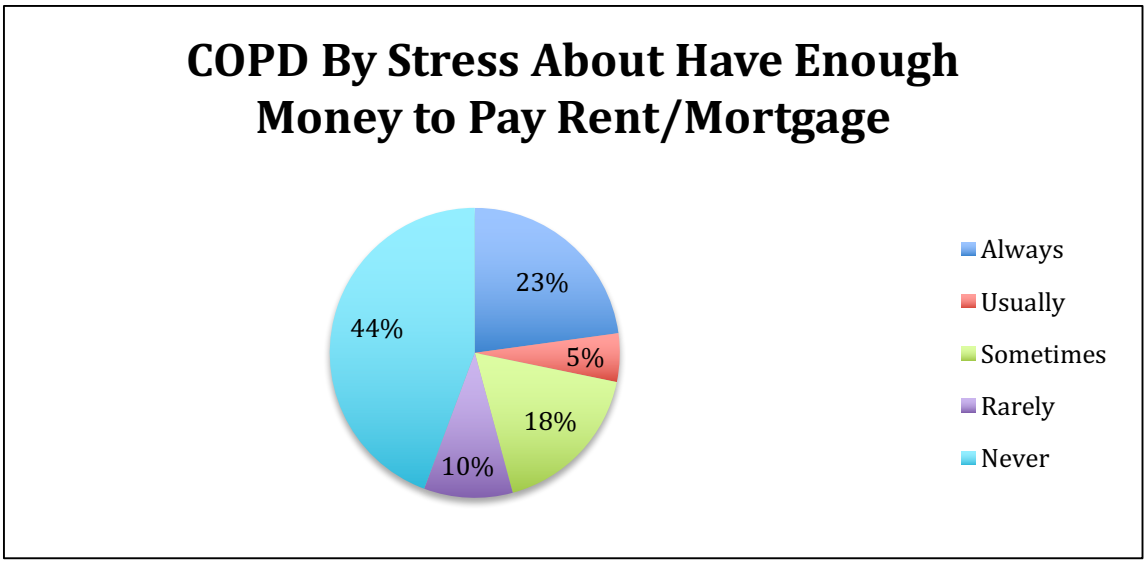

Figure 19. *Distribution of COPD by stress about having enough money to pay rent/mortgage.*

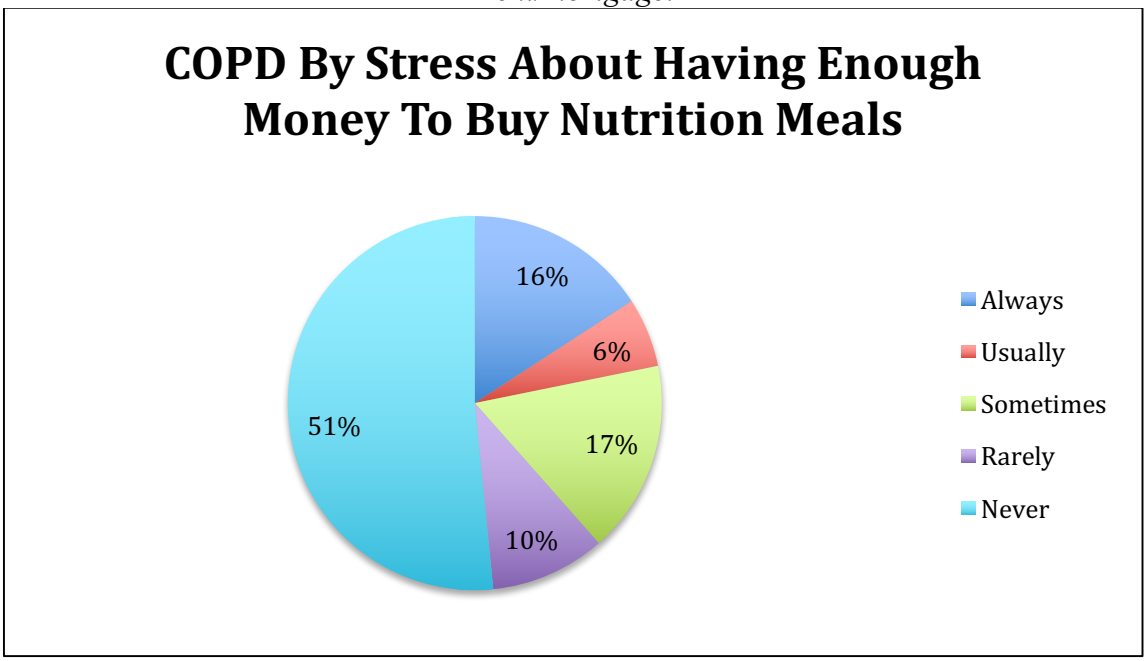

Figure 20. *Distribution of COPD by stress about having enough money to buy nutrition meals.*

The following sections will include the results of the descriptive analysis, inferential analysis, and the predictive analysis for the COPD predictor variable and the HRQoL variables including the physical health, mental health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone.

4. 2. 1. Results of Descriptive Analysis:

The descriptive analysis was conducted for determining the frequencies of each one of the HRQoL indicator variables for the people who have been told that they had COPD in the United States. The findings showed that, in adult patients of COPD, percentage of poor general health status (22.45%) is higher than excellent general health status (3.28%). In contrast, people with no COPD showed higher percentage of excellent general health status (19.09%) than poor general health status (3.77%), table 5 & figure 21.

Table 5:

The distribution of general health status for adult patients of COPD in the United States.

Descriptive Statistics to Describe The Distribution of The Predictor and the Indicator Variables						
Predictor variable		Indicator variable				
		General Health Status				
		Excellent No. (Weighted %)	Very Good No. (Weighted %)	Good No. (Weighted %)	Fair No. (Weighted %)	Poor No. (Weighted %)
Do you have COPD?	Yes	1246 (3.28)	5144 (13.54)	11423 (30.06)	11652 (30.67)	8531 (22.45)
	No	80653 (19.09)	146123 (34.58)	130243 (30.82)	49579 (11.73)	15951 (3.77)
	Total	81899 (17.78)	151267 (32.85)	141666 (30.76)	61231 (13.30)	24482(5.32)

Note: *Data were obtained from BRFSS 2014 database.*

In addition, the results showed that 65.3% of COPD patients reported having some or all of the past 30 days of their physical health was not good, while 34.70% of COPD adult patients reported no physical health problems during the past 30 days, table 3 & figure 21. One other hand, the results showed that 44.33% of COPD patients reported having some or all of the past 30 days of their mental health was not good, while 55.67% of COPD adult patients reported no mental health problems during the past 30 days, table 6 & figure 21.

Table 6:
The distribution of mental health and the physical health for adult patients of COPD in the United States.

Descriptive Statistics to Describe the Distribution of The Predictor and the Indicator Variables						
Predictor variable	Indicator variables					
	Mental health is not good during some or all the past 30 days No. (Weighted %)			Physical health is not good during some or all the past 30 days No. (Weighted %)		
Do you have COPD?	Yes	None	Total	Yes	None	Total
Yes	16441 (44.33)	20649 (55.67)	37090 (100)	23945 (65.3)	12752 (34.70)	36697 (100)

Note: *Data were obtained from BRFSS 2014 database.*

Furthermore, the results showed that adult patients of COPD have high percentages in activity limitations (5.01%), difficulty in walking or climbing stairs (4.31%), difficulty in dressing or bathing (1.26%), and difficulty in doing errands alone (2.02%), table 7 & figure 21.

Table 7:
The distribution of activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone for adult patients of COPD in the United States.

Descriptive Statistics to Describe The Distribution of The Predictor and The Indicator Variables					
Predictor variable		Indicator variables			
		Activity Limitations No. (Weighted %)	Difficulties in Walking or Climbing Stairs No. (Weighted %)	Difficulties in Dressing or Bathing No. (Weighted %)	Difficulties in Doing Errands Alone No. (Weighted %)
Do you have COPD?	Yes	22323 (5.01)	19119 (4.31)	5618 (1.26)	8960 (2.02)
	No	88457 (19.40)	59529 (13.42)	13580 (3.06)	25122 (5.67)
	Total	110780 (24.87)	364936 (17.23)	19198 (4.32)	34082 (7.69)

Note: *Data were obtained from BRFSS 2014 database.*

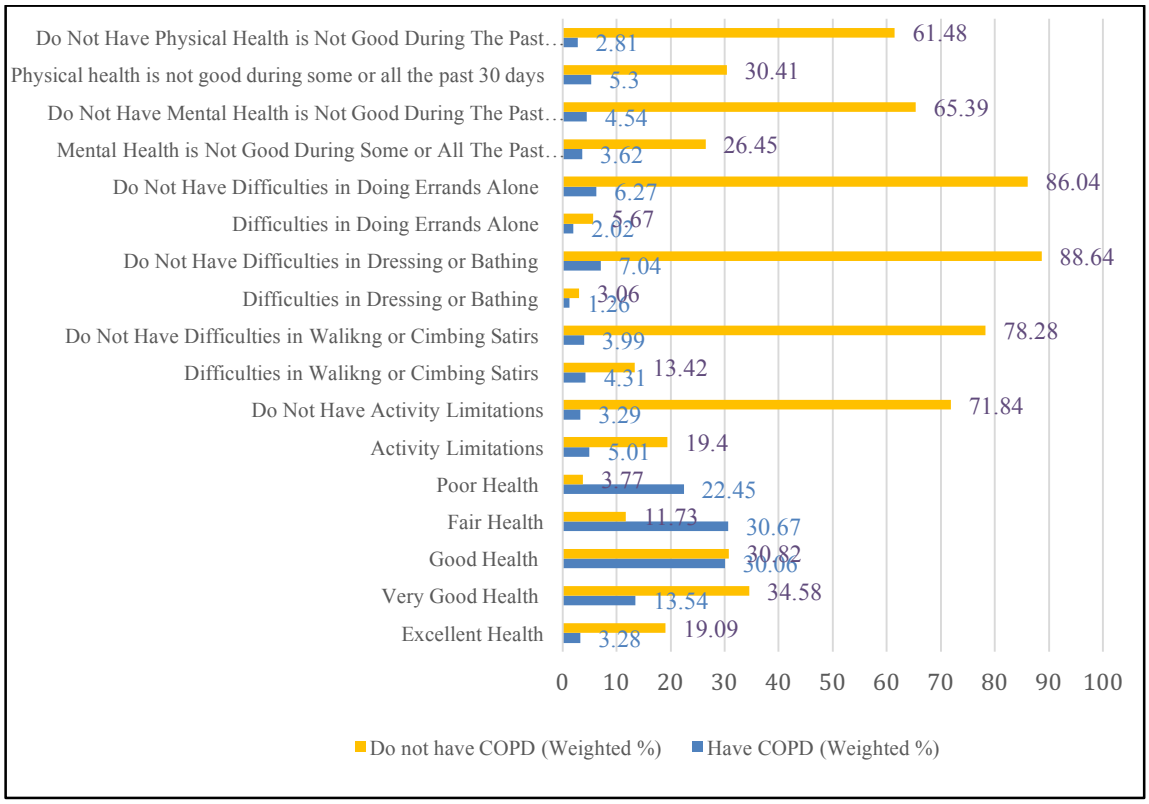

Figure 21: *The distribution of general health status, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health for adult patients of COPD in the United States.* Note: *Data were obtained from BRFSS 2014 database.*

4. 2. 2. Results of Inferential Analysis:

Several inferential statistics were conducted to examine the associations between the predictor variable and each indicator variables of HRQoL. First, Chi-square tests have been performed to indicate the associations between COPD variable and the activity limitations, mental health, physical health, difficulty in walking or climbing stairs, difficulty in dressing or bathing, and difficulty in doing errands alone variables. The significance level was chosen to be equal to 0.05 or less. The results of inferential statistics showed that all p-values of Chi-square test are <.0001, table 8. Therefore, the null hypothesis is rejected and there are significant associations between the predictor variable and each one of the indicator variables. These results led to conduct predictive

models to investigate the relationships between COPD and each one of the HRQoL factors.

Table 8.
The associations between COPD and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone of adult COPD patients.

P-value of Inferential Statistics to Determine the Associations Between the Predictor and the Indicator Variables						
Predictor Variable	Indicator Variables					
	Mental Health	Physical Health	Activity Limitations	Difficulties in Walking or Climbing Stairs	Difficulties in Dressing or Bathing	Difficulties in Doing Errands Alone
Do you have COPD?	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Note: *Chi-square tests were performed to determine the associations between COPD and each of the, activity limitations, mental health, physical health difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone. Data were obtained from BRFSS 2014 database.*

4. 2. 3. Results of Predictive Analysis:

To predict the relationships between COPD predictor and each one of HRQoL indicator variables, predictive models such as logistic regression models were used. First, logistic regression models have been performed to predict the relationships between COPD variable and the activity limitations, difficulty in walking or climbing stairs, difficulty in dressing or bathing, and difficulty in doing errands alone variables. The significance level was chosen to be equal 0.05 or less. The results of the logistic regression models showed that all p-values are Pr > ChiSq as <.0001, table 9. Then, more logistic regression models have been performed to predict the relationships between COPD and each of the physical health and mental health variables. These models also showed that all p-values are Pr > ChiSq as <.0001, table 9. Therefore, the null hypothesis is rejected and COPD predictor variable is a significant predictor of activity limitations, mental health, physical health, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone.

Table 9.
Predictive models to determine the relationships between COPD and the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationships Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (COPD)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	0.178	0.0134	16523.3721	<.0001	0.173-0.183
Difficulties in Walking or Climbing Stairs	0.156	0.0135	19018.0464	<.0001	0.151-0.160
Difficulties in Dressing or Bathing	0.187	0.0206	6577.3086	<.0001	0.180-0.195
Difficulties in Doing Errands Alone	0.197	0.0168	9350.5531	<.0001	0.191-0.204
Mental Health	0.636	0.0128	1253.5564	<.0001	0.620-0.652
Physical health	0.474	0,0120	3841.8193	<.0001	0.463-0.486

Note: *Data were obtained from BRFSS 2014 database.*

4. 3. Results of Hypothesis Two:

Frequency distribution test has been conducted on the smoking variables including: the current smoking variable, frequency now smoking variable, interval since last smoked variable, and smoked 100 cigarettes in entire life variable to determine their frequencies in adult COPD patients. Then, many inferential tests such as Chi-Square tests have been used to identify the associations between the smoking variables and the HRQoL indicator variables of COPD patients. Finally, regression models have been implemented to determine the relationships between the HRQoL indicator variables and the smoking variables, especially the smoking cessation duration variable of patients with COPD.

4. 3. 1. Results of Descriptive Analysis:

The distribution of COPD by the smoking variables including the current smoking variable, frequency now smoking variable, and interval since last smoked variable has been conducted. The results showed that 2.73% of COPD patients are not current smokers, while 5.59% of them are current smokers, table 10 and figure 22.

Table 10:

The distribution of the current smoking status for COPD patients.

Descriptive analysis to describe the distribution of the predictor and indicator variables			
Predictor variable		Indicator variable	
		Current smoking status	
		No, not currently smoking No. (Weighted %)	Yes, currently smoking No. (Weighted %)
Do you have COPD?	Yes	24682 (5.59)	12030 (2.73)
	No	350704 (79.48)	53823 (12.20)
	Total	375386 (85.08)	65853 (14.92)

Note: *Data were obtained from BRFSS 2014 database.*

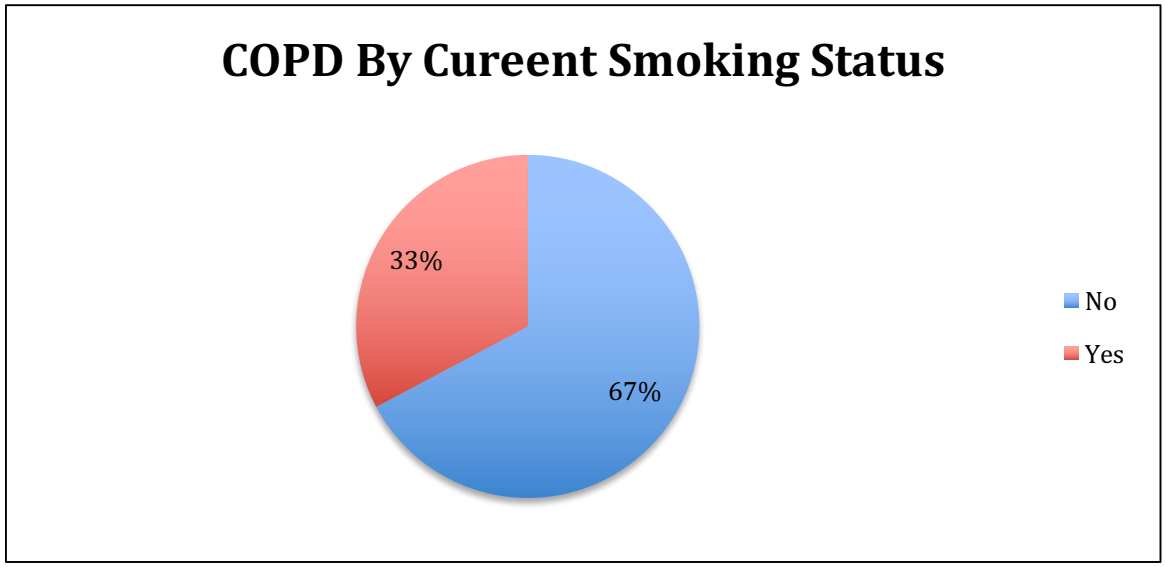

Figure 22. *Distribution of COPD by Current smoking status.*

Also, the results showed that 75.81% of COPD patients have reported that they have at least smoked 100 cigarettes in their entire life, table 11 and figure 23.

Table 11:

The distribution of the smoked 100 cigarettes in entire life for COPD patients.

Descriptive analysis to describe the distribution of the Predictor and indicator variables			
Predictor variable		Indicator variable	
		Smoked 100 cigarettes in entire life	
		Yes, No. (Weighted %)	No, No. (Weighted %)
Do you have COPD?	Yes	27885 (6.31)	8899 (2.01)
	No	166302 (37.65)	238565 (54.02)
	Total	375386 (85.08)	65853 (14.92)

Note: *Data were obtained from BRFSS 2014 database.*

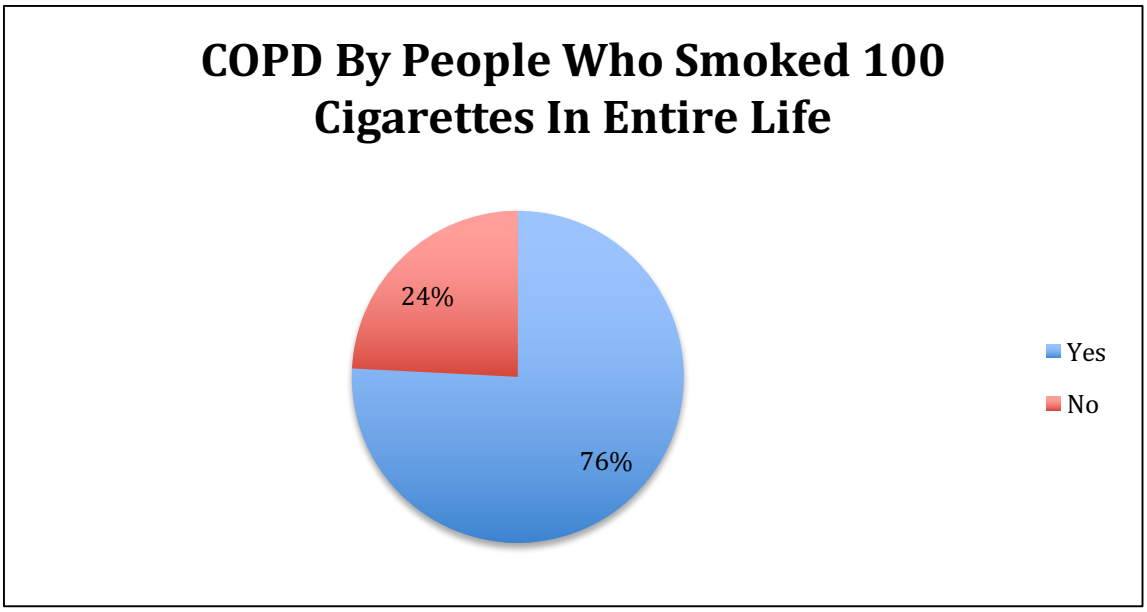

Figure 23. *Distribution of COPD by People who smoked 100 cigarettes entire life.*

In addition, the results showed that 8.15% of COPD patients don't smoke at all in terms of frequency of days now smoking. However, 4.71% of COPD patients have reported smoking every day. On the other hand, the results showed that 10.45% of COPD patient have stated that they smoke someday, table 12 and figure 24.

Table 12:

The distribution of the frequency of now smoking for COPD patients in the United States.

Descriptive analysis to describe the distribution of the predictor and indicator variables				
Predictor variable		Indicator variable		
		Frequency now smoking		
		Smoke everyday No. (Weighted %)	Smoke someday No. (Weighted %)	No at all No. (Weighted %)
Do you have COPD?	Yes	9123 (4.71)	2907 (1.50)	15783 (8.15)
	No	37643 (19.43)	16180 (8.35)	112139 (57.87)
	Total	46766 (24.13)	19087 (9.85)	127922 (66.02)

Note: *Data were obtained from BRFSS 2014 database.*

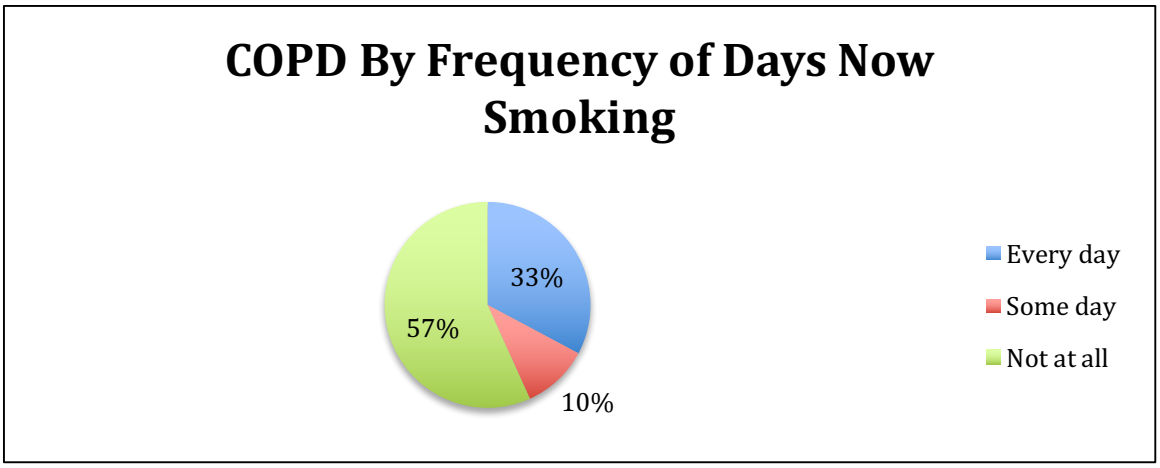

Figure 24. *Distribution of COPD by Frequency of days now smoking.*

Finally, the results showed that 7.34% of COPD patients have stopped smoking in the past 10 years or more, table 13. In contrast, 1.96 % of COPD patients have reported that they stopped smoking in the past 5 years, while 1.61% of them have reported that they stopped smoking in the past 10 years. The other percentages are shown as 0.31% for COPD patients who reported stopping smoking within the past month, 0.28% for who stopped smoking in the past 3 months, 0.31% for who stopped smoking in the past 6 months, 0.51% for who stopped smoking in the past year, and 0.04% for who never smoked regularly, table 13. Figure 25 shows the observed numbers of interval since last smoked for COPD patients.

Table 13:

The distribution of the interval since last smoked for COPD patients in the United States.

Descriptive analysis to describe the distribution of the predictor and indicator variables									
Predictor variable		Indicator variable							
		Interval since last smoked							
		Within the past month. No. (Weighted %)	Within the past 3 months No. (Weighted %)	Within the past 6 months No. (Weighted %)	Within the past year No. (Weighted %)	Within the past 5 years No. (Weighted %)	Within the past 10 years No. (Weighted %)	10 Years or more No. (Weighted %)	Never Smoked regularly No. (Weighted %)
Do you have COPD?	Yes	393 (0.31)	350 (0.28)	388 (0.31)	642 (0.51)	2497 (1.96)	2041 (1.61)	9333 (7.34)	45 (0.04)
	No	2341 (1.84)	2102 (1.65)	2255 (1.77)	3600 (2.83)	13155 (10.35)	10818 (8.51)	76299 (60.04	830 (0.65)
	Total	2734 (2.15)	2452 (1.93)	2463 (2.08)	4242 (3.34)	15652 (12.32)	12859 (10.12)	85632 (67.38)	875 (0.69)

Note: *Data were obtained from BRFSS 2014 database.*

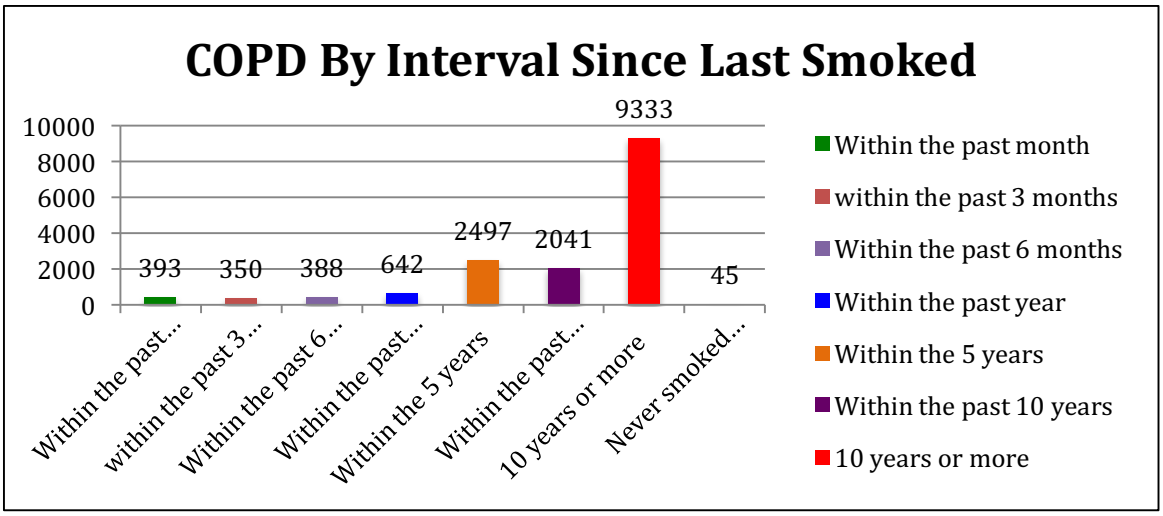

Figure 25. *The distribution of COPD by the interval since last smoked. It shows the observed numbers for each of the factors in the interval since last smoked variable for COPD patients.* Note: *Data were obtained from BRFSS 2014 database.*

4. 3. 2. Results of Inferential Analysis:

Many inferential analysis tests have been performed to determine the associations between the smoking variables for COPD patients, especially the interval since last smoked variable, and the HRQoL indicator variables including the mental health, physical health, activity limitations, difficulty in walking or climbing stairs, difficulty in dressing or bathing, and difficulty in doing errands alone. In the beginning, Chi-square tests have been conducted to test the associations between each one of the smoking predictor variables and each one of the activity limitations, and the difficulties variables. The results showed that the current smokers status of COPD patients is significantly associated with each one of the activity limitations and the difficulties variables, table 14. The p-values of the Chi-square were <.0001 for all of the associations. Furthermore, more Chi-square tests have been conducted to determine the associations between each of the smoking predictor variables and the mental health, physical health indicator variables of COPD patients. The results showed that the association between the current smoking status of COPD patients and the mental health is statistically significant with a p-value as

<.0001, table 14. In addition, the results showed that the association between the current smoking status for COPD patients and the physical health is statistically significant with a p-value as <.0001, table 14.

Table 14.
The associations between current smoking status and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone of adult COPD patients.

P-value of Inferential Analyses to Determine the Associations Between the Predictor and the Indicator Variables						
Predictor Variable	Indicator Variables					
	Mental Health	Physical Health	Activity Limitations	Difficulties in Walking or Climbing Stairs	Difficulties in Dressing or Bathing	Difficulties in Doing Errands Alone
Current smoking status	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Note: *Chi-square tests were performed to determine the associations between current smoking status and each of the mental health, physical, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone. Data were obtained from BRFSS 2014 database.*

In addition, the results of the Chi-square showed that the associations between the smoked 100 cigarettes in entire life for COPD patients and each of the activity limitations, and the difficulty in walking or climbing stairs variables are statistically significant with p-values as <.0001, table 16. In addition, the smoked 100 cigarettes in entire life predictor variable and each of the difficulty in dressing or bathing and difficulty in doing errands alone are associated significantly with p-values as 0.0005 and 0.0020, respectively, table 15. On the other hand, the Chi-square tests indicated significant associations between the smoked 100 cigarettes in entire life variable and the mental health and the physical health indicator variables of COPD patients with a p-value as <.0001, table 15.

Table 15.

The associations between smoked 100 cigarettes in entire life and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone of adult COPD patients.

P-value of Inferential Analyses to Determine the Associations Between the Predictor and the Indicator Variables						
Predictor Variable	Indicator Variables					
	Mental Health	Physical Health	Activity Limitations	Difficulties in Walking or Climbing Stairs	Difficulties in Dressing or Bathing	Difficulties in Doing Errands Alone
Smoked 100 cigarettes in entire life	<.0001	<.0001	<.0001	<.0001	0.0005	0.0020

Note: *Chi-square tests were performed to determine the associations between smoked 100 cigarettes in entire life and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone. Data were obtained from BRFSS 2014 database.*

Moreover, the Chi-square results indicated that the associations between the frequency of days now smoking predictor variable and each one of the activity limitations, and the difficulties indicator variables are statistically significant with p-values as <.0001, table 16. In addition, Chi-square tests showed that the frequency of days now smoking predictor variable is also significantly associated with each one of the mental health and physical health variables with p-values as <.0001, table 16.

Table 16.

The associations between frequency of days now smoking and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone of adult COPD patients.

P-value of Inferential Analyses to Determine the Associations Between the I Predictor and the Indicator Variables						
Predictor Variable	Indicator Variables					
	Mental Health	Physical Health	Activity Limitations	Difficulties in Walking or Climbing Stairs	Difficulties in Dressing or Bathing	Difficulties in Doing Errands Alone
Frequency days now smoking	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Note: *Chi-square tests were performed to determine the associations between frequency of days now smoking and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone. Data were obtained from BRFSS 2014 database.*

On the other hand, the Chi-square results showed that the interval since last smoked variable predictor variable and each one of the activity limitations, the difficulty in dressing or bathing, and the difficulty in doing errands alone indicator variables are significantly associated with p-values as <.0001, while the p-value was 0.0014 for the difficulty in walking or climbing stairs which is also statistically significant, table 17. Moreover, the Chi-square tests showed that the associations between the interval since last smoked predictor variable of COPD patients and the mental health and physical health indicator variables are statistically significant with a p-value as <.0001, table 17.

Table 17.
The associations between interval since last smoked and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone of adult COPD patients.

P-value of Inferential Analyses to Determine the Associations Between the Predictor and the Indicator Variables						
Predictor Variable	Indicator Variables					
	Mental Health	Physical Health	Activity Limitations	Difficulties in Walking or Climbing Stairs	Difficulties in Dressing or Bathing	Difficulties in Doing Errands Alone
Interval since last smoked	<.0001	<.0001	<.0001	0.0014	<.0001	<.0001

Note: *Chi-square tests were performed to determine the associations between interval since last smoked and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone. Data were obtained from BRFSS 2014 database.*

4. 3. 3. Results of Predictive Analysis:

The relationships between the smoking predictor variables and each one of the HRQoL indicator variables were investigated by creating several predictive regression models. First, the relationships between the current smoking status predictor variable and each one of the HRQoL indicator variables (including activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands) were investigated by conducting many logistic regression models. The results

showed that the relationships between those indicator variables and the current smoking status variable are statistically significant with Pr > ChiSq as <.0001, table 18. Then, other logistic regression models were created to investigate the relationships between the current smoking status predictor variable with the mental health and physical health indicator variables of COPD patients. The p-value for the predictive model was statistically significant as Pr > ChiSq<.0001, table 18. The results indicate that current smoking status is a significant predictor of activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Table 18.

Predictive models to determine the relationships between the current smoking status and the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (Current smoking status)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	1.420	0.0113	958.7959	<.0001	1.389-1.452
Difficulties in Walking or Climbing Stairs	1.294	0.0128	403.3160	<.0001	1.252-1.327
Difficulties in Dressing or Bathing	1.524	0.0219	370.1196	<.0001	1.460-1.590
Difficulties in Doing Errands Alone	1.720	0.0168	1040.0942	<.0001	1.664-1.778
Mental Health	1.462	0.0101	1412.0648	<.0001	1.434-1.491
Physical Health	1.165	0.00992	237.7578	<.0001	1.143-1.188

Note: *Data were obtained from BRFSS 2014 database*

Second, the relationships between the smoked 100 cigarettes in entire life predictor variable for COPD patients and the HRQoL indicator variables including the activity limitations, and the difficulties variables were investigated by creating several logistic regression models. The results showed that the relationships between those indicator variables and smoked 100 cigarettes in entire life variable are statistically significant with Pr > ChiSq as <.0001, table 19. Then, more logistic regression models were created to investigate the relationship between the smoked 100 cigarettes in entire

life variable with the mental health and physical health variable of COPD patients. The p-value for the predictive model was statistically significant as Pr > ChiSq <.0001, table 19. The results signify that smoked 100 cigarettes in entire life factor is a significant predictor of the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone of adult, mental health, and physical health of COPD patients.

Table 19.
Predictive models to determine the relationship between smoked 100 cigarettes in entire life and the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (smoked 100 cigarettes in entire life)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	0.633	0.00871	2766.5386	<.0001	0.622-0.643
Difficulties in Walking or Climbing Stairs	0.679	0.0101	1481.1529	<.0001	0.666-0.692
Difficulties in Dressing or Bathing	0.666	0.0194	437.9158	<.0001	0.641-0.692
Difficulties in Doing Errands Alone	0.691	0.0148	624.3017	<.0001	0.671-0.711
Mental Health	0.921	0.00775	112.6909	<.0001	0.907-0.935
Physical Health	0.917	0.00739	138.6738	<.0001	0.903-0.930

Note: *Data were obtained from BRFSS 2014 database*

Third, the relationships between the frequency of days now smoking predictor variable of COPD patients and the HRQoL indicator variables including the activity limitations and the difficulties variables were examined by creating many logistic regression models. The results showed that the relationships between those indicator variables and the frequency of days now smoking variable are statistically significant with Pr > ChiSq as <.0001, table 20. Then, other logistic regression models were created to investigate the relationships between the frequency of days now smoking predictor variable with the mental health and physical health indicator variables of COPD patients. The p-values of the predictive models were statistically significant as Pr > ChiSq <.0001, table 20. The results suggest that frequency of days now smoking factor is a significant

predictor of the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Table 20.
Predictive models to determine the relationship between frequency of days now smoking and the activity limitations due to health problems, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (frequency of days now smoking)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	0.946	0.00696	62.6413	<.0001	0.934-0.959
Difficulties in Walking or Climbing Stairs	0.981	0.00783	6.2447	0.0125	0.966-0.996
Difficulties in Dressing or Bathing	0.896	0.0133	67.6734	<.0001	0.873-0.920
Difficulties in Doing Errands Alone	0.814	0.0104	393.7694	<.0001	0.798-0.831
Mental Health	0.796	0.00631	1303.9954	<.0001	0.786-.0.806
Physical Health	0.935	0.00612	119.0269	<.0001	0.924-0.947

Note: *Data were obtained from BRFSS 2014 database*

Finally, the relationships between the interval since last smoked predictor variable for COPD patients and the HRQoL indicator variables including the activity limitations, and the difficulties variables were investigated by conducting many logistic regression models. The results showed that the relationships between the interval since last smoked predictor variable and those indicator variables are statistically significant with Pr > ChiSq as <.0001, table 21. Then, more logistic regression models were conducted to investigate the relationships between the interval since last smoked predictor variable with the mental health and physical health variables of COPD patients. The p-values for the predictive model was statistically significant as Pr > ChiSq <.0001, table 21. The logistic models indicate that interval since last smoked factor is a significant predictor of the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Table 21.

Predictive models to determine the relationship between interval since last smoked and the activity limitations due to health problems, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (interval since last smoked)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	1.017	0.00543	9.9059	0.0016	1.006-1.028
Difficulties in Walking or Climbing Stairs	1.053	0.00631	66.4199	<.0001	1.040-1.066
Difficulties in Dressing or Bathing	0.943	0.0104	32.1841	<.0001	0.924-0.962
Difficulties in Doing Errands Alone	0.921	0.00823	99.6039	<.0001	0.906-0.936
Mental Health	0.861	0.00479	978.5553	<.0001	0.853-0.869
Physical Health	0.957	0.00467	89.1067	<.0001	0.948-0.966

Note: *Data were obtained from BRFSS 2014 database.*

4. 4. Results of Hypothesis Three:

Many descriptive analysis methods have been conducted on the comorbidities predictor variables including: the body mass index (BMI) variable, diabetes, coronary heart disease, and stroke to determine their frequency in adult COPD patients. Then, several inferential tests such as Chi-square tests to distinguish the relationships between the comorbidities predictor variables and the HRQoL indicator variables of adult COPD patients. Finally, regression models have been employed to determine the associations between the HRQoL indicator variables and each one of the comorbidities variables in adult COPD patients.

4. 4. 1. Results of Descriptive Analysis:

The distributions of the comorbidities variables (including the body mass index, diabetes, coronary heart disease, and stroke) in adult COPD patients have been conducted. The result showed that 3.23% of COPD patients are obese, while 2.60% of them are overweight, table 22 and figure 26. Also, the results showed that 2.29% of COPD patients have normal weight, while 0.27% of them are underweight.

Table 22:

The distribution of the body mass index of adult COPD patients in the United States.

Descriptive analysis to describe the distribution of the Predictor and Indicator variables					
Predictor variable		Indicator variable			
		Body mass index			
		Underweight No. (Weighted %)	Normal weight No. (Weighted %)	Overweight No. (Weighted %)	Obese No. (Weighted %)
Do you have COPD?	Yes	1149 (0.27)	9895 (2.29)	11219 (2.60)	13967 (3.23)
	No	6063 (1.40)	131407 (30.43)	145292 (33.65)	112843 (26.13)
	Total	7212(1.67)	141302 (32.72)	156511 (36.24)	126810 (29.37)

Note: *Data were obtained from BRFSS 2014 database.*

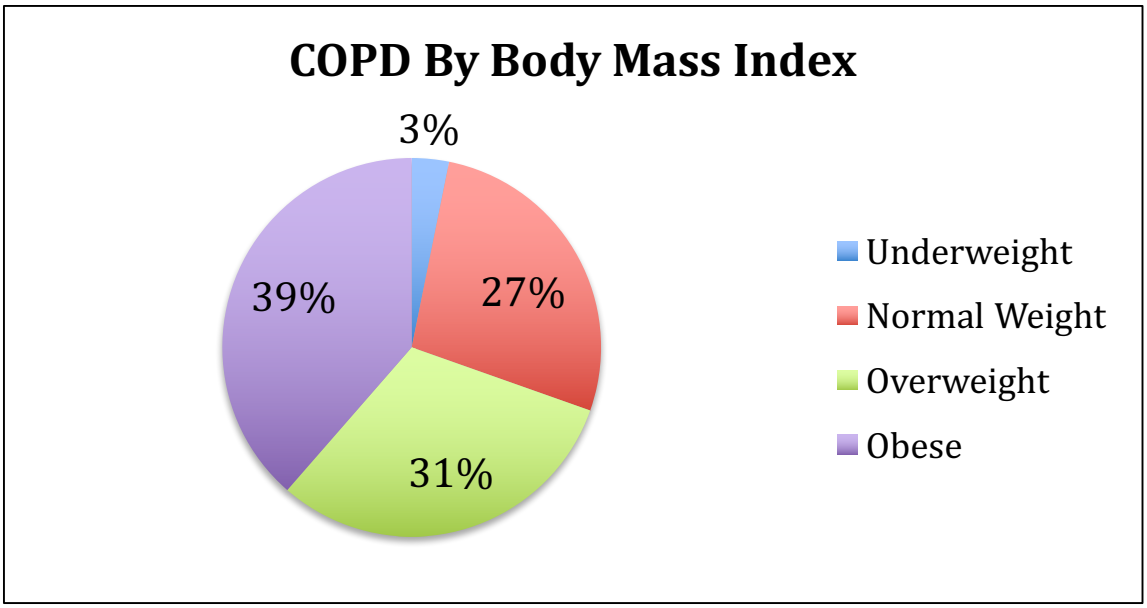

Figure 26. *Distribution of COPD by body mass index.*

In addition, the results indicated that 2.08% of COPD patients have been told that they have diabetes, while 5.89% of them don't have diabetes, table 23 and figure 27.

Table 23:

The distribution of diabetes for adult COPD patients in the United States.

Descriptive analysis to describe the distribution of the Predictor and Indicator variables					
Predictor variable		Indicator variable			
		Diabetes			
		Yes No. (Weighted %)	Yes, but female told during pregnancy No. (Weighted %)	No No. (Weighted %)	No, pre-diabetes or borderline diabetes No. (Weighted %)
Do you have COPD?	Yes	9624 (2.08)	279 (0.06)	27184 (5.89)	1044 (0.23)
	No	51008 (11.05)	3913 (0.85)	362007 (78.42)	6555 (1.42)
	Total	60632 (13.13)	4192 (0.91)	389191 (84.31)	7599 (1.65)

Note: *Data were obtained from BRFSS 2014 database.*

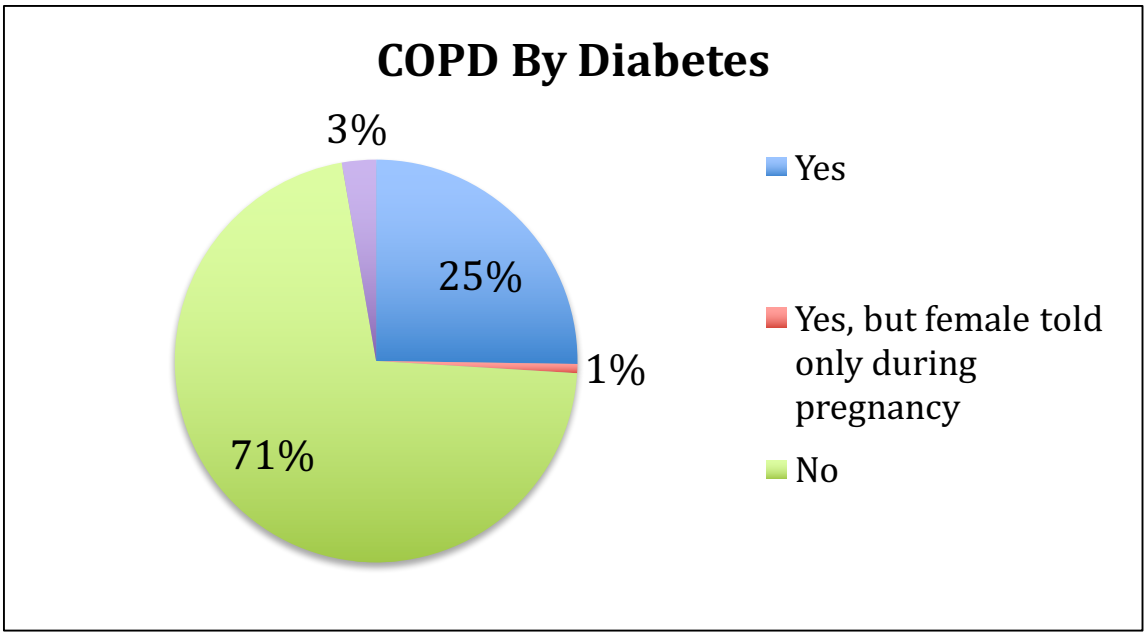

Figure 27. *Distribution of COPD by Diabetes.*

On the other hand, the results showed that 1.59% of the COPD patients reported having been told that they have coronary heart disease, whereas 6.55% of them don't have the disease, table 24 and figure 28.

Table 24:

The distribution of coronary heart disease for adult COPD patients in the United States.

Descriptive analysis to describe the distribution of the Predictor and Indicator variables			
Predictor variable		Indicator variable	
		Coronary heart disease	
		Yes, No. (Weighted %)	No, No. (Weighted %)
Do you have COPD?	Yes	7315 (1.95)	30060 (6.55)
	No	20916 (4.56)	400354 (87.29)
	Total	28231 (6.16)	430414(93.84)

Note: *Data were obtained from BRFSS 2014 database.*

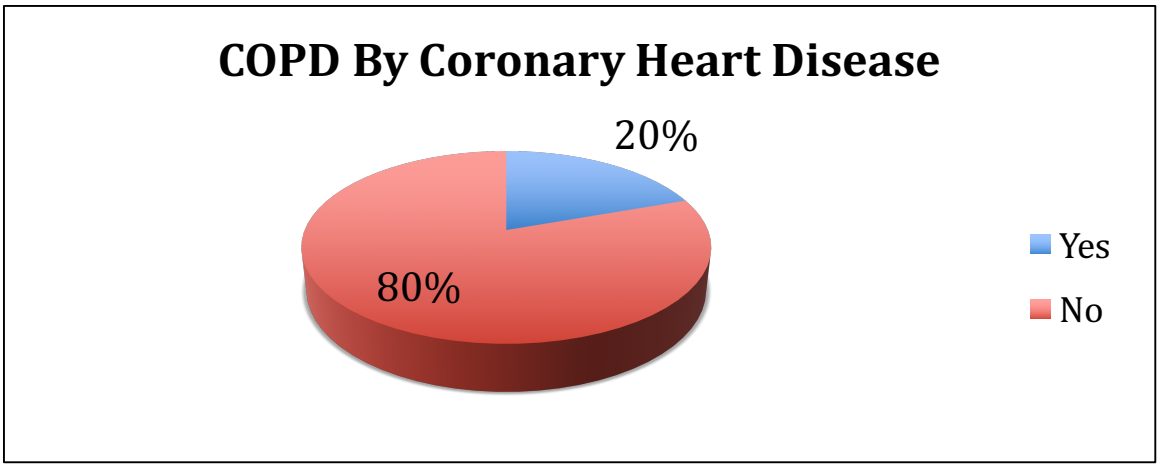

Figure 28. *Distribution of COPD by coronary heart disease.*

Finally, the descriptive analysis showed that 0.93% of the COPD patients have ever been diagnosed with stroke, while 7.30% of them have not been diagnosed with this disease, table 25 and figure 29.

Table 25:

The distribution of stroke for adult COPD patients in the United States.

Descriptive analysis to describe the distribution of the Predictor and Indicator variables			
Predictor variable		Indicator variable	
		Stroke	
		Yes, No. (Weighted %)	No, No. (Weighted %)
Do you have COPD?	Yes	4289 (0.93)	33637 (7.30)
	No	14689 (3.19)	408480 (88.59)
	Total	18978 (4.12)	442117 (95.88)

Note: *Data were obtained from BRFSS 2014 database.*

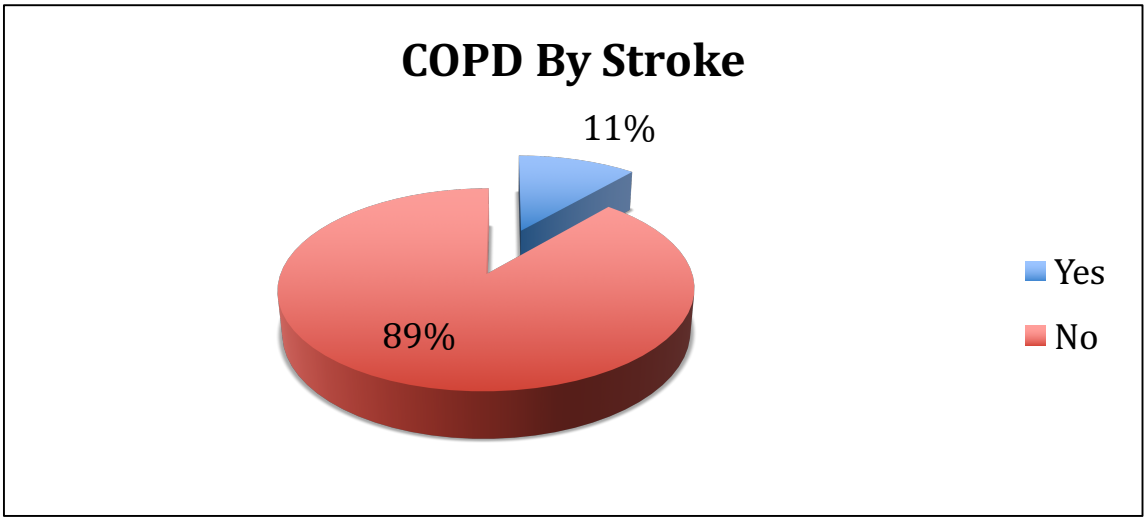

Figure 29. *Distribution of COPD by Stroke.*

4. 4. 2. Results of Inferential Analyses:

Many inferential analysis tests have been performed to determine the associations between the comorbidities predictor variables in adult COPD patients and the HRQoL indicator variables including the mental health, physical health, activity limitations, difficulty in walking or climbing stairs, difficulty in dressing or bathing, and difficulty in doing errands alone. First, Chi-square tests have been conducted to test the associations between each one of the comorbidities variables and each one of the activity limitations, and the difficulties variables. The results showed that the body mass index of COPD patients is significantly associated with each of the activity limitations, and the difficulties variables, table 26. All of the associations have p-values as <.0001. In addition, the results of the Chi-square tests showed that the associations between the diabetes, coronary heart disease, and stroke predictor variables in adult COPD patients and each of the activity limitations, and the difficulties variables are statistically significant with p-values as <.0001, table 26.

Second, more Chi-square tests have been performed to determine the associations between the comorbidities predictor variables including the BMI, diabetes, coronary heart disease, and stroke of COPD patients with each of the mental health and physical health indicator variables. The results showed that the associations between the BMI, diabetes and coronary heart disease, stroke variables with each one of the mental health and physical health variables are statistically significant with p-values as <.0001, table 26.

Table 26.

The associations between the comorbidities and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone of adult COPD patients.

P-value of Inferential Analyses to Determine the Associations Between the Predictor and the Indicator Variables						
Predictor Variable	Indicator Variables					
	Mental Health	Physical Health	Activity Limitations	Difficulties in Walking or Climbing Stairs	Difficulties in Dressing or Bathing	Difficulties in Doing Errands Alone
Body mass index	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Diabetes	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Coronary heart disease	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Stroke	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Note: *Chi-square test was performed to determine the associations between the comorbidities and each of the mental health, physical health, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone. Data were obtained from BRFSS 2014 database.*

4. 4. 3. Results of Predictive Analysis:

The relationships between the comorbidities predictor variables and each one of the HRQoL indicator variables were examined by generating several predictive regression models. First, the relationships between the BMI predictor variable and the indicator variables including the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone were investigated by creating several logistic regression models. The results showed that the relationships between those HRQoL indicator variables and the BMI variable are statistically significant with Pr > ChiSq as <.0001, table 27. Then, other logistic regression models were created to examine the relationships between the body mass index with the mental health and physical health variables for COPD patients. The p-values for these predictive models were statistically significant as Pr > ChiSq as <.0001, table 27. The results indicate that body mass index is a significant predictor of the activity

limitations, the difficulties variables, mental health, and physical health of adult COPD patients.

Table 27.
Predictive models to determine the relationships between body mass index and the, activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (Body mass index)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	1.430	0.00539	4405.6379	<.0001	1.415-1.445
Difficulties in Walking or Climbing Stairs	1.709	0.00639	7023.4070	<.0001	1.687-1.730
Difficulties in Dressing or Bathing	1.440	0.0117	975.7282	<.0001	1.408-1.474
Difficulties in Doing Errands Alone	1.258	0.00884	675.0532	<.0001	1.236-1.280
Mental Health	1.050	0.00468	109.0110	<.0001	1.041-1.060
Physical Health	1.188	0.00448	1478.6091	<.0001	1.178-1.199

Note: *Data were obtained from BRFSS 2014 database.*

Second, the relationships between diabetes predictor variable of COPD patients and the HRQoL indicator variables including the activity limitations, and the difficulties variables were investigated by conducting many logistic regression models. The results indicated that the relationships between those indicator variables and the diabetes variable are statistically significant with Pr > ChiSq as <.0001, table 28. Then, different logistic regression models were implemented to examine the relationships between diabetes predictor variable with the mental health and physical health variables of COPD patients. The p-values of the predictive models were statistically significant as Pr > ChiSq <.0001, table 28. The regression models show that the diabetes factor is a significant predictor of the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Table 28.

Predictive models to determine the relationships between diabetes and the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (Diabetes)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	0.658	0.00557	5661.5233	<.0001	0.651-0.665
Difficulties in Walking or Climbing Stairs	0.552	0.00594	10002.4399	<.0001	0.546-0.558
Difficulties in Dressing or Bathing	0.644	0.0103	1824.3473	<.0001	0.631-0.657
Difficulties in Doing Errands Alone	0.639	0.00812	3050.0302	<.0001	0.629-0.649
Mental Health	0.982	0.00539	11.9094	0.0006	0.971-0.992
Physical Health	0.818	0.00495	1638.3363	<.0001	0.811-0.826

Note: *Data were obtained from BRFSS 2014 database.*

Third, the relationships between the coronary heart disease predictor variable of COPD patients and the HRQoL indicator variables including: the activity limitations, and the difficulties variables were examined by creating many logistic regression models. The results showed that the relationships between those indicator variables and the coronary heart disease variable are statistically significant with Pr > ChiSq as <.0001, table 29. Then, more logistic regression models were conducted to investigate the relationships between the coronary heart disease predictor variable with the mental health and physical health indicator variables of COPD patients. The p-values of the predictive models were statistically significant with Pr > ChiSq as <.0001, table 29. The results indicate that the coronary heart disease factor is a significant predictor of the activity limitations, difficulties in walking or climbing stairs, the difficulties variables, mental health, and physical health of COPD patients.

Table 29.

Predictive models to determine the relationships between the coronary heart disease and the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, mental health, and physical health of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (Coronary Heart Disease)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	0.332	0.0156	4993.9038	<.0001	0.322-0.343
Difficulties in Walking or Climbing Stairs	0.305	0.0162	5373.0589	<.0001	0.296-0.315
Difficulties in Dressing or Bathing	0.444	0.0263	949.5119	<.0001	0.422-0.468
Difficulties in Doing Errands Alone	0.428	0.0211	1616.2929	<.0001	0.410-0.446
Mental Health	1.045	0.0157	7.7706	0.0053	1.013-1.077
Physical Health	0.665	0.0140	844.5282	<.0001	0.647-0.683

Note: *Data were obtained from BRFSS 2014 database.*

Finally, the relationships between stroke predictor variable of COPD patients and the HRQoL indicator variables including the activity limitations, and the difficulties variables were investigated by conducting many logistic regression models. The results showed that the relationships between the stroke variable and those indicator variables are statistically significant with Pr > ChiSq as <.0001, table 30. Then, other logistic regression models were conducted to investigate the relationships between the stroke predictor variable with the mental health and physical health indicator variables of patients with COPD. The p-values for the predictive models were statistically significant with Pr > ChiSq as <.0001, table 30. The results propose that the stroke factor is a significant predictor of the activity limitations, and the difficulties variables of adult COPD patients.

Table 30.

Predictive models to determine the relationships between stroke and the activity limitations, difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone of adult COPD patients.

Logistic Regression Models to Determine the Relationship Between the Predictor and the Indicator Variables					
Indicator variables	Predictor variable (Stroke)				
	Odds Ratio	Standard Error	Wald Chi-Square	Pr > ChiSq.	95% Confidence interval
Activity Limitations	0.269	0.0194	4588.4416	<.0001	0.259-0.280
Difficulties in Walking or Climbing Stairs	0.227	0.0197	5669.4952	<.0001	0.219-0.236
Difficulties in Dressing or Bathing	0.270	0.0281	2173.7386	<.0001	0.256-0.286
Difficulties in Doing Errands Alone	0.243	0.0230	3784.2514	<.0001	0.233-0.255
Mental Health	0.844	0.0187	81.8501	<.0001	0.814-0.876
Physical Health	0.637	0.0173	676.5850	<.0001	0.616-0.659

Note: *Data were obtained from BRFSS 2014 database.*

CHAPTER V

DISCUSSIONS AND CONCLUSIONS

5. 1. Discussions:

Several techniques have been used to determine the effects of many health conditions related to COPD on the health-related quality of life of adult patients with COPD. The data that is used in this study was obtained from the Behavioral Risk Factors Survey Systems 2014 database. The main goals of this original study are to identify how the HRQoL of COPD patients is affected by the period of smoking cessation, comorbidities, and the disease itself. Each one of these effects was carried by separate hypothesis and conducted by using descriptive analysis, inferential analysis, and predictive analysis methods. Frequency distribution method was the main technique in the descriptive analysis of COPD and each one of the study variables. In addition, several Chi-square tests were implemented in the inferential analysis for all of the study variables. Then, for determining the relationships between the study variables, many of predictive models such as logistic regression models were conducted. The first hypothesis of this study was designed to determine how COPD affects the HRQoL of adult patients in the United States. The second hypothesis was created to identify how smoking status, especially the interval time of last smoking, has important effects on the HRQoL of adult patients with COPD.

Furthermore, the third hypothesis was conducted for determining the effects of specific comorbidities such as high BMI, diabetes, coronary heart disease, and stroke on

the HRQoL of COPD patients in the United States. Thus, the following sections with include thorough discussions of the results of each hypothesis.

5. 1. 1. Discussion of The Results of Hypothesis One:

Patients with COPD have more risk of having poor HRQoL than patients without COPD [52]. It has been projected that the health care costs for COPD would be $800 billion in the next two decades [24]. At the beginning, the descriptive analysis of the distribution of the demographic variables of COPD patients have indicated that in 2014, American women were more likely to report having been told that they had COPD. Females had a higher percentage (5.29%) than males (2.97%). The results showed that 64.67% of the COPD respondents were females. This is a similar result from the sex-adjusted distribution of COPD in the US from 2011 to 2013. In addition, non-Hispanic American Whites were more likely to report having COPD than any other race in the United States with a percentage of 6.75%. The results indicated that out of the respondents who said yes that they have been told they had COPD, 81.74% of them were non-Hispanic Whites. This result is constant with a race-adjusted distribution of COPD in the United States from 2011 to 2013. Moreover, the descriptive analysis showed that people who are 55 years old and older are more likely to report COPD.

Moreover, several descriptive analyses, inferential analysis, and predictive analytics methods were conducted to identify the frequencies, associations, and relationships between the HRQoL indicator variables and the single predictor variable in this hypothesis, which is the COPD variable. First of all, the results indicated that 3.28% of COPD patients have excellent general health status, while 22.45% of them have poor general health status.

Second, the descriptive analysis of the distribution of COPD variable by the activity limitations because of health problem variable showed that 5.01% of COPD respondents have reported having activity limitations. This result suggests that around 60.40% of people who have reported having COPD have activity limitations. In addition, Chi-square test determined a statistically significant association (p-value <.0001) between these two variables. This resulted in the implantation of a logistic regression model which gave Pr > ChiSq as <.0001. This result means that the null hypothesis should be rejected and indicated that these two variables are significantly related, and that COPD is a significant predicator of the activity limitations of adult patients. It suggests that if an individual has COPD, he or she would have 5.01% chance to have activity limitations because of the disease.

Third, the descriptive analysis methods showed that between the COPD patients there were 4.31% of them have difficulties in walking or climbing stairs, 1.26% of them have difficulties in dressing or bathing, and 2.02% of them have difficulties in doing errands alone. In addition, Chi-square tests indicated that the difficulties variables are significantly associated with the COPD variable with p-values as <.0001. These results led to the performance of several logistic regression models to determine the relationships between COPD and the difficulties variables. All these logistic regression models showed Pr > ChiSq as <.0001, which indicated that the null hypothesis should be rejected. All these models indicated that COPD is a significant predictor of each one of the difficulties variables. This suggests that an individual with COPD would have chances to experience difficulties in walking or climbing stairs, difficulties in dressing or bathing, or difficulties in doing errands alone.

Finally, the results of distributions of the mental health and physical health of COPD patients showed that 65.3% of COPD patients reported having some or all of the past 30 days of their physical health was not good, while they showed that 44.33% of COPD patients reported having some or all of the past 30 days of their mental health was not good. Moreover, Chi-square tests indicated statistically significant associations between the COPD variable and these mental health and physical health variables with p-values as <.0001. The inferential results led to the implementation of several logistic regression models to determine the relationships between the COPD variable and mental health and physical health variables. The results showed that COPD and the mental health and physical health variables are significantly related with Pr > ChiSq as <.0001. This suggests that the null hypothesis is rejected for each variable and that COPD is a significant predictor of the mental health and physical health of adult patients with COPD. This means that an individual with COPD would have about 65.3% and 44.33% to have high number of days of no good mental health and physical health, respectively. To sum up, all the inferential analysis tests and predictive analysis models have indicated that COPD is associated with each of the HRQoL significantly, and that COPD is a significant predictor of these factors of HRQoL of adult COPD patients. This would lead to suggesting that these factors should be monitored regularly in patients with COPD so they can have better outcomes for their disease maintenance and management.

5. 1. 2. Discussion of The Results of Hypothesis Two:

5. 1. 2. 1. Discussion of the Current of Smoking Status and the HRQoL:

The distribution of current smoking status for COPD patients in the United States has been investigated. It showed that 5.59% of the respondents are current smokers, while

2.73% of the COPD respondents don't smoke currently. In addition, several Chi-square tests indicated that the current smoking variable of patients with COPD is significantly associated with the HRQoL variables (including the activity limitations and the difficulties variables) with p-values as <.0001. Furthermore, Chi-square tests have determined that the current smoking status variable and the mental health and physical health indicator variables are statistically associated. These results led to the performance of several predictive regression models to determine the relationships between current smoking status and each one of the HRQoL indicator variables. All the logistic regression models showed Pr > ChiSq as <.0001 for the predictor variable and each of the activity limitations, and the difficulties variables, which indicated that the null hypothesis should be rejected. All these models indicated that current smoking status is a significant predictor of each of these variables.

Moreover, different logistic regression models showed that current smoking variable is also a significant predictor of the mental health and physical health of adult COPD patients. This suggests that an individual with COPD who is a current smoker would have 5.59% chance to experience difficulties in walking or climbing stairs, difficulties in dressing or bathing, difficulties in doing errands alone, activity limitations, worse mental health, and worse physical health. While it also suggests that the physical health is not effected by the current smoking status of COPD patients.

5. 1. 2. 2. Discussion of the Smoked 100 Cigarettes in Entire Life and the HRQoL:

The distribution of smoked 100 cigarettes in entire life of COPD patients in the United States has been examined. It indicated that 6.31% of the respondents had smoked 100 cigarettes in their entire life, while 2.01% of the COPD respondents haven't smoked

100 cigarettes in their entire life. Furthermore, many Chi-square tests showed that this predictor variable for patients with COPD is significantly associated with the HRQoL variables including the activity limitations, and the difficulties variables. Moreover, the Chi-square tests have determined that this predictor variable with the mental and physical health variables are statistically associated.

Therefore, these results directed to the implementation of many predictive regression models to determine the relationships between this predictor variable and each of the HRQoL variables. All the logistic regression models indicated Pr > ChiSq as <.0001 for the predictor variable and each of the activity limitations and the difficulties variables, which indicated that the null hypothesis should be rejected. All these models indicated that smoked 100 cigarettes in entire life is a significant predictor of each of these indicator variables. Additionally, more logistic regression models indicated that smoked 100 cigarettes in entire life is also a significant predictor of the mental health and physical health of adult patients with COPD. This recommends that a person with COPD who has smoked 100 cigarettes in her or his entire life have 6.31% chance to encounter difficulties in walking or climbing stairs, difficulties in dressing or bathing, and difficulties in doing errands alone, activity limitations, poor mental health, and poor physical health.

5. 1. 2. 3. Discussion of the Frequency of Days Now Smoking and the HRQoL:

The distribution of frequency of days now smoking of COPD patients in the United States has been inspected. It signified that 4.71% of the respondents are smoking every day, while 1.50% of the COPD respondents do smoke some days. In addition, it showed that 8.15% of the respondents do not smoke at all. Many Chi-square tests showed

that this predictor variable of patients with COPD is significantly associated with the HRQoL indicator variables including the activity limitations, and the difficulties variables. On the other hand, two Chi-square tests have determined that this predictor variable and the mental health and the physical health variables are statistically associated with p-values as <.0001.

These results led to the execution of several predictive regression models to determine the relationships between the frequency of days now smoking variable and each of the HRQoL indicator variables. The p-values of all the logistic regression models showed the Pr > ChiSq as <.0001 for this predictor variable and each of the activity limitations, and the difficulties variables, which indicated that the null hypothesis should be rejected. All these models indicated that frequency of days now smoking is a significant predictor of each of these variables. Furthermore, different logistic regression models signified that frequency of days now smoking is also a significant predictor of the mental health and physical health of adult COPD patients.

The logistic regression models indicated the difference between the levels of the smoking frequency variable for COPD patients which includes (everyday smoking, someday smoking, and not at all) for their effects on the HRQoL indicators, table 31. Because of the close differences between the first two levels of the predictor variable, we will only discuss the differences between the smoking everyday and not at all levels. The results showed that individuals with COPD who smoke everyday have 21.38% risk of having activity limitations when compared to the COPD patients who don't smoke at all. In addition, when compared to the COPD patients who don't smoke at all, the individuals with COPD who smoke everyday have more risks of having difficulties in walking or

climbing stairs (6.29%), difficulties in dressing or bathing (37.08%), difficulties in doing errands alone (73.24%), poor mental health (81.46%), and poor physical health (24.31%). These results suggest that a patient with COPD who smokes everyday has higher risk to encounter difficulty in walking or climbing stairs, difficulty in dressing or bathing, difficulty in doing errands alone, activity limitations, poor mental health, and poor physical health than the COPD individuals who don't smoke at all. Therefore, this study indicates that HRQoL factors of COPD patients are affected by smoking everyday more than not smoking at all.

Table 31.
Logistic regression models to determine the relationships between each level of the frequency of days now smoking predictor variable and each of the HRQoL indicator variables.

Logistic Regression Models to Determine the Relationship Between the Levels of Predictor and the Indicator Variables

	Predicator Variable Frequency of Days Now Smoking					
	Smoking Everyday		Smoking Some Days		Not at all	
Indicator Variables	OR	95% CI	OR	95% CI	OR	95% CI
Activity Limitations	1.113	0.902-0.222	1.084	1.041-1.128	0.898	0.874-0.923
Difficulties in Walking or Climbing Stairs	1.032	1.000-1.064	1.061	1.010-1.1000	0.969	0.940-1.000
Difficulties in Dressing or Bathing	1.206	1.143-1.272	1.306	1.208-1.411	0.829	0.786-0.875
Difficulties in Doing Errands Alone	1.468	1.408-1.530	1.189	1.119-1.264	0.681	0.654-0.710
Mental Health	1.541	1.503-1.580	1.063	1.023-1.105	0.649	0.633-0.666
Physical Health	1.130	1.102-1.157	1.191	1.015-1.096	0.885	0.864-0.907

OR= Odds Ratio / CI= Confidence interval

5. 1. 2. 4. Discussion of the Interval Since Last Smoked and the HRQoL:

The distribution of interval since last smoked of the COPD patients in the US has been examined. It showed that 7.34% of the respondents had stopped smoking in the past 10 years or more, while 1.61% of them stopped smoking within the past 10 years and 1.96% of them stopped smoking within the past 5 years. Then, several Chi-square tests showed that the interval since last smoked variable of patients with COPD is significantly associated with the HRQoL indicator variables including the activity limitations, and the

difficulties variables. On the other hand, two Chi-square tests have identified that this predictor variable with the mental health and physical health variables are statistically associated.

These results guided for performing many predictive regression models to determine the relationships between the predictor variable and each of the HRQoL indicator variables. The p-values of all the logistic regression models showed the Pr > ChiSq as <.0001 for the predictor variable and each of the activity limitations, and the difficulties variables, which indicated that the null hypothesis should be rejected. All of these models indicated that interval since last smoked is a significant predictor of each of these variables. Additionally, more logistic regression models indicated that interval since last smoked is also a significant predictor of the mental health and physical health of adult COPD patients.

The logistic regression models showed the differences between the levels of the interval since last smoking indicator variable for COPD patients which includes (within the past month, with the past 3 months, within the past 6 months, within the past year, within the past 5 years, within the past 10 years, 10 years or more, and never smoked regularly) for their effects on the HRQoL indicators, table 32. Because of the close differences between multiple levels of the predictor variable, we will only discuss the differences between the within the past month and within the past 10 years level. The results indicated that individuals with COPD who have stopped smoking within the past month have 44.00% risk of having poor mental health when compared to the COPD patients who have stopped smoking within the past 10 years. In addition, when compared to the COPD people who have stopped smoking within the past 10 years, the persons

with COPD who have stopped smoking within the past month have higher risks of having activity limitations (15.61%), difficulties in walking or climbing stairs (1.76%), difficulties in dressing or bathing (32.38%), difficulties in doing errands alone (42.10%), and poor physical health (25.44%). The findings indicate that an individual with COPD who has stopped smoking within the past month has more risk to face difficulty in walking or climbing stairs, difficulty in dressing or bathing, difficulty in doing errands alone, activity limitations, poor mental health, and poor physical health than the people who have stopped smoking within the past 10 years. Therefore, this study indicates that HRQoL factors of COPD patients are affected by duration of smoking cessation.

Table 32.

Logistic regression models to determine the relationships between specific levels of the interval since last smoked predictor variable and each of the HRQoL indicator variables.

Logistic Regression Models to Determine the Relationship Between the Levels of Predictor and the Indicator Variables

	Predicator Variable Interval Since Last Smoked					
	Within the past month		Within the pas 10 years		10 Years or more	
Indicator Variables	OR	95% CI	OR	95% CI	OR	95% CI
Activity Limitations	1.091	0.891-1.336	0.933	0.777-1.119	1.045	0.875-1.248
Difficulties in Walking or Climbing Stairs	0.914	0.723-1.155	0.898	0.728-1.108	1.069	0.871-1.311
Difficulties in Dressing or Bathing	0.940	0.645-1.368	0.678	0.481-0.955	0.618	0.443-0.862
Difficulties in Doing Errands Alone	1.265	0.910-1.760	0.825	0.608-1.121	0.809	0.600-1.089
Mental Health	1.547	1.288-1.857	0.989	0.837-1.168	0.706	0.600-0.830
Physical Health	1.236	1.037-1.473	0.957	0.817-1.121	0.904	0.775-1.054

OR= Odds Ratio / CI= Confidence interval.

5. 1. 3. Discussion of The Results of Hypothesis Three:

5. 1. 3. 1. Discussion of the Body Mass Index and the HRQoL:

The distribution of the body mass index of COPD patients in America has been examined. It indicated that 2.23% of the respondents were obese, while 2.60% of the COPD respondents were overweight. In contrast, the results showed that 0.27% of COPD patients are underweight and 2.29 of them have normal weight. Then, several Chi-square tests implied that the body mass index of COPD patients is significantly associated with

the HRQoL indicator variables (including: the activity limitations and the difficulties variables) with p-values as <.0001. On the other hand, two Chi-square tests have determined that the body mass index variable with the mental health and physical health variables are statistically associated.

These results guided to the performance of many predictive regression models to identify the relationships between body mass index variable and each one of the HRQoL indicator variables. All of the logistic regression models showed Pr > ChiSq as <.0001 for the predictor variable and each of the activity limitations and the difficulties variables, which indicated that the null hypothesis should be rejected. All of these models indicated that body mass index is a significant predictor of each one of these HRQoL indicators. Moreover, other logistic regression models showed that body mass index variable is also a significant predictor of the mental health and physical health of COPD patients.

The predictive models indicated the differences between the levels of the body mass index variable for COPD patients which includes (underweight, normal weight, overweight, and obese) for their effects on the HRQoL indicators, table 33. Because of the close differences between the multiple levels of this predictor variable, we will only examine the differences between the normal weight and obese levels. The results indicated that individuals with COPD who are obese have 75.39% risk of having difficulties in dressing or bathing when compared to the COPD patients who have normal weight. In addition, when compared to the people with COPD who have normal weight, the patients with COPD who are obese have higher risks of having difficulties in walking or climbing stairs (101.23%), activity limitations (73.27%), difficulties in doing errands alone (53.65%), poor mental health (12.50%), and poor physical health (37.51%). The

results indicate that an obese individual with COPD has higher risk to experience difficulty in walking or climbing stairs, difficulty in dressing or bathing, difficulty in doing errands alone, activity limitations, poor mental health, and poor physical health than the COPD patients who have normal weight. Thus, this study indicates that HRQoL factors of COPD patients are affected by the amount of their body mass index.

Table 33.

Logistic regression models to determine the relationships between specific levels of the body mass index smoked predictor variable and each of the HRQoL indicator variables.

Logistic Regression Models to Determine the Relationship Between the Levels of the Predictor and the Indicator Variables

	Predicator Variable Body Mass Index (BMI)					
	Normal Weight		Overweight		Obese	
Indicator Variables	OR	95% CI	OR	95% CI	OR	95% CI
Activity Limitations	0.639	0.596-0.685	0.771	0.720-0.826	1.378	1.286-1.476
Difficulties in Walking or Climbing Stairs	0.580	0.535-0.629	0.804	0.743-0.871	1.769	1.634-1.914
Difficulties in Dressing or Bathing	0.490	0.431-0.556	0.572	0.505-0.648	1.083	0.958-1.225
Difficulties in Doing Errands Alone	0.443	0.407-0.490	0.443	0.404-0.486	0.773	0.706-0.846
Mental Health	0817	0.769-0.869	0.710	0.669-0.775	0.926	0.871-0.984
Physical Health	0.784	0.738-0.831	0.818	0.771-0.868	1.146	1.081-1.216

OR= Odds Ratio / CI= Confidence interval.

5. 1. 3. 2. Discussion of the Diabetes and the HRQoL:

The distribution of diabetes of the COPD patients in The U.S.A. has been tested. It signified that 2.03% of the COPD respondents had diabetes, while 5.89% of them do not have diabetes. In addition, it showed that 0.06% of the female COPD patients had diabetes during pregnancy. After that, many Chi-square tests displayed that the diabetes variable of adult patients with COPD is significantly associated with the HRQoL indicator variables including the activity limitations and the difficulties variables. On the other hand, two Chi-square tests have determined that this predictor variable with the mental health and physical health variables are statistically associated with p-values as <.0001.

These results led to the implementation of numerous predictive regression models to determine the relationships between the diabetes predictor variable and each one of the

HRQoL variables. The p-values of all the logistic regression models showed the Pr > ChiSq as <.0001 for the predictor variable and each of the activity limitations and the difficulties variables, which indicated that the null hypothesis should be rejected. All these models indicated that diabetes is a significant predictor of each of these HRQoL indicator variables. Furthermore, different logistic regression models suggested that diabetes is also a significant predictor of the mental health and physical health of adult COPD patients.

The logistic regression models indicated that the difference between the diabetes variable and COPD variable alone for their effects on the HRQoL indicators. The results showed that COPD patients who also have diabetes have 114.48% risk of having activity limitations when compared to the patients who have COPD alone. In addition, when compared to the patients who COPD alone, the individuals with COPD and diabetes have more risks of having difficulties in walking or climbing stairs (111.86%), difficulties in dressing or bathing (109.98%), difficulties in doing errands alone (105.74%), poor mental health (42.76%), and poor physical health (53.25%). These results suggest that a patient with COPD and diabetes has higher risk to encounter difficulty in walking or climbing stairs, difficulty in dressing or bathing, difficulty in doing errands alone, activity limitations, poor mental health, and poor physical health than the individuals with COPD alone. Therefore, this study indicates that HRQoL factors of COPD patients are affected by diabetes as a comorbid condition.

5. 1. 3. 3. Discussion of the Coronary Heart Disease and the HRQoL:

The distribution of coronary heart disease of COPD patients in the U.S. has been examined. It showed that 6.55% of the COPD respondents do not have coronary heart

disease, while 1.95% of them had coronary heart disease. Then, several Chi-square tests displayed that the coronary heart disease predictor variable of patients with COPD is significantly associated with the HRQoL indictor variables including the activity limitations and the difficulties variables. In addition, two Chi-square tests have determined that this predictor variable with the mental health and the physical health variables are statistically associated with p-values as <.0001.

Therefore, these results led to the operation of various predictive regression models to determine the relationships between the coronary heart disease predictor variable and each one of the HRQoL indicator variables. The p-values of all of the logistic regression models showed the Pr > ChiSq as <.0001 for the predictor variable and each one of the activity limitations and the difficulties variables, which indicated that the null hypothesis should be rejected. All of these models indicated that coronary heart disease is a significant predictor of each one of these HRQoL indicator variables. Additionally, other logistic regression models recommended that coronary heart disease is also a significant predictor of the mental health and physical health of COPD patients.

The logistic regression models indicated that the difference between the coronary heart disease variable and the COPD variable alone for their effects on the HRQoL indicators. The results showed that COPD patients who also have coronary heart disease have 81.45% risk of having difficulties in dressing or bathing when compared to the individuals who have COPD alone. Furthermore, when compared to the patients who COPD alone, the patients with COPD and coronary heart disease have higher risks of having difficulties in walking or climbing stairs (64.64%), activity limitations (60.39%), difficulties in doing errands alone (73.92%), poor mental health (48.66%), and poor

physical health (33.53%). These results suggest that a patient with COPD and coronary heart disease has increased risk to encounter difficulty in walking or climbing stairs, difficulty in dressing or bathing, difficulty in doing errands alone, activity limitations, poor mental health, and poor physical health than the individuals with COPD alone. Therefore, this study indicates that HRQoL factors of COPD patients are affected by coronary heart disease as a comorbid condition.

5. 1. 3. 4. Discussion of the Stroke and the HRQoL:

The distribution of the stroke of COPD patients in the United States has been examined. It indicated that 0.93% of the COPD respondents had stroke, while about 7.30% of the COPD respondents didn't have stroke. Then, numerous of Chi-square tests showed that the stroke for the patients with COPD is significantly associated with the HRQoL variables including the activity limitations and the difficulties variables with p-values as <.0001. In addition, two Chi-square tests have determined that the stroke predictor variable with the mental health and physical health variable are statistically associated.

Therefore, these results led to the performance of several predictive regression models to determine the relationships between the stroke predictor variable and each one of the HRQoL indicator variables, except the mental health variable. All of the logistic regression models showed Pr > ChiSq as <.0001 for the predictor variable and each one of the activity limitations and the difficulties variables, which showed that the null hypothesis should be rejected. All of these models indicated that stroke is a significant predictor of each one of these HRQoL indicators. Additionally, other logistic regression

models showed that the stroke variable is also a significant predictor of the mental health and physical health of COPD patients.

The logistic regression models indicated that the difference between the stroke variable and the COPD variable alone for their effects on the HRQoL indicators. The results showed that COPD patients who also have stroke have 40.71% risk of having activity limitations when compared to the persons who have COPD alone. In addition, when compared to the individuals who COPD alone, the patients with COPD and stroke have higher risks of having difficulties in walking or climbing stairs (37.67%), difficulties in dressing or bathing (36.32%), difficulties in doing errands alone (20.90%), poor mental health (28.10%), and poor physical health (29.34%). These results suggest that an individual with COPD and stroke has more risk to encounter difficulty in walking or climbing stairs, difficulty in dressing or bathing, difficulty in doing errands alone, activity limitations, poor mental health, and poor physical health than the patients with COPD alone. Therefore, this study indicates that all of the HRQoL factors of COPD patients are affected by stroke as a comorbid condition.

5. 2. Conclusions:

Chronic obstructive pulmonary disease (COPD) is one of the most common inflammatory lung diseases in the world [(1)]. Inflammations cause the progressive obstruction to the airflow in the lung. It has been suggested that COPD cases represent 95% among all cases of chronic lower lung diseases [(2)]. COPD is usually represented as several lung diseases including emphysema, chronic bronchitis, and refractory asthma [(3)]. In 2011, it was reported by the CDC that 15 million individuals with COPD were living in the United States [(5)]. People with COPD may show general symptoms, which include

shortness of breath, wheezing, lack of energy, chest tightness, blueness of lips or fingernail beds, weight loss, and frequent respiratory infections [9]. However, individuals with COPD may show severe symptoms that differ from other people in relation to the severity of their disease [10]. Therefore, patients may have poor health-related quality of life because of their disease [12].

This study aimed to redefine our understanding of the effects of COPD, other comorbidities, and smoking cessation duration on the HRQoL of adult COPD patients in the United States. The database of the Behavioral Risk Factor Surveillance System 2014 was obtained to perform statistical analysis by using the Statistical Analysis System SAS software Release 9.4 to accomplish the goals of this research. The descriptive analysis of the demographic variables indicated that women are more likely to acquire COPD than men. It also recommended that non-Hispanic whites are more at risk of having the disease than the other races in the United States. In addition, the results showed that older American (55 years and older) are also considered at high risk of developing the disease. Furthermore, the descriptive analysis and the inferential analysis methods showed that most of the study's factors of COPD are significantly associated with the HRQoL indicators. For instance, the results for the first hypothesis, which investigated the relationship between COPD and each one of the HRQoL factors, showed that there were statistically significant associations between them. Nearly all of the Chi-square tests in the inferential analysis had p-values as <.0001. In addition, the predictive models for the first hypothesis showed that COPD is a significant predictor of each one of the HRQoL indicators. This means that COPD patients would have poor quality of life and, thus, they

should be monitored by their healthcare providers to improve the overall outcomes of their disease.

On the other hand, the descriptive analysis of the second hypothesis, which was designed to determine the effects of the smoking cessation period on the HRQoL factors of adult COPD patients, showed that 7.34% of COPD patients have stopped smoking in the past 10 years or more. Moreover, the findings of the inferential analysis methods of this hypothesis showed that smoking quitting duration was significantly associated with each one of the HRQoL factors with p-values as <.0001. Then, the logistic regression models indicated that quitting smoking period is statistically significant predictor of most of the HRQoL indicators of adult patients with COPD. In addition, patients with COPD who have stopped smoking within the past month have higher risks of having activity limitations (15.61 %), difficulties in walking or climbing stairs (1.76%), difficulties in dressing or bathing (32.38%), difficulties in doing errands alone (42.10%), poor mental health (44.00%), and poor physical health (25.44%) when compared to the COPD people who have stopped smoking within the past 10 years. This would give good hope for the current smokers COPD patients and smoking healthy individuals, so that they should quit smoking very early in order to get improved and good health-related quality of life, and to avoid any sever outcomes of their disease.

Moreover, the descriptive analysis for the determination of the effects of several comorbidities including high body mass index, diabetes, coronary heart disease, and stroke, indicated that 3.23% of the COPD patients are obese. Also, it showed that out of the COPD respondents there were 2.08% of diabetic individuals, 1.95% of individuals who had coronary heart disease, and 0.93% of individuals who have had stroke in their

lives. Then, the findings of the inferential analysis methods for this hypothesis showed that each one of the comorbidities of COPD patients are statistically and significantly associated with the HRQoL indicators. All of the p-values of the Chi-square tests for the associated variables were <.0001.

Furthermore, the predictive models for the associated variables have shown that each one of the BMI, diabetes, coronary heart disease, and stroke variables are significant predictors of each one of the HRQoL indicators of adult patients with COPD. In addition, COPD patients who are obese have higher risks of having difficulties in walking or climbing stairs (101.23%), activity limitations (73.27%), difficulties in dressing or bathing (75.39%), difficulties in doing errands alone (53.65%), poor mental health (12.50%), and poor physical health (37.51%), when compared to the people with COPD who have normal weight.

On the other hand, individuals with COPD and diabetes have increased risks of having difficulties in walking or climbing stairs (111.86%), difficulties in dressing or bathing (109.98%), difficulties in doing errands alone (105.74%), activity limitations (114.48%), poor mental health (42.76%), and poor physical health (53.25%) when compared to the patients who COPD alone. Moreover, the patients with COPD and coronary heart disease have more risks of having difficulties in walking or climbing stairs (64.64%), activity limitations (60.39%), difficulties in doing errands alone (73.92%), difficulties in dressing or bathing (64.64%), poor mental health (48.66%), and poor physical health (33.53%) when compared to the individuals who COPD alone.

In addition, the patients with COPD and stroke have increased risks of having activity limitations (40.71%), difficulties in walking or climbing stairs (37.67%),

difficulties in dressing or bathing (36.32%), difficulties in doing errands alone (20.90%), poor mental health (28.10%), and poor physical health (29.34%) when compared to the patients who COPD alone. These findings suggest that COPD patients who have one or some of these comorbidities would be at a great risk to suffer from poor HRQoL. This means that better disease assessment and management are much needed for those people by their healthcare providers to improve the clinical practice in the United States for adult COPD patients with comorbidities.

To sum up, this study was conducted to add on the understating of the effects of the smoking cessation period and comorbidities on the health-related quality of life of adult COPD patients in the United States. This study shows the importance of early smoking cessation for healthy people and COPD patients because it would reduce the chance of suffering from poor HRQoL. On the other hand, this study also shows that COPD patients with one or more comorbidities are at risk of experiencing poor HRQoL. It suggests that the disease of those patients should be assessed and monitored for acquiring better disease outcomes and improved management of the disease. Finally, the findings of this study will significantly improve the healthcare practice for COPD patients.

5. 3. Future Recommendations:

Since the BRFSS data are based on self-reporting survey, this study should be implemented in clinical practices and the diagnosis of the disease should be reported by physicians for reflecting clinical assessment of the effect of the predictors of the study on the health-related quality of life of the COPD patients. In addition, this study has to be implemented in different populations and several countries for generalizing the results of

the study in a global manner. The implementation of similar studies should include all the wide range of people in the population of a such country because this study only included the people who had resident telephones and personal cell phones. This would give more precise determination of the effect of the predictors of the study on the HRQoL of all of the COPD patient in the population. Finally, the predictors and the HRQoL indicators of this study should be studied in data designed for the purpose of determining the effect of the smoking cessation and specific comorbidities on the HRQoL of adult COPD patients.

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