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Adults' Knowledge and Beliefs Surrounding Obstructive Sleep Apnea

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Abstract

Undiagnosed individuals with signs and symptoms of obstructive sleep apnea (OSA) are at higher risk of severe health complications than healthy individuals, and they pose a huge economic burden on society as well. Some scholars reported the lack of public knowledge of OSA as a major contributor to this phenomenon. However, there is a lack of information about assessing public knowledge and health belief of OSA and its nature across the risk level of having OSA.

Two self-reporting questioners were used in this mixed method study, a PI developed survey, the Obstructive Sleep Apnea Knowledge and Belief (OSA-KAB) © was used assess adults' knowledge and health beliefs surrounding OSA, and the STOP-Bang questionnaire that was used to categorized individuals based on their risk level of developing OSA.

The quantitative data result indicated a sever lack of knowledge of OSA across all seven subscales and was confirmed by the qualitive data. Additionally, while there was a significant, positive relationship between the knowledge and health belief, neither knowledge nor health belief scores were influenced by the risk level of OSA.

The results of this support a definite need to increase public knowledge about OSA, specifically risk factors and complications due to their impact on health belief. In addition, business owners need to identify the economic value of addressing their employees' risk of OSA, as the cost of diagnosing and treating OSA was identified as a major barrier to usage.

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Chapter I

Introduction

Background of the Problem

Since the first report of sleep apnea by Jung and Kuhl in 1965, OSA has proven to be more than just a simple sleep-related disorder sleep (Sidney Burwell et al., 1956). OSA is a condition that affects millions of individuals and one that can be accurately diagnosed and treated effectively (Myers, Mrkobrada, & Simel, 2013). It is estimated that at least 20 million Americans suffer from moderate to severe OSA and at least one in five Americans (60 million) has mild sleep apnea (Young et al., 2007). In fact, OSA is the second most common sleep disorder. A sleep study involving a full night in the laboratory is considered the golden standard for diagnosing OSA, and in the United States, sleep study referrals have increased 12-fold in the last 10 years (Lettieri, 2009). Despite this, approximately 80% of individuals with OSA remain undiagnosed (T Young, Evans, Finn, & Palta, 1997).

In addition, OSA has been associated with immediate consequences and long-term complications that have implications beyond the individual. This issue makes OSA important from a public health perspective. Undiagnosed and untreated OSA patients require more health care resources compared to diagnosed patients. In fact, one study forecast that diagnosing and treating all 29.4 million Americans with OSA could save $100.1 billion and reduce the cost per person from $5,511 to $2,105 (Frost & Sullivan, 2016). In fact, reducing the number of undiagnosed OSA patients is one of the retained and modified objectives from the Healthy People 2010 agenda that was included in Healthy People 2020. Clearly, the goal is to increase the percentage of diagnosed individuals with symptoms of OSA from 25.5% to 28% (Office of

Disease Prevention and Health Promotion [ODPHP], 2016). Therefore, the first step to achieve this goal is to investigate and understand the barriers that keep individuals with signs and symptoms of OSA from seeking medical attention. According to Frost and Sullivan (2016), four main barriers to seeking medical attention for OSA include general public awareness, primary care physician education, diagnosis and treatment costs, and employer/payer investment for chronic care management. In this study we sought to explore general public awareness of OSA through the lens of the health belief model using a PI developed survey that measured public knowledge and health beliefs regarding OSA, in order to dive deeper into the barrier of public awareness.

Need for the Study

This study adds to the limited literature exploring and focusing on the individual's knowledge base before a diagnosis of OSA as a means to address health and wellness. Specifically, this survey was designed to address incentives and barriers to seeking medical attention for OSA through the lens of a well-established model: the health belief model. A definite need to improve knowledge and awareness of OSA and its comorbidities exists not only among the public but among health care providers as well. In fact, a study reported that many health care providers are unaware of the cardiovascular impact of sleep-disordered breathing (Umlauf et al., 2004).

To reduce the number of undiagnosed OSA patients, several studies have focused on understanding the role of health care practitioners in identifying high-risk individuals and the barriers associated with OSA diagnosis and treatment. Current research in this area suggests that

routine screenings are needed for all patients visiting their primary care clinics (Miller & Berger, 2016). The Institute of Medicine (IOM) Committee on Sleep Medicine and Research has stated that awareness among the general public and health care professionals is low, given the magnitude of OSA prevalence. In addition, multiple studies have reported positive associations between a high level of education and being diagnosed and treated (V. Kapur et al., 2002; T Young et al., 1997).

Ascertain public's baseline familiarity with OSA is a step forward to understand of the phenomena of undiagnosed individuals. The only few studies that explored public's knowledge of sleep and sleep related breathing disorders reported poor awareness of sleep apnea, sleepiness, and complications (Arous et al., 2017; Gupta & Gupta, 2014; Sia et al., 2016). However, to date, no tools have been developed and validated to measure public knowledge of OSA symptoms, risk factors, complications, medical professions that can diagnose and treat, and diagnostic and treatment options. Once these tools have been developed, educational programs about OSA can be developed to specifically address areas of weakness in the public's knowledge. In fact, according to the health belief model, the decision to obtain a diagnostic test disregards the presence of symptoms and depends on the person's readiness, feasibility for the procedure, and a stimulus (Rosenstock, 2005).

Problem Statement

Undiagnosed individuals with OSA are not only at risk themselves but are negatively influencing the health and wellness of the community as well. OSA has been associated with fatal comorbidities such as hypertension, heart failure, arrhythmias, coronary artery disease, stroke, metabolic syndrome, type II diabetes, depression, adverse perioperative events, cancer,

and death (Knauert, Naik, Gillespie, & Kryger, 2015). In addition, untreated OSA has been associated with reduced quality of life and increases in motor vehicle, home, and work accidents (Knauert et al., 2015). The American Academy of Sleep Medicine (AASM) estimated the economic cost of undiagnosed OSA in 2015 to be approximately $150 billion. The total cost can be divided into four major categories: lost productivity ($86.9 billion), comorbid diseases ($30 billion), motor vehicle accidents ($26.2 billion), and workplace accidents ($6.5 billion). The lack of knowledge about OSA was reported as one of the factors responsible for the large percentage of undiagnosed individuals, which lies at 80% (Frost & Sullivan, 2016). However, only few studies have attempted to further explore this lack of knowledge among undiagnosed individuals.

Significance of the Study

Such a study can provide imperative information regarding adults' public knowledge and beliefs about OSA. This information can be used to selectively allocate resources to address knowledge deficiencies in any of the six knowledge constructs or to enhance public belief in the urgency of addressing their sleep problems. In addition, the OSA-KAB can be used as a measurement tool to assess the effectiveness of any educational effort aimed to improve and enhance an adult's knowledge and beliefs about OSA.

Purpose of the Study

The purpose of this study was to explore adults' who are not diagnosed with OSA, knowledge and health beliefs about OSA. In addition, the relationship, if it exists, between knowledge and health beliefs will be explored. Finally, the PI will assess whether there is a

difference in overall knowledge and health beliefs about OSA depending on the adult's level of risk (high, moderate, and low) for OSA.

Research Questions

Because little is reported about public knowledge and health-related beliefs for undiagnosed individuals, four primary questions were established:

- RQ1: What do adults who are not diagnosed with OSA know about OSA?
- RQ2: What are adults who are not diagnosed with OSA's health beliefs about obstructive sleep apnea?
- RQ3: Is there a relationship between adults who are not diagnosed with OSA's overall knowledge and their health belief scores specific to OSA?
- RQ4: Is there a difference in overall knowledge and health beliefs specific to OSA among adults with high, moderate, and low risks of OSA?

Chapter II

Literature Review

History of obstructive sleep apnea

Sleep breathing disorders includes range of disorders, categorized into OSA, central sleep apnea or sleep-related hypoventilation. The first mention of sleep breathing disorders in the scholarly world was in the article by Burwell et al. (1956) titled "Extreme Obesity Associated with Alveolar Hypoventilation: A Pickwickian Syndrome." Burwell named the association of excessive sleepiness and respiratory failure as the "Pickwickian syndrome," after a fictional character created by Charles Dickens, Samuel Pickwick, a middle-aged obese man who snored and choked in his sleep (Sidney Burwell et al., 1956). Initially, scholars only associated sleep breathing disorder with obesity. However, Lugaresi(1969) and his colleagues reported similar breathing abnormities in non-obese patients (Lugaresi,1966). A decade later, sleep apnea was categorized into: diaphragmatic (or central), obstructive and mixed disorders. In addition, hemodynamic changes were documented during sleep for OSA patients (Guilleminault, Eldridge, Simmon, & Dement, 1975).

Currently, OSA is the most common sleep-related breathing disorder. It is characterized by repetitive episodes of apnea (a complete collapsing of the upper airway) or hypopnea (a partial collapsing of the upper airway resulting in >30% reduction in baseline airflow) that last 10 seconds or more despite breathing effort (American Academy of Sleep Medicine Task Force, 1999; Sutherland & Cistulli, 2015). These episodes causes hypercapnia that stimulate the central

nervous system to increase respiratory effort and pharyngeal muscle activity which eventually overcome the obstruction (Carlucci, Smith, & Corbridge, 2013; Somers et al., 2008). Furthermore, due to their similar pathophysiology and physiologic consequences, both apnea and hypopnea episodes are reported in episodes per hour as Apnea hypopnea index (AHI). A confirmed OSA syndrome diagnosis requires 15 apnea, hypopnea episodes per hour regardless of associated symptoms or five apnea, hypopnea episodes with associated symptoms (e.g., excessive daytime sleepiness, fatigue, or impaired cognition)(American Academy of Sleep Medicine Task Force, 1999; V. K. Kapur et al., 2017; Somers et al., 2008). It has been noted in the literature that apnea hypopnea episodes are longer during REM sleep then non-REM sleep in individuals with OSA(Findley, Wilhoit, & Suratt, 1985).

Pathophysiology of OSA

The underlying pathophysiology for OSA is complex and it may vary between persons. In contrast to other human organs, the human pharynx is a unique structure that only contains muscles and soft tissue and it is not protected by a rigid skeleton structure (Fig- 2). The pharynx's unique structure of muscles and soft tissues is essential for phonation, swallowing and breathing. During inhalation the airway is susceptible to collapse due to the negative pressure generated by the diaphragm and other respiratory muscles (van Lunteren & Strohl, 1986). Via the use of MRI narrower upper airway has been documented, predominantly in the lateral dimension in individuals with OSA compared to normal individuals (Schwab et al., 1995). Across the different sleep stages, OSA is usually more present during the rapid eye movement (REM) stage, because of the reduction in muscle tone and increase in arousal threshold in REM

sleep. In addition, supine sleeping position was found to worsen OSA, due to the gravitational effect on the base of the tongue (Manuel et al., 2012). A wide range of pathophysiological mechanisms, beyond the changes in the upper airway, can lead to OSA including anatomical and neuromuscular mechanisms, lung volume, ventilatory control, arousal threshold, upper airway surface tension, and rostral fluid shift. Therefore, the treatment of OSA should address each pathophysiology concern (Sutherland & Cistulli, 2015).

Risk Factors

Any anatomic and neuromuscular abnormalities that can cause narrowing or collapsing of the pharyngeal airway are considered risk factors for OSA. Additionally, obesity, hormonal changes, age, gender, ethnicity, craniofacial and upper-airway structure, family history, smoking and alcohol consumption are all considered risk factors for OSA. Specifically, increased body weight which increases parapharyngeal fat deposition surrounding upper airway and alters neural compensatory mechanisms that maintain airway patency is known to be responsible for changing the normal upper airway mechanics during sleep (Fogel, Malhotra, & White, 2004). The

Wisconsin cohort study reported a 10% increase in body weight was associated with a 6-fold increase in OSA risk in undiagnosed individuals (P E Peppard, Young, Palta, Dempsey, & Skatrud, 2000). Furthermore, the severity of OSA has been reported to decrease after successful engagement in a weight loss program or surgery in adults (Dobrosielski, Patil, Schwartz, Bandeen-Roche, & Stewart, 2015; Terry Young, Peppard, & Gottlieb, 2002). Males have been noted to be more susceptible to OSA than females in both diagnosed and undiagnosed populations with ratios of (8:1) and (2:1) respectively (Terry Young, Peppard, et al., 2002). However, hormonal changes have been noted as an independent risk factor in females. For instance, reduction in progesterone level was associated with developing or worsening OSA among pregnant women. Moreover, post-menopausal women are at high risk of developing OSA due to the hormonal changes that increase fat mass on the upper body (Netzer, Eliasson, & Strohl, 2003; Wimms, Woehrle, Ketheeswaran, Ramanan, & Armitstead, 2016). Furthermore, Wisconsin Sleep Cohort study reported that postmenopausal women were 3 times more likely to have moderate to severe OSA when compared to premenopausal women (Terry Young, Finn, Austin, & Peterson, 2003). In fact, hormonal therapy was shown to lessen the risk of OSA particularly among women 50 to 59 years old (Shahar et al., 2003). The prevalence of OSA increases steadily with age until it plateaus after the age of 65 years (Bixler, Vgontzas, Ten Have, Tyson, & Kales, 1998; Terry Young, Shahar, et al., 2002). Several studies reported higher incidence of OSA in African Americans, mainly in the age group between 25-65 years old, compared to Caucasian-Americans in the general population when they controlled for other risk factors (Friedman et al., 2006; Hui et al., 2017). Interestingly, upper airway structure and narrowed nasal cavities may explicate some of the variation in risk for obstructive sleep apnea across different racial groups. For example, Asians' narrower cranial base angle could be the

reason for increased the prevalence or the severity OSA in comparison to Caucasian-Americans when controlling for age and weight (Li, Kushida, Powell, Riley, & Guilleminault, 2000). In fact, several large-scale studies have confirmed a role for inheritance and familial factors in the genesis of obstructive sleep apnea the Cleveland Family Study. Zhang (2014) concluded that multiple gene-gene interactions contributing to obesity, craniofacial structure, ventilator control and asleep-awake pattern may increase the risk for OSA (Zhang, Xiao, & Luo, 2014). Furthermore, certain human behaviors have been associated with OSA, including cigarette smoking and alcohol consumption. Alcohol consumption especially before sleep, causes the upper airway dilator muscles to relax and increases upper airway resistance, leading to longer apnea, worsening hypoxemia and apnic episodes in asymptomatic none symptomatic normal or asymptomatic individuals(Al Lawati, Patel, & Ayas, 2009; Carole et al., 1981; Mitler, Dawson, Henriksen, Sobers, & Bloom, 1988). Kashyap, Hock, & Bowman (2001) reported that the prevalence of OSA among current smokers was 2.5 times higher than among former smokers and nonsmokers combined (Kashyap, Hock, & Bowman, 2001). In fact, cigarette smoking was found to be associated with lower oxygen saturation during sleep and heavy smokers presenting with more severe OSA. In the Wisconsin Cohort study the prevalence of OSA in cigarette smokers was 35% higher than among none smokers (Wetter, Young, Bidwell, Badr, & Palta, 1994).

Comorbid Condition

The impact of OSA on global health is recognized across the literature. Fragmented sleep, in addition to intermittent hypoxia and hypercapnia intrathoracic pressure swings, and reduction in tidal volume activate the sympathetic nervous system. The activation of the sympathetic nervous system causes hemodynamic stress and upsurge inflammatory cytokines manifested in an increase in heart rate and blood pressure and marked increased levels of systemic inflammatory markers (Carlucci et al., 2013; Nadeem et al., 2013).

Approximately 60% of patients with OSA present to the clinic with symptoms that include unexplained excessive daytime sleepiness, loud snoring, choking or shortness of breath sensations during sleep, restless sleep, unrefreshing sleep, changes in personality, and nocturia (Manuel et al., 2012; Patil, Schneider, Schwartz, & Smith, 2007; Thorpy, 2012). Additionally, OSA patients are at risk for adverse health conditions such as hypertension (Schein, Kerkhoff, Coronel, Plentz, & Sbruzzi, 2014), heart failure (Sun, Shi, Li, & Chen, 2013), arrhythmias (Vizzardi et al., 2014), coronary artery disease (Campos-Rodriguez et al., 2014), stroke (Cho et al., 2013), metabolic syndrome (Lin, Chen, Yu, Liu, & Gao, 2014), type II diabetes (Guest, Panca, Sladkevicius, Taheri, & Stradling, 2014), depression (Gagnadoux et al., 2014), adverse perioperative events (Memtsoudis et al., 2014), and cancer (Chen et al., 2014), and death (Rich, Raviv, Raviv, & Brietzke, 2011), especially in untreated, severe cases. The effect of OSA on the cardio vascular system is profound, and extensive. For example, male patients with OSA were found to be 6 times more likely to be treated for congestive heart failure (Roger et al., 2012; SHAHAR et al., 2001). In addition, several studies reported sleep apnea as an independent risk

factor for hypertension (Lurie, 2011; Nieto, 2000; Paul E. Peppard, Young, Palta, & Skatrud, 2000).

Prevalence of OSA

According to AASM, there are at least 29 million adults in the U.S. with OSA(Paul E. Peppard et al., 2013). However, the exact prevalence of OSA has yet to be determined. The reported prevalence of OSA varies across the literature due to the significant methodological heterogeneity, subgroups and most importantly the definition of OSA. For example OSA prevalence among bariatric surgery patient is between 70% and 80% and between 60% and 70% in transient ischemic attack or stroke patient(Johnson & Johnson, 2010; Ravesloot, Van Maanen, Hilgevoord, Van Wagensveld, & De Vries, 2012). Therefore, large longitudinal studies such as The Cleveland Family Study (CFS) and The Wisconsin Sleep Cohort (WSC) with over 3700 participants accumulatively were lunched, focusing on the prevalence and the development of sleep apnea over time. Initial reports from the two studies documented a significant progression in OSA over time (Tishler, Larkin, Schluchter, & Redline, 2003; Terry Young, Peppard, et al., 2002). The Wisconsin Sleep Cohort (WSC) is an ongoing longitudinal study that produced around 100 publications on the causes, consequences, and natural history of sleep disorders.

Based on the current definition of OSA (AHI ≥ 5 events/h, combined with clinical symptoms), the prevalence of OSA condense to be 14% of men and 5% of women. The estimates of moderate to severe sleep-disordered breathing (apnea-hypopnea index, measured as events/hour, ≥15) are 10% among 30–49-year-old men; 17% among 50–70-year-old men; 3% among 30–49-year-old women; and 9% among 50–70 year-old women (Terry Young et al.,

1993). The Cleveland Family Study (CFS) is another major longitudinal study between 1990 and 2006 in which a steady increase in OSA has been noted. Peppard et al. (2013) estimated the increase in OSA over the past two decades to be between 14% and 55%, depending on the subgroup. The increased rate of obesity, which is a major risk factor for OSA, could partially explain the rise in OSA prevalence (Terry Young, Paul E. Peppard, 2005). In a systematic review, Senaratna et al. (2016) examined 24 studies and reported the overall OSA prevalence in adults to be between 9% and 38%. In addition, OSA was found to be more prevalent in men than in women, with estimates of 13–33% and 6–19%, respectively. In general, having a high BMI and being male, older age, and postmenopausal status are all major risk factors for OSA (Patil et al., 2007; Senaratna et al., 2016).

Diagnosing OSA

The diagnosis of OSA is based on physical examination and objective testing. Clinical indications of OSA are excessive daytime sleeping, loud snoring, witnessed apnea, and arousals due to gasping or choking during sleep (Epstein et al., 2009). In addition, the AASM V a full night sleep study either in-laboratory, fully attended PSG, or at home with portable monitors (PM) are all considered objective measures (Epstein et al., 2009). However, the full-night, attended in-laboratory PSG (Type I) sleep study is considered to be the gold standard in diagnosing OSA. This 12-channel test collects electrical biosignal information such as electroencephalogram (EEG), electrooculogram (EOG), chin electromyogram, airflow, oxygen saturation, respiratory effort, electrocardiogram (ECG) or heart rate, and body position (Berry, Brooks, & Gamaldo, 2012). However, there are some limitations to PSG, such as cost, limited availability, and first night effect. At home-based polysomnography (H-PSG), is only

recommended in cases where patient mobility is limited or in patients that are more likely to have moderate to severe OSA. In addition, (H-PSG) can record similar number of channels as PSG but at home and without the presence of the sleep technologist. Therefore, the quality of H-PSG is sometimes inferior to the quality of an attended in-laboratory PSG (Bruyneel, Libert, Ameye, & Ninane, 2015). The minimum criteria for diagnosis are either a minimum of 15 events per hour, or five events per hour with the presence of any of the following: excessive daytime sleepiness; unrefreshing sleep; fatigue; insomnia; gasping or choking; or loud snoring reported by bed partner. In fact, the severity of OSA depends on the number of apnea events recorded on the Apnea Hypopnea Index (AHI): OSA is considered mild if the AHI is between 5 and 15; moderate if the AHI is between 15 and 30; and severe if the AHI is 30 or more (Epstein et al., 2009). Although there has been an upsurge in sleep laboratories, there is still not enough laboratories to match the clinical demands. According to Colten (2006) only 425 polysomnograms per 100,000 population are performed each year (Colten, Altevogt, Research, & And, 2006). Additionally, a decade later, and while the US population increased by 13%, and adult obesity increased by 5%, the number of accredited sleep centers increased only by 9%(Hales, Carroll, Fryar, & Ogden, 2017). According to the AASM there are more than 2,500 accredited sleep centers. Still, sleep laboratories are labor-intensive specialized facilities. Therefore, sleep experts and monitor manufacturers developed portable sleep monitors (PSM) to allow patients to be diagnosed in their home and reduce the pressure on sleep laboratories. However, according to the AASM recommendation, PSM can only replace PSG in patients with high likelihood of having moderate to severe OSA, or in those for whom SG is too difficult to perform due to immobility, safety, or critical illness. Additionally, PSM can only be performed

in conjunction with comprehensive sleep assessment, and under the supervision of a sleep specialist (Collop, Anderson, & Boehlecke, 2007).

Screening tools

The AASM recommends that primary care providers screen patients who are at high risk of developing OSA, even if they don't have any sleep-related symptoms (Aurora & Quan, 2016; Epstein et al., 2009). Several screening tools have been developed to detect individuals with OSA in various health care settings. The four main screening tools often used to detect OSA and daytime consequences are the Epworth Sleepiness Scale (ESS), the Berlin Questionnaire (Berlin), the STOP-Bang questionnaire and STOP questionnaire (STOP). The ESS was developed as a simple, self-administered tool designed to measure the level of daytime sleepiness in adults through rating the level of sleepiness in eight different situations (Netzer, Stoohs, Netzer, Clark, & Strohl, 1999). The Berlin Questionnaire was developed to detect OSA, and it measure the severity of three OSA symptoms (frequency of snoring and apneas, daytime sleepiness and sleepiness while driving) via 11 items (Netzer et al., 1999). The STOP-Bang Questionnaire consists of eight dichotomous (yes/no) questions representing signs and symptoms of sleep apnea (snoring, tiredness, observed apnea, high blood pressure, BMI, age, neck circumference and male gender). The STOP questionnaire is a shorter version of the STOP-Bang that contains 4 items. A Meta-analysis study that examined 108 studies with a total of 47989 participants reported the superiority of STOP-Bang compared to other tools with significantly higher sensitivity. Furthermore, STOP-Bang has pooled sensitivity levels for detecting mild,

moderate, and severe OSA were 88%, 90% and 93% respectively, and specificity level of 42%, 36% and 34% respectively (Chiu et al., 2016).

Treatment for OSA

In 1981, Continuous Positive Pressure ventilation (CPAP) machine was first used to treat five individuals who suffered from severe OSA. The CPAP machines were successful in preventing upper airway occlusion during sleep by delivering low levels of pressure (range 4.5-10 cm H2O) via nasal mask. Prior to 1981, the only effective treatment for OSA was tracheostomy (Sullivan, Issa, Berthon-Jones, & Eves, 1981). To date, positive pressure ventilation is still the treatment of choice for mild, moderate, and severe OSA (Epstein et al., 2009). The positive airway pressure works as a pneumatic splint that prevents the airway from collapsing. Several studies have found that adherence to nighttime CPAP therapy resulted in significant improvements in patients' quality of life, daytime sleepiness, and other symptoms after 6 months of treatment with CPAP (Jurado-gamez et al., 2015). In addition, mandibular advancement and losing weight have also been found to reduce the severity of OSA (Chan et al., 2010; Thomasouli et al., 2013). Other treatment approaches available to treat OSA, include hypoglossal nerve stimulation (HNS)(Oliven et al., 2007), increasing lung volume (Heinzer et al., 2005), ventilation stability (Wellman et al., 2008), increasing arousal threshold (Krol, Knuth, & Bartlett, 1984), manipulating surface tension of the upper airway lining liquid (Lam, Kairaitis, Verma, Wheatley, & Amis, 2008), and exercising to decrease fluid accumulation in the neck region (Giebelhaus, Strohl, Lormes, Lehmann, & Netzer, 2000).

Undiagnosed OSA

According to the AASM, there are around 23.5 million undiagnosed individuals with OSA in the USA (Frost & Sullivan, 2017). Undiagnosed, untreated OSA patients are at risk of severe clinical consequences and economic costs that affect both the individual and the society. Undiagnosed OSA patients are at higher risk for hypertension, heart failure, arrhythmias, coronary artery disease, stroke, metabolic syndrome, type II diabetes, depression, adverse perioperative event, cancer, and finally death (Knauert et al., 2015). Furthermore, OSA is directly related to quality of life at home and at work. At home, untreated OSA has been associated with diminished quality of life for both the patient and family members (Baldwin et al., 2001). Furthermore, study findings support that patients with OSA are ten times more likely to have workplace disability and eventually cost more in reduced productivity, healthcare costs, and motor vehicle accidents (Hoffman, Wingenbach, Kagey, Schaneman, & Kasper, 2010; Littner, 2007; Omachi, Claman, Blanc, & Eisner, 2009; Vennelle, Engleman, & Douglas, 2010). According to AAA, drowsy driving causes nearly 29% or 328,000 crashes each year, 109,000 injuries and 6,400 fatalities (Brian C. Tefft, 2014). In fact, commercial drivers treated on CPAP had a 73% reduction in preventable driving accidents (Berger, FCCP, Owen, & Wu, 2005). The AASM estimated the yearly cost of undiagnosed OSA in 2015 as approximately $150 billion (Frost & Sullivan, 2016). The total cost can be divided into four major categories: lost productivity ($86.9 billion), comorbid diseases ($30 billion), motor vehicle accidents ($26.2 billion), and workplace accidents ($6.5 billion). Additionally, a diagnosed OSA induvial can spend around $2,105 a year for testing, appointments, treatment devices and surgery if necessary versus $6,336 for undiagnosed one. Diagnosing and treating all 29.4M Americans with OSA

could save $100.1 billion. The projected annual per patient diagnosis and treatment costs are 67% less than leaving patients undiagnosed (Frost & Sullivan, 2017).

Raising OSA Awareness

There is a definite need to improve the knowledge and awareness of OSA and its comorbidities not only among the public, but health care providers, as well. In fact, a study reported many health care providers are unaware of the cardiovascular impact of sleep-disordered breathing (Umlauf et al., 2004) . In order to reduce the number of undiagnosed OSA patients, several studies have focused on understanding the role of health care practitioners in identifying high-risk individuals and the barriers associated with OSA diagnosis and treatment. Based upon the current work in this area, it has been suggested that routine screenings are needed for all patients visiting their primary care clinics (Miller & Berger, 2016). Additionally, the AASM identified four barriers negatively affecting the diagnosis and treatment of OSA. These barriers include general public awareness, primary care physician education, diagnosis and treatment costs, and employer/payer investment for chronic care management (Frost & Sullivan, 2016). The Institute of Medicine (IOM) Committee on Sleep Medicine and Research has stated that awareness among the general public and health care professionals is low, given the magnitude of the burden. In addition, multiple studies have reported positive associations between level of education and being diagnosed and treated (V. Kapur et al., 2002; T Young et al., 1997). In order to develop educational strategies for the public, it will be useful to first ascertain the public's baseline familiarity with OSA. However, to date no tools have been developed and validated to measure the public's knowledge about OSA, nor has a measurement

tool been designed to measure public's awareness of OSA symptoms, risk factors, complications, and diagnostic options. Once this has been accomplished, educational programs about OSA could be developed to specifically address areas of weakness in the public's knowledge base. These specific areas include knowledge of OSA risk factors, complications, and treatment options. In fact, according to the Health Belief Model (HBM), the decision to obtain a diagnostic test disregards the present of symptoms and depends on the person's readiness, procedure feasibility and a stimulus (Rosenstock, 2005).

Health Belief Model

The HBM is a commonly used model in health education and was developed based on value expectancy theory by 3 psychologists Hochbaum, Rosenstock and Kegels in the1950s in response to the failure of a free tuberculosis (TB) health screening program (Hochbaum, 1958). The HBM consist of six constructs: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers cues to action, and self-efficacy (Glanz, Rimer, & Lewis, 2002). According to the HBM in order for a person with OSA to seek medical diagnosis, he/she first has to suspect that there is a high chance of having an OSA problem (perceived susceptibility). In addition, the chances of this individual seeking medical attention increases if he/she knows OSA is a serious condition that could lead to sever complication or even death (perceived severity). Furthermore, seeking medical attention increases if one knows the diagnosis and the treatment options could produce tangible benefits (perceived benefits) and were not too expensive or unfeasible (perceived barriers). Additionally, the presence of other factors may initiate the process (cue for action), such as the federal regulation urging railroads across the country to test train operators for obstructive sleep apnea after the New Jersey deadly train crash September,

2016 (“After NJ Transit train crash, transit regulators targeting sleep apnea,” 2016). The final constraint is whether the person has the confidence in their ability to seek medical attention for OSA (self-efficacy). HBM has been used frequently as a framework to develop survey, promote awareness, to predict health behavior in varies diseases and conditions to raise awareness of multiple health concerns. For example, HBM has been used in exploring the severity and prevalence of HPV infection, cancer prevention benefits of the human papillomavirus vaccination (Blasi, King, & Henrikson, 2015), promoting of Human Immunodeficiency virus HIV testing in Africa (Blasi et al., 2015), and predicting adherence to CPAP (Olsen, Smith, Oei, & Douglas, 2008). The flexibility of the HBM allowed the scholars to use the model in different ways. In fact, some surveys were built using four constructs (Lu et al., 2018; Rakhshanderou, Ghaffari, & Rafie, 2017; Wang, Hsu, Wang, Huang, & Hsu, 2014) or five constructs (Araban, Baharzadeh, & Karimy, 2017; Blavos, Glassman, Sheu, Diehr, & Deakins, 2014), or the entire model (Saunders, Dann, Griest, & Frederick, 2014). The early application of the model presented inconsistent results in predicting health behavior. Suzanne, (2001) utilized the HBM to predict breast cancer screening behaviors. The predictive power of the model alone was low, ranging from 15 to 27%. However, when socioeconomic status was included the model predictability increased to 47% (Yarbrough & Braden, 2001). Furthermore, for Routine HIV counseling and testing the HBM was able to explain 25.1% of the variance in acceptance of Routine counseling and testing (Nöthling & Kagee, 2013). Therefore, this model provides a basis for this study to explore public’s health belief about seeking medical attention for OSA.

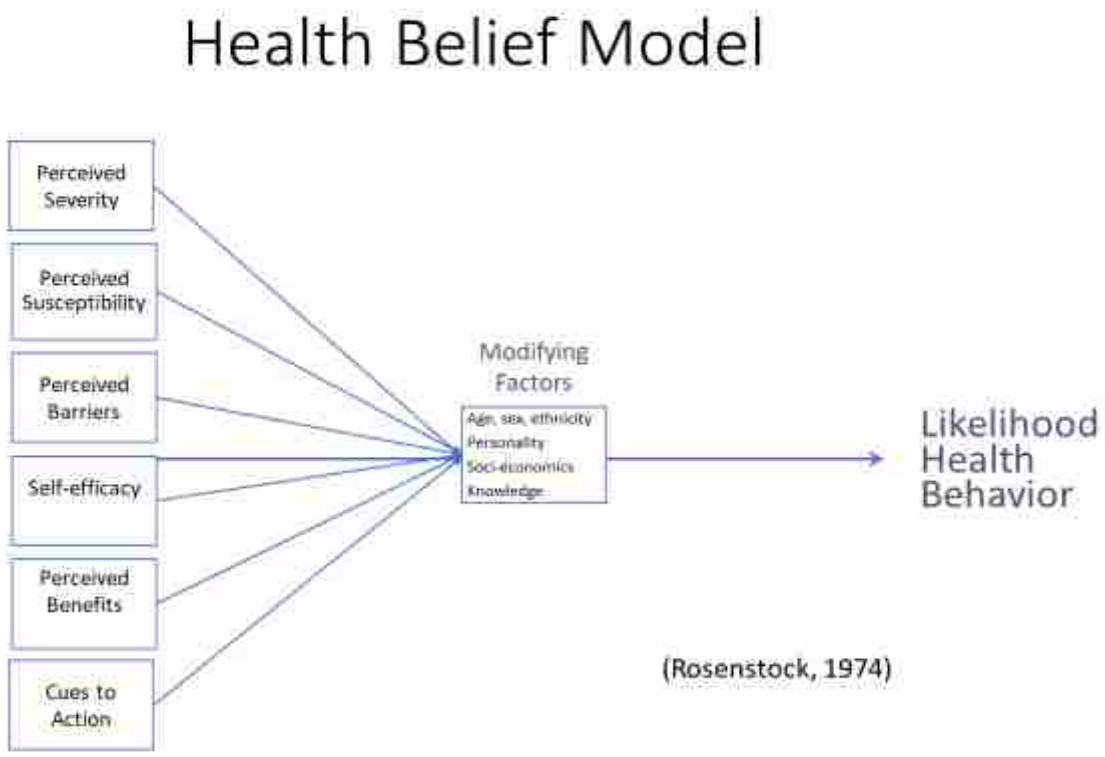

Figure 1. Health Belief Model

Chapter III

RESEARCH METHODS

Research Design

This study used a mix method research design, exploratory, comparative, cross-sectional using a self-reporting questionnaire. It is cross sectional exploratory because it attempted to gain a better understanding of an issue which is public's knowledge and health belief of OSA at a single point of time; and comparative because it compared the participants' knowledge and health belief of OSA across three groups.

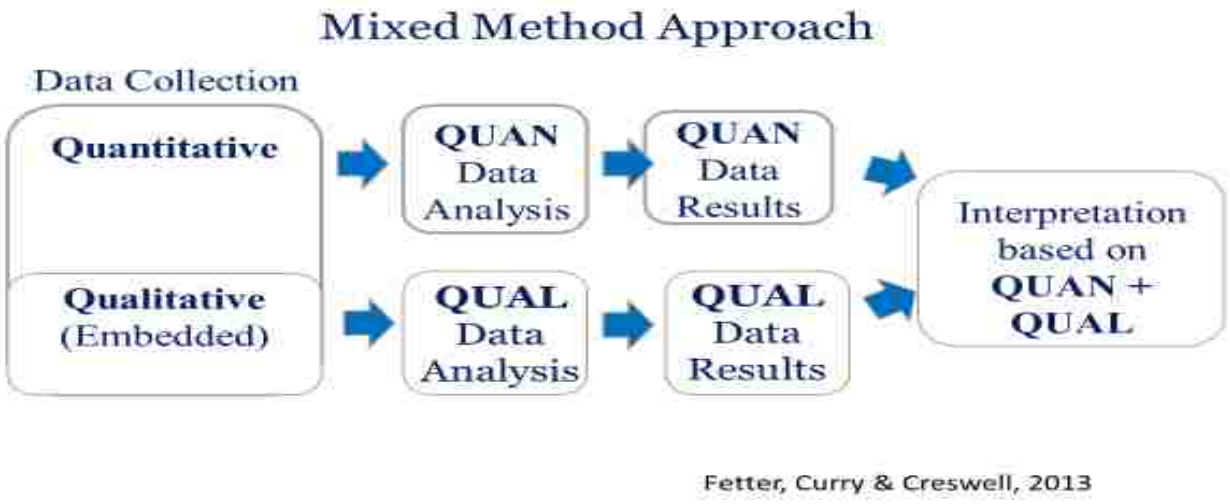

Figure 2. Mixed method approach

Concurrent embedded mixed design

Mixed method design combines quantitative and qualitative data collection and analysis in single study. The concurrent embedded design approach collects both qualitative and quantitative data at the same time by including one type with in the another. In this study the (QUAN + qual) design was used, where the quantitative data is given the priority to guide the study, and the qualitative data provides a supporting role and allows for the "voice" of the participants to be heard (Creswell & Clark, 2003).

The quantitative data consists of two main sections, the descriptive statistics and inferential statistics. Participants who met the inclusion criteria and were willing to voluntarily participate in the study accessed the survey through a link provided in the letter of solicitation. The link contained two questionnaires (OSA-KAB) (Appendix A) and STOP-Bang, (Appendix B) participant characteristics. Knowledge and health beliefs about OSA were collected from the OSA-KAB while STOP-bang categorized the participants according to their risk level as low, intermediate or high risk of developing OSA. On one hand, descriptive statistics includes participants' demographic characteristics, OSA risk level, knowledge scores and health beliefs scores from (**RQ1 and RQ2)**. On the other hand, inferential statistics were used to assess the relationship if exists between overall knowledge and health belief scores **(RQ3)** and differences in the participants' knowledge and belief scores based on their risk level for OSA **(RQ4).**

The qualitative section was obtained from participants' responses to each of the five open-ended question. The answers were used to confirm the presence of predetermined themes and identify new themes that emerged. The open-ended questions were designed to support, explain and provide additional depth to the quantitative section. The questions seek out the

participants' point of view regarding the benefit of early treatment, disadvantages delaying treatment, and the facilitators and barriers to seeking medical attention for OSA. The predetermined themes were taken from the literature.

Variables

- Total knowledge score, which is the average of the seven knowledge subscales.
- Total Health Belief score, which is the sum of the following formula Perceived Sus + Perceived Sev + Perceived Ben+ Cues to -Perceived Barr
- The risk of OSA according to the STOP-Bang, which categorizes the participant as at high, intermediate or low risk of developing OSA

Table 1

Summary of Attributes of Variables Used in Analysis

Variable Name	Description	Measurement Level	Method of Calculation	Possible Score Range
Total knowledge score	The measurement of the participant's knowledge of OSA	Interval	The average of the seven knowledge subscales	0-100
Total Health Belief score	Measurement of the health belief based on the health belief model	Interval	OSA-KAB	16-80
The risk of OSA	The risk of developing OSA	Ordinal	STOP-Bang	0-8

Instrumentation Validity and reliability

This study used two instruments the STOP-Bang and the OSA-KAB.

STOP-Bang questionnaire is a screening tool designed to categorize individuals according to their risk level of getting OSA. It is the property of the University of Toronto and was developed in 2008 based on the Berlin questionnaire. The questionnaire consists of 8 yes or no questions where each question represents a risk factor or signs and symptoms of OSA. The scoring was based on the latest recommended by the University Health Network University of Toronto who owns the tools. A person will be at low risk if he/she answered yes to up to two questions and at intermediate risk if they answered yes to three to four questions and at high risk if they answered yes to more than four questions or yes to two or more of four STOP questions in addition to being male gender or has BMI > 35kg/m2 or their neck circumference 17 inches / 43cm in male or 16 inches / 41cm in female (Chung, Yang, Brown, & Liao, 2014). In a meta-analysis comparing most widely used OSA screening tools in the US, reported superiority of STOP-Bang to other screening tools with pooled sensitivity and specificity levels range from 88%-93% and 35%-42% (Chiu et al., 2016). In addition, STOP-Bang has been used in over 108 studies with a total of 47 989 participants and has been translated to 13 different languages. The tool is free to use for academic purposes with authorization that was obtained from the owner (The University of Toronto) for the use in this study Appendix C.

OSA-KAB

The OSA-KAB was developed by the PI based on the six constructs of the Health Belief Model to assess public knowledge and health belief of OSA among undiagnosed individuals

(Hochbaum, 1958). The OSA-KAB tool is a 50 items questionnaire that was developed through a multiple stage process colloquially termed as “modified Delphi process”. The Delphi process is a technique that utilizes experts review to establish a consensus on the study instrument and its ability to measure what it intended to measure (Linstone, 1975). Therefore, the Delphi process provides a mean to assess basic validity measures (face and content validity). The Delphi panel consisted of four experts in sleep, higher education and tool development. The Delphi process took two rounds for its 50 items to achieve 80% agreement. Furthermore, participant’s responses were used to test the validity and the reliability of the tool. Construct validity is defined as "the degree to which a test measures what it claims, or purports, to be measuring" (Brown, 1996, p. 231). Confirmatory factorial analysis was conducted on the 23 items relating to Health belief of OSA using principal component analysis with Varimax (orthogonal) rotation. The analysis yielded 6 factors explaining a total of 60.73% of the variance for the entire set of variables. Only 16 items belonging to five constructs passed face and constructs validity. Three constructs maintained the same items (Perceived Susceptibility, Perceived Severity, Perceived cues to action). Furthermore, one construct lost one item (Perceived Barrier). Moreover, the construct Perceived Benefit one constructs lost two items. Finally, Perceived Self-efficacy lost all four initial items that passed face validity. Therefore, the construct Perceived self-efficacy was removed from the study.

Reliability measurement

Reliability is the degree to which an assessment tool produces stable and consistent results. Cronbach’s alpha was used to assess the internal consistency of the OSA-KAB. The Cronbach’s alpha coefficient for the five constructs ranged from 0.69 to 0.82 as follows,

Perceived Severity 0.69, Perceived Susceptibility 0.70, Perceived Benefit 0.82, Perceived Barriers 0.74, Perceived Cues to Action .72

Sample

Participation in this study was completely voluntary and anonymous. Any adult that received the Letter of Solicitation and Implied Consent were eligible to participated in the study as long as they had never been diagnosed with OSA and were able to read and write in the English language.

Procedure

After receiving IRB approval the PI sent an invitation e-mail to the Department Chair of Interprofessional Health Sciences and Health Administration at Seton Hall University. The e-mail contained a description of the study and a request for the chair to forward the Letter of Solicitation and Implied consent (Appendix D) via the department administrative assistant to all the students, alumni and anyone else meeting the inclusion criteria. Embedded in the letter of solicitation is a link to OSA-KAP and the STOP-Bang questionnaires, which were housed on Survey Monkey (SurveyMonkey®). Survey Monkey® was used to facilitate survey accessibility, improve security and protect the participants' identity. Potential participants were permitted to access the survey anytime and anywhere if they can access internet. Additionally, Survey Monkey® allowed the researcher to download soft copies of the survey data collected compatible with (such as a Microsoft® Excel® spreadsheet) for further formats.

Participants that met the inclusion criteria listed on the Letter of Solicitation and were willing to volunteer accessed the survey via the link. Additionally, the Letter of Solicitation

incorporated language that encourages recipients to forward the link (embedded within the letter) to any friends, colleagues, or associates that they think may fit the described criteria for inclusion requested. In addition, all potential participants were requested to forward the email containing the letter of solicitation to others that they believe they meet the inclusion criteria. Since the recipients may have forwarded the link to any number of secondary recipients and those secondary recipients were then able to forward it to any number of tertiary recipients, this is termed exponential snowball sampling. The Department of Interprofessional Health Sciences and Health Administration at Seton Hall University was the starting point of a snowball sampling technique used in this study. Snowball sampling is a form of nonprobability sampling that offers researchers the ability to utilize a target demographic to find other members within the same target parameters through referral by the initial recipients (Goodman, 1961). Figure three is an illustration of the study procedure.

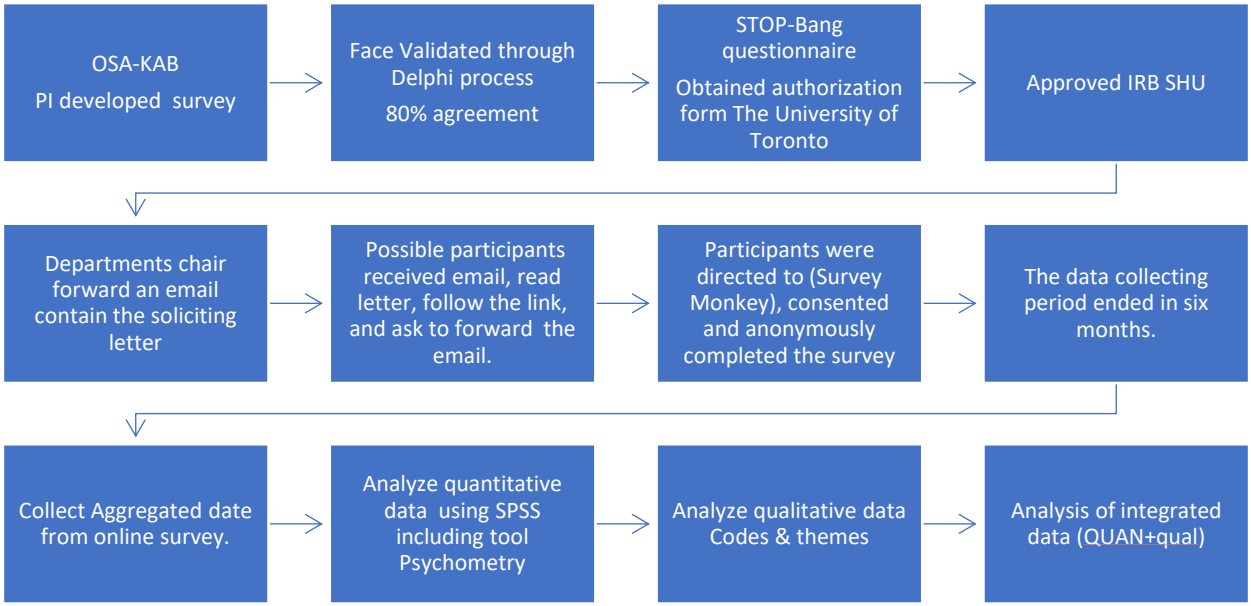

Figure 3. Study Procedure

Data Analysis

Quantitative Data

The data collection period continued from April 2018- October 2018. On October 2018, the PI ended data collection and downloaded the data of 220 participants from Survey Monkey® as an Excel file and stored it on a portable USB flash memory drive. That data containing flash drive was kept securely locked in a cabinet with access only by the primary investigator, to assure data integrity. The data was then reviewed for completeness and 29 participants were excluded from final analysis. The final analysis included only participants who completed the completed more than 70% of the survey.

Descriptive statistics was used to report and summarize participants' demographics and responses. Frequencies of responses were used to report each of the health belief items, while mean scores were reported for each of the seven knowledge subscales. The total knowledge score was the average of all the seven subscales while the Total Health Belief score was the sum of adding Perceived Susceptibility + Perceived Severity + Perceived Benefits + Cues to Action - Perceived Barriers of (RQ1 and RQ2)

- Inferential statistics:
    - **Pearson correlation** was used to determine if there is a relationship between overall knowledge and health belief scores (RQ3).
    - **MANOVA** was used to assess if there were a significant difference in the participants' Knowledge and belief scores based on their risk level for OSA (RQ4)

Qualitative Data

Content analysis and thematic analysis are suitable for this type of researchers where relatively low level of interpretation is applied, because of the content. Thematic analysis as an independent qualitative descriptive approach is mainly described as "a method for identifying, analyzing reporting patterns (themes) within data" (Braun & Clarke, 2006). Figure four illustrate the qualitative data analysis used in this study.

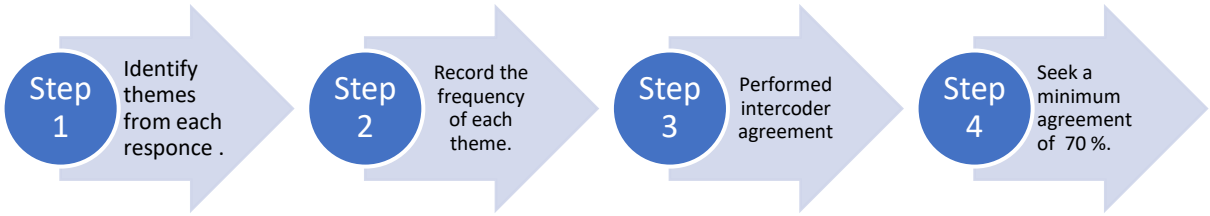

Figure 4. Qualitative data analysis

Purpose

This study had two purposes:

(1) To determine the overall knowledge about obstructive sleep apnea, and health beliefs about obstructive sleep apnea among adults.

(2) To assess the relationship between overall knowledge and health belief subscales about obstructive sleep apnea among these participants.

Research questions

1. What do adults who are not diagnosed with OSA know about it?

2. What health beliefs about OSA do adults who are not diagnosed with OSA have
3. Is there a relationship between overall knowledge and health belief score specific to OSA in adults who are not diagnosed with OSA?
4. Is there a difference in overall knowledge and health belief score based upon adults' risk for OSA as measured by STOP-BANG: high, intermediate and low?

Chapter IV

Results

The purpose of this study was to explore overall knowledge, and health beliefs of adults regarding obstructive sleep apnea (OSA), and to assess the relationship if exists between them using a PI created tool OSA-KAB. Additionally, this study sought to assess if OSA risk levels based on STOP-Bang effect knowledge and health belief.

The analysis consists of two major components. First, a quantitative data analysis which included descriptive and inferential statistics. The descriptive Statistics were used to report participants' knowledge and health belief of OSA including rank, count, percent, frequency, means and stander deviation to answer RQ1 & RQ2. While inferential statistics were used to assess the relationship if exist between knowledge and health belief RQ3 and whether the risk level of OSA determined by STOP-Bang effect knoewdeg and health belief of OSA. For all statistical analyses an alpha of 0.05, with a power of .80 was performed using SPSS software version 25.

The second component reviewed the qualitative data using content analysis as outlined in Creswell & Clark (2011). In this study, the qualitative data is not being used to cross validate data but rather capture a different dimension of the same phenomenon. Using content analysis approach from the open-ended questions, the PI was able to categorize open-ended questions based upon frequently used words and phrases and develop themes.

Quantitative Findings: Descriptive Statistics

Sample Characteristics

Participants minimum age was 20 and the maximum age was 80 with an average age of 42.22 years (SD = 15.10 Table 2). The majority of 191 participants (64 %) were female, and over half (52%) of the sample were married, and one-third (32%) were single (Table 3). In addition, most of the sample were educated with 33% possessing a Master degree and 29.3% a Bachelor's degree (Table 4). Approximately, two-thirds of the sample (60.2%) identified themselves as white followed by Native Hawaiian or other Pacific Islander (15.7%) (Table 5).

Table 2

Age of Study Sample

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Please indicate your age in years.	180	60	20	80	42.11	15.090
Valid N (listwise)	180					

Table 3

Marital Status of Study Sample

		N	%
Marital Status	Single	62	32.5
	Married	100	52.4
	Separated	2	1.0
	Divorced	17	8.9
	Widowed	5	2.6

Table 4

Educational Level of Study Sample

		N	%
Educational Level	Master's degree	63	33.0
	Bachelor's degree	56	29.3
	High school diploma	38	19.9
	Professional (MD, DDS, PhD,etc.	7	8.9
	Grade School	6	3.1
	Some high school	2	1.0

Table 5

Ethnicity the Study Sample

		N	%
Ethnicity	White	115	60.2
	Native Hawaiian or other Pacific Islander	30	15.7
	Black or African American	12	6.3
	Hispanic, Latino, or Spanish origin	10	5.2
	Middle Eastern or North African	10	5.2
	Some other race, ethnicity, or origin	1	.5

Previous knowledge of OSA

The first question of the survey asks participants if they received information or education about obstructive sleep apnea disorder. Only 57 individuals or around one-third of the participants indicated they received information about OSA. The main source of information was noted as online followed by college and handouts (Table 6).

Table 6

Participant sources of information about OSA

	N	%
Total	57	29
Online	20	10
College	17	9
Consultation	7	4
Face to Face	12	6
Handouts	14	7
Other	9	5

Risk level of OSA

Participants were divided into three groups based on their OSA risk as measured by the STOP-Bang questionnaire. Table 7, shows that 62% of the participants who completed the survey were at a low risk of developing OSA.

Table 7

Participant OSA risk level

	N	%
Total	186	
Low 0-2	116	62
Intermediate 3-4	34	18
High >4	36	19

A total of 186 participants completed the STOP-Bang questionnaire. Interestingly, 31% of the participants felt tired, fatigued, or sleepy during the daytime, and 23% admitted they snore loud enough to be heard through closed doors or wakeup bed partner. Table 8 illustrates percipients' responses to each of the STOP-Bang item.

Table 8

Participant response to STOP-Bang

	N	%
Total	186	
Snoring	44	23
Tired	59	31
Observed	28	15
HTN	38	20
BMI	45	24
Age >50	58	32
Neck size	48	25
Male Gender	63	33

Knowledge of OSA

In this study, the first research question aimed to explore public knowledge of OSA across six different subscales: risk factors, signs and symptoms, complications, diagnostic approaches, health professions that can diagnose OSA, health professions that treat OSA, and treatment options for OSA. Participants were free to choose from a list of answers and had an option to type their response in text field. The lowest knowledge score (28.4) was reported in recognizing health profession that can diagnose OSA, whereas: the highest score (44.75) was reported in recognizing diagnostic approaches for OSA as shown in table 9.

Table 9

Knowledge across different subscales

	N	Mean	Std. Deviation	Variance
Risk factors	191	30.52	26.21	687.10
Signs and symptoms	191	41.37	30.31	918.95
Complications	191	36.79	33.95	1152.64
Diagnostic	191	44.75	34.79	1210.32
Profession can diagnose	191	28.40	27.05	731.59
Professions can treat	191	37.93	30.23	913.92
Treatment options	191	44.11	35.38	1251.57
Valid N (listwise)	191			

When the participants were asked about OSA risk factors signs, 66% of them selected obesity as the most risk factor and 52%. selected structural deformities as shown in table 10.

Table 10

OSA risk factors identified by the participants

	N	%
Total	191	
Obesity	126	66
Race	24	13
Pneumonia*	29	15
Gender	42	22
Genetics	63	33
Alcohol use	73	38
Pregnancy	30	16
Drug use	63	33
Postmenopausal	15	8
Structural Deformities	100	52
Reduction in muscle tune	52	27
I don’t know	60	31
Other	2	1

Note *incorrect answer

When the participants were asked about OSA signs and symptoms, 62% of them selected loud and chronic (ongoing) snoring and choking or gasping during sleep and 54% selected daytime sleepiness as shown in table 11.

Table 11

OSA signs and symptoms identified by the participants

	N	%
Total	191	
Loud and chronic (ongoing) snoring	119	62
Daytime Sleepiness	104	54
Morning headaches	66	35
Fever*	4	2
Memory loss	43	23
Waking up frequently from sleep for Urination	28	15
Choking or gasping during sleep	118	62
Skin Rashes*	3	2
Dry mouth when waking up	84	44
I don’t know	51	28
Other	2	1

Note *incorrect answer

When the participants were asked about OSA complications, cardiovascular complications were the most selected choices. 45% of the participants selected heart attack and 42% selected abnormal heart rate as shown in table 12.

Table 12

OSA complication identified by the participants

	N	%
Participants	191	
High blood pressure	78	41
Motor and work accidents	77	40
Diabetes	30	16
Heart attack	86	45
Stroke	66	35
Abnormal heart rate	81	42
I do not know	74	39
Other	6	3

When the participants were asked about OSA diagnostic approaches, the golden stander to diagnosed OSA was the most selected choices. 62% of the participants selected full night in lab sleep study and 45%. selected physical examination as shown in table 13.

Table 13

OSA diagnostic approaches identified by the participants

	N	%
Participants	191	
Blood sample*	15	8
Chest X-ray*	24	13
Full night in lab sleep study	119	62
Full night at home sleep study	69	36
Physical examination	86	45
Family medical histories	66	35
I do not know	59	31
Other	2	1

Note *incorrect answer

When the participants were asked about medical professionals that can diagnose OSA, 66% of them selected sleep specialists and 40% selected family medicine physicians as shown in table 14.

Table 14

Medical professionals that can diagnose OSA

	N	%
Participants	191	
Family medicine physicians	76	40
Internists	42	22
Sleep specialists	126	66
Pediatricians	30	16
Nurse practitioners	35	18
Physician assistants	31	16
Dentists	14	7
Surgeons*	15	8
I do not know	62	32
Other	4	2

Note *incorrect answer

When the participants were asked about medical professionals that can treat OSA, 65% of them selected sleep specialists and 40% selected family medicine physicians as shown in table 15.

Table 15

Medical professionals that can treat OSA

	N	%
Participants	191	
Family medicine physicians	84	44
Internists	51	27
Sleep specialists	125	65
Pediatricians*	32	17
Nurse practitioners	40	21
Physician assistants	39	20
Dentists	14	7
Surgeons	29	15
I do not know	55	29
Other	3	2

Note *incorrect answer

When the participants were asked about OSA treatment options, 58% of them selected behavior changes as shown in table 16.

Table 16

OSA treatment options identified by the participants

	N	%
Participants	191	
Oral appliances	95	50
Behavior changes	71	37
Surgery	68	36
Positive airway pressure	82	43
Weight loss	110	58
Anti-allergic medication*	35	18
Oxygen nebulizer*	57	30
I do not know	60	31
Other	7	4

Note *incorrect answer

Health Belief

Research question two aimed to explore participants health belief across five different constructs; (Perceived severity, perceived susceptibility, perceived barrier, perceived benefit, and cue to action). Figure five shows the percipients responses for each construct.

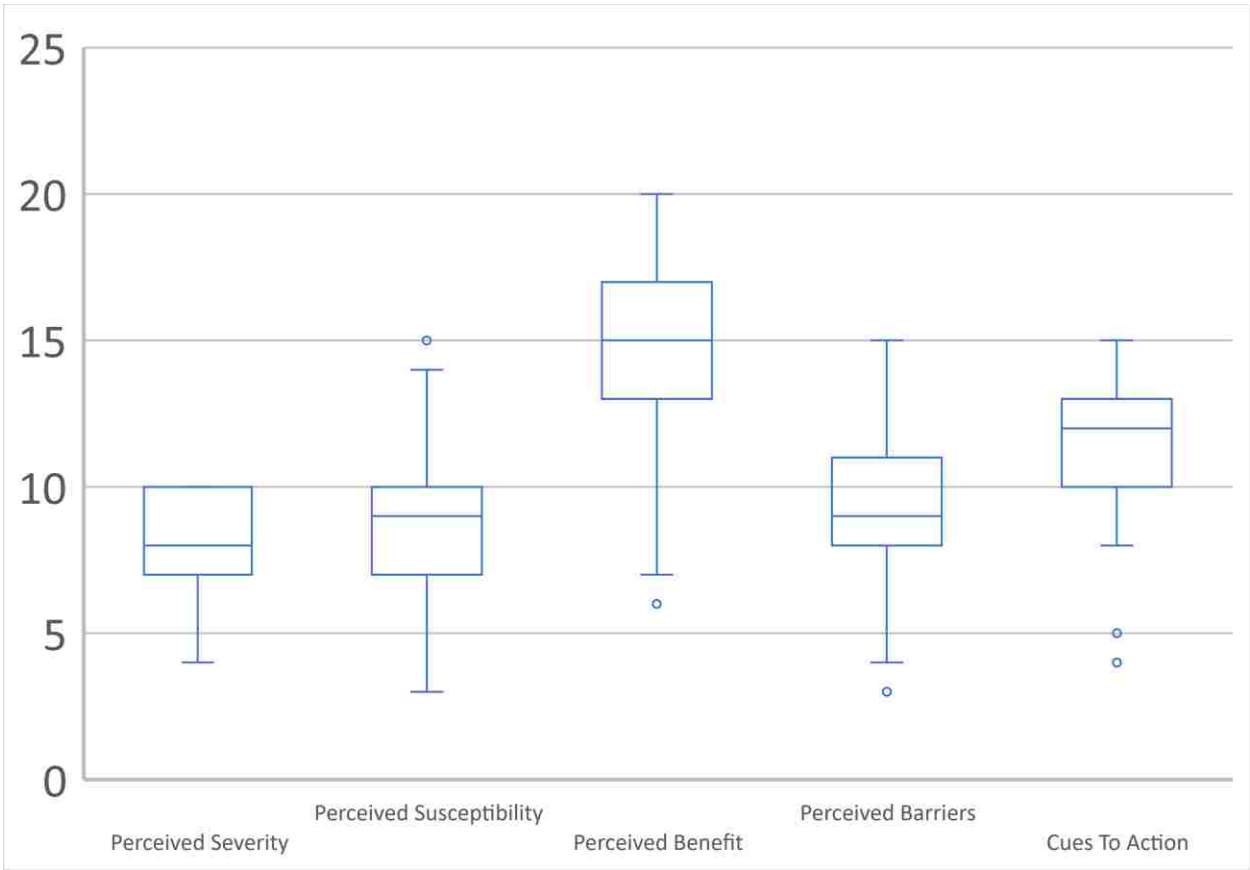

Figure 5. Box plot the participants' scores across the five constructs

The perceived severity construct was designed to measure the participants' belief about the severity of OSA. It consists of three items with a possible score range between 3-15. Table 17 shows participants' responses to perceived severity items.

Table 17

Participants responses to perceived severity constructs.

Perceived Severity construct	**Responses**
1. OSA is a serious disorder.	Strongly agree 81 (42.4%) Agree 75 (39.3) Neutral 33 (17.3) Disagree 0 Strongly disagree 0
2. Untreated OSA can lead to death	Strongly agree 58 (30.4%) Agree 65 (34.0%) Neutral 54 (28.3) Disagree 8 (4.2) Strongly disagree 1(0.5%)
3. Having a minimum of six hours of uninterrupted sleep is more important than treating OSA	Strongly agree 11 (5.8) Agree 23 (12) Neutral 70 (36.6) Disagree 59 (30.9) Strongly disagree 26 (13.6)

The perceived susceptibility construct was designed to measure the participants' belief about their risk of developing OSA. The construct consists of three items with a possible score range between 3-15. Table 18 shows participants' responses to perceived severity items.

Table 18

Participants responses to perceived susceptibility construct.

Perceived Susceptibility construct	**Responses**
4. I am at risk for developing OSA	Strongly agree 19 (5.2%) Agree 49 (25.7%) Neutral 74 (38.7%) Disagree 49 (25.7%) Strongly disagree 20 (10.5)
5. It is likely that I have OSA.	Strongly agree 2 (1%) Agree 19 (9.9%) Neutral 56(29.3%) Disagree 72 (37.7) Strongly disagree 40 (20.9%)
6. It is possible that I will develop OSA if I gain more weight	Strongly agree 23 (12%) Agree 81 (42.4%) Neutral 63 (33%) Disagree 15 (7.9%) Strongly disagree 7 (3.7%)

The perceived benefits construct was designed to measure the participants' belief about the benefit of treating OSA. The construct consists of four items with a possible score range between 4-20. Table 19 shows participants' responses to perceived benefits items.

Table 19

Participants responses to perceived benefits construct

Perceived Benefits. construct	Responses
7. Treating OSA can lower high blood pressure.	Strongly agree 21 (11%) Agree 73 (38.2) Neutral 86 (45%) Disagree 6 (3.1) Strongly disagree 3 (1.6%)
8. Treating OSA will reduce the overall cost of my personal health care	Strongly agree 33 (17.3%) Agree 82 (42.9%) Neutral 60 (31.4%) Disagree 7 (3.7%) Strongly disagree 7 (3.7%)
9. Treating OSA will reduce my risk of getting into a traffic accident.	Strongly agree 38 (19.9%) Agree 72 (37.7%) Neutral 60 (31.4%) Disagree 12 (6.3%) Strongly disagree 6 (3.1%)
10. Treating OSA will improve my overall health	Strongly agree 61 (31.9%) Agree 84 (44%) Neutral 38 (19.9%) Disagree 1 (0.5%) Strongly disagree 3 (1.6%)

The perceived barriers construct was designed to measure the participants' belief about the barriers that keep them from seeking medical attention for OSA. The construct consists of three items with a possible score range between 1-15. Table 20 shows participants' responses to perceived barriers items.

Table 20

Participants responses to perceived barriers construct

Perceived Barriers construct	**Responses**
11. I am worried that I cannot afford the diagnostic tests for OSA	Strongly agree 27 (14%) Agree 42 (22%) Neutral 80 (41.9%) Disagree 25 (13.1%) Strongly disagree 14 (7.3%)
12. I am worried that I cannot afford the treatment for OSA	Strongly agree 24 (12.6%) Agree 52 (27.2%) Neutral 70 (36.6%) Disagree 27 (14.1%) Strongly disagree 14 (7.3%)
13. I am unsure which health professional I should talk to if I experience signs and symptoms of OSA	Strongly agree 5 (2.6%) Agree 45 (23.6%) Neutral 47 (24.6%) Disagree 65 (34%) Strongly disagree 25 (13.1%)

The cues to action construct was designed to measure the participants' belief about facilitators to seek medical attention for OSA. The construct consists of three items with a possible score range between 1-15. Table 21 shows participants' responses to cues to action items.

Table 21

Participants responses to cue of action construct

Perceived Cues to Action construct	**Replies**
14. I believe that a positive experience with a friend or family member can motivate me to seek medical attention for OSA	Strongly agree 43 (22.5%) Agree 85 (44.5%) Neutral 46 (24.1%) Disagree 11 (5.8) Strongly disagree 0 (0%)
15. I believe that if my job required me to check for obstructive sleep apnea, I would be motivated to seek medical attention for it.	Strongly agree 47 (24.6%) Agree 85 (44%) Neutral 43(22.5%) Disagree 8 (4.2%) Strongly disagree 4 (2.1%)
16. I believe complaints from my partner about my snoring would motivate me to seek medical attention for OSA	Strongly agree 44 (23%) Agree 84 (44%) Neutral 47 (24.6%) Disagree 8 (4.2%) Strongly disagree 4 (2.1%)

Barriers to diagnosis

The most commonly cited barriers to OSA diagnosis were the lack of knowledge, the cost of treatment, the cost of test, embarrassment from wearing a mask, and the location of the testing facility. One of the survey item asked the participants to rank these five barriers from highest to lowest. The result showed 69 of the 163 (42%) participants who answered this question ranked lack of knowledge as the first barrier of the people figure six.

Rank the following barriers that may impact the diagnosis of OSA from 1 to 5

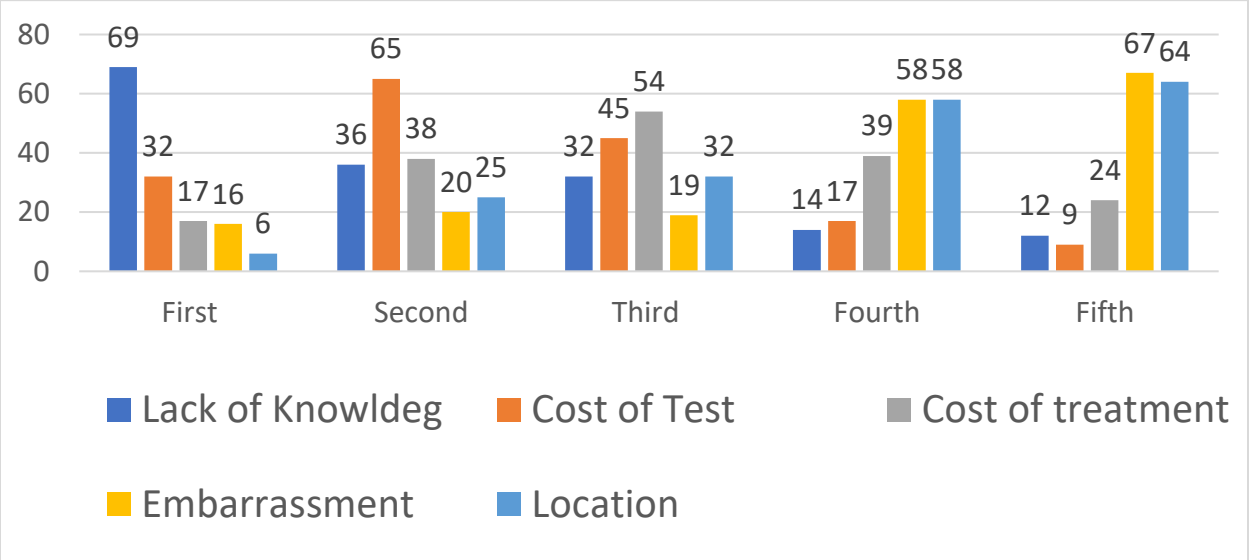

Figure 6. Bar graph demonstrating responses to ranking barriers

Research question 3 aimed to assess the relationship if exist between knowledge and health belief of OSA. The total knoewdeg score and the health belief score were treated as interval level variables. The data were assessed for the assumptions of independence, normality, and homogeneity of variances. the relationship was assessed using person correlation. Pearson correlation revealed a statistically significant relationship between overall knowledge and health belief score, $r = 0.48$, $n = 183$, $p < 0.001$. Table22.

Table 22

Correlations Between total knowledge and health belief

		Total Knowledge	Health Belief
Total Knowledge	Pearson Correlation	1	.479**
	Sig. (2-tailed)		.000
	N	191	183
Health Belief	Pearson Correlation	.479**	1
	Sig. (2-tailed)	.000	
	N	183	183

**. Correlation is significant at the 0.01 level (2-tailed).

Post hoc analysis of the test, revealed that the study had adequate sampling and reliability power (.99) figure seven.

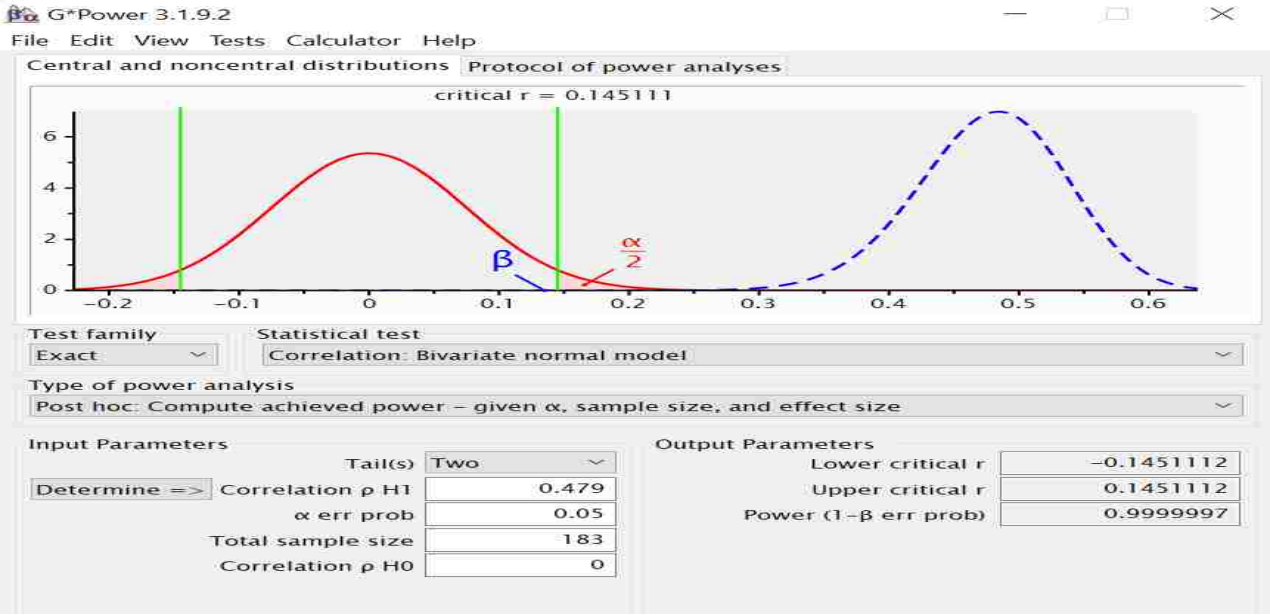

Figure 7. Post hoc power analysis using G*power

The fourth research question aimed to explore if the risk of OSA measured by STOP-Bang questionnaire effects the knowledge and health belief of OSA. The STOP-Bang divided the participants into three different groups based on their risk level of OSA. The total knoewdeg score and the health belief score were treated as interval level variables. The data were assessed for homogeneity of variances and covariances, normality and the absence of multicollinearity. A one-way MANOVA was calculated examining the effect of risk level of OSA (low, intermediate, high) on Knowledge and Health Belief scores. No significant effect was found, F (4, 354) = 13.74, $p > .05$; Wilk's $\Lambda = 0.96$, partial $\eta^2 = .02$. Neither Knowledge no Health belief scores were influenced by risk level of OSA determined by STOP-BANG questionnaire figure 8.

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.964	2386.883[b]	2.000	177.000	.000	.964	4773.767	1.000
	Wilks' Lambda	.036	2386.883[b]	2.000	177.000	.000	.964	4773.767	1.000
	Hotelling's Trace	26.970	2386.883[b]	2.000	177.000	.000	.964	4773.767	1.000
	Roy's Largest Root	26.970	2386.883[b]	2.000	177.000	.000	.964	4773.767	1.000
RiskLevel	Pillai's Trace	.041	1.885	4.000	356.000	.112	.021	7.540	.569
	Wilks' Lambda	.959	1.895[b]	4.000	354.000	.111	.021	7.578	.572
	Hotelling's Trace	.043	1.904	4.000	352.000	.109	.021	7.616	.574
	Roy's Largest Root	.043	3.844[c]	2.000	178.000	.023	.041	7.687	.691

a. Design: Intercept + RiskLevel

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

Figure 8. One-way MANOVA

Post hoc Analysis of the test using G*Power revealed that the study did not have adequate sampling and reliability power (.57). we need a minimum of 118 participants in each of the three groups is needed to achieve a power of (0.8). figure 9

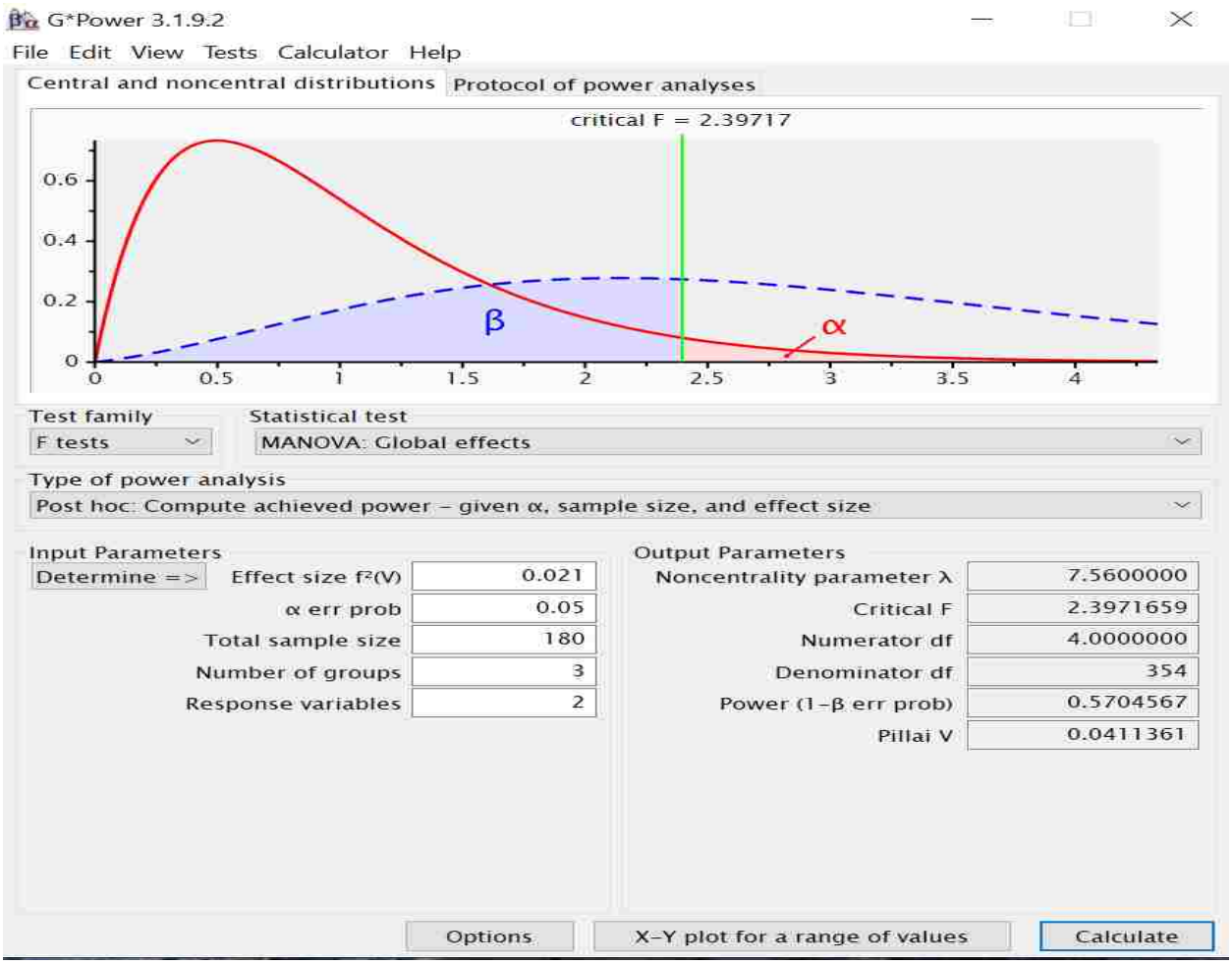

Figure 9. Post hoc power analysis using G*power

Qualitative data analysis

The five-open ended-question were designed to explore the participants' prospective in regard to the benefits of treating OSA, the negative impact of delaying the treatment, and the facilitators and barriers to seek medical attention for OSA. The responses were used to identify predetermined themes and new themes that emerged. Intercoder agreement was performed via peer review to discuss findings (Cresswell & Clark, 2011) with 70% reviewers' agreement being reached.

The first open-ended question asked the participants about of benefit of treating OSA earlier. Among the 171 participants who answered this question General health improvement was the most frequent answer, followed by noticeable improvement in sleep. Table 23 provides samples of the participants' responses to first question "What are the positive effects of early treatment for OSA"?

Table 23

Participants response to the first question

Themes	Sample participants response	Frequency
Predefined Theme 1 Prevent Health Consequences of OSA	P7: “Not having chronic complications”. P24: “Elimination of life threatening risks”	42
Predefined Theme 2 Lack of knowledge about OSA	P3: “I don’t know” P44. “I don’t have an idea”.	37
Predefined Theme 3 Prevent Cardiovascular Health Consequences	P17: “No blood pressure” P42: “reduce the effects on the heart and other systems”.	11
Predefined Them 4 Improve Interpersonal relationship	P183:”more positive relationship w/sleep partner”	1
Emergent Theme 1 General health improvement	P31: “Feeling well and have energy ”. P81: “You'd become healthier if you catch it early”.	69
Emergent Theme 2 Noticeable Improvement in sleep	P26: “Uninterrupted night sleep”. P140” better sleep”	44

The second open-ended question asked the participants about negative effects of delaying the treatment for OSA. Among the 169 participants who answered this question Health consequences of OSA was the most frequent answer, followed by the lack of knowledge of OSA.

Table 24 provides samples of the participants' responses to second question "What are the negative effects of delaying the treatment for OSA"?

Table 24

Participants response to the second question

Themes	Sample participants response	Frequency
Predefined Theme 1 Health Consequences of OSA	P7: "Chronic condition" P26: "May create severe sleep disorders and general health problems".	63
Predefined Theme 2 Lack of knowledge about OSA	P10: "Probably Other complications that I'm not aware of"	47
Predefined Theme 3 Physical effects of OSA	P5: "Weight gain. Inability to work or function during the day. Inability to focus and concentrate on school work and studying".	44
Predefined Theme 4 Mental and emotional effects of OSA	P7: "fatigue; brain fog; irritability; unable to do job". P18: "Adverse effect on the heart brain and person feeling"	11
Predefined Theme 5 Cost of treatment and diagnosis	P18:" Higher cost of treatment, unhealthy lifestyle"	5
Predefined Theme 6 Interpersonal effect OSA	P170: "Possible loss of life partner" P189: "additional strain on partner exposed to symptoms/concerned for me".	2

The third open-ended question asked the participants about factors that would motivate them to seek medical attention for OSA. Among the 171 participants who answered this question, health consequences of OSA was the most frequent answer, followed by the physical effect of OSA. Table 25 provides samples of the participants' responses to third question "What would motivate you to seek medical attention for OSA"?

Table 25

Participants response to the third three

Themes	Sample participants response	Frequency
Predefined Theme 1 Health Consequences of OSA	P5: "Decreased sleep quality". P51: "lack of sleep "	41
Predefined Theme 2 Lack of knowledge about OSA	P84: "Nothing that I know of". P126: "I don't know".	26
Predefined Theme 3 Interpersonal reasons	P145: "my partner telling me that he thinks I might have it".	26
Predefined Theme 4 Primary care physician education	**P3:** "based on my doctor opinion when I told him". P46:" A diagnosis or my doctor to push me"	8
Predefined Theme 5 Diagnosis and treatment costs	**P72**:" A 75% off your sleep test coupon".	6
Emergent Theme 1 Awareness of the condition	**P19**:" Being aware of my healthy sleep " **P50**:" When I notice a problem physically"	41

The fourth open-ended question asked the participants about factors that would motivate them to seek medical attention for OSA if they suspect they have OSA. Among the 171 participants who answered this question, health consequences of OSA was the most frequent answer, followed by awareness of the condition. Table 26 provides samples of the participants' responses to fourth question "What would motivate you to seek medical attention if you suspect you have signs of OSA?"

Table 26

Participants response to the fourth question

Themes	Sample participants response	Frequency
Predefined Theme 1 Health Consequences of OSA	P5: "Decreased sleep quality". P51: "lack of sleep ".	41
Predefined Theme 2 Lack of knowledge about OSA	P6: "I don't know". P32: "No comment ".	31
Predefined Theme 3 Interpersonal reasons	P111: "My girlfriend would be pissed because my snoring would keep her up. I'd probably go to alleviate her burden".	14
Predefined Theme 4 Primary care physician education	P9: "Recommended doctor ". P67: "Communication with my doctors".	7
Predefined Theme 5 Diagnosis and treatment costs	P18:" High insurance". P41:" no costs (low costs), not very far away".	5
Emergent Theme 1 Awareness of the condition	P38:" The fact that I suspect something wrong that corresponds having OSA"	41

Emergent Theme 2 Improve health	P18:" Higher cost of treatment, unhealthy lifestyle".	6

The fifth open-ended question asked the participants about the barriers that will prevent them from seeking medical attention for OSA if they suspect they have OSA. Among the 171 participants who answered this question, the cost of the diagnosis was the most frequent barriers. Table 27 provides samples of the participants' responses to fifth question "What would prevent you from seeking medical attention if you suspect you have signs of OSA?"

Table 27

Participants response to the fifth question

Themes	Sample participants response	Frequency
Predefined Theme 1 Diagnosis and treatment costs	P5: “Insurance coverage and diagnostic cost”. P11: “Cost of medication, cost of diagnosis, and the insurance”.	64
Predefined Theme 2 Lack of knowledge about OSA	P6: “I don't know”. P74: “IDK”.	18
Predefined Theme 3 Discomfort of wearing a mask	P:46:” Not being able to wear the mask at night”. P121: “Wearing a CPAP machine at night.”.	13
Predefined Theme 5 Knowledge of OSA	P50: “A lack of enough clear information”. P67: “Sufficient knowledge about OSA”.	5
Emergent Theme 1 No barrios	P18:” No specific reason to delay diagnosis”. P64:” Nothing that I am aware of. When I need medical attention to seek it out”.	35
Emergent Theme 2 Time availability for the test	P1:” Lack of available time and increased time waiting for physician availability”.	14
Emergent Theme 3 Healthcare accessibility	P56:” Delaying of appointment/ unavailability of sleep lab near to home place”.	8

Chapter V

Discussion and Conclusion

OSA is a serious, life-threatening sleep disorder, and the fact that there are around 23.5 million people who remain undiagnosed is shocking (Paul E. Peppard et al., 2013). According to AASM, lack of education, underestimation of the seriousness of the condition, and allocation of the necessary resources to other acute illnesses may have led to increase the number of undiagnosed individuals (Frost & Sullivan, 2016). Awareness of the condition necessitates a basic knowledge of OSA.

The purpose of this study was to explore overall knowledge, and health beliefs of adults regarding obstructive sleep apnea (OSA), and to assess the relationship if exists between them using a PI created tool OSA-KAB. Additionally, this study sought to assess if OSA risk levels based on STOP-Bang effect knowledge and health belief.

Quantitative Findings

Risk Level of OSA

According to the STOP-Bang questionnaire, 19% of the participants are at high risk of developing OSA. Given the tool's high sensitivity (> 80% across the three OSA levels), the result is within the reported prevalence average of 9% and 38%.(Senaratna et al., 2016).

Knowledge about OSA

The quantitative data analysis revealed a severe OSA knowledge deficiency or lack of knowledge. This lack of knowledge about OSA manifested in the low scores across the seven subscales. Participants struggled the most in recognizing OSA risk factors, complications, and health professionals who are able to diagnose OSA. Similar findings were reported in other parts of the world, such as Singapore, France, and Nigeria. In Singapore, only 22% of the participants were able to report at least one risk factor, and 30.9% knew at least one complication (Sia et al., 2016). In France, about two-thirds of the participants recognized most of the symptoms. However, there was a significant lack of knowledge of complications, especially cardiological and neurological complications. In Nigeria, 77% of the participants did not recognize snoring as a sign of OSA. Furthermore, there was a gender disparity in knowledge. In fact, in a sample consisting mainly of females (64%), only 30 (16%) recognized pregnancy, and 15 (8%) recognized being postmenopausal as risk factors for OSA. Young (1999) was the first to report the gender disparity in reporting signs of OSA.

Health Beliefs about OSA

It was clear from the results that the participants believe OSA was not severe enough for them to seek medical attention since none of the participants had ever been diagnosed with OSA. Further assessment of the results showed that participants believed neither that OSA was severe enough to require treatment nor that there were significant benefits for treating OSA. One way to improve the public health belief about OSA is to improve people's knowledge about the seriousness of OSA and the benefits of treating it. Nonetheless, we found a significant relationship between knowledge of and health beliefs about OSA. In fact, previous study

reported the benefit of using HBM educational program in rising awareness and modified health behavior. Zare et al. 2016 reported significant improvement in knowledge and preventive behaviors in individuals of prostate cancer after using HBM based educational program (, 2016).

Barriers to Diagnosis

Understanding the barriers that keep individuals with OSA from seeking medical attention is an extremely important topic. Therefore, we asked the participants two questions about the barriers. The first one was a ranking question based on the information located in the literature; the second one was an open-ended question. The result of the open-ended question will be addressed under the qualitive findings section. For the ranking question, participants reported that lack of knowledge was the most significant barrier, followed by cost of treatment and diagnosis. That result was similar to what Frost & Sullivan (2016) reported.

Qualitative Findings

Five open-ended questions were embedded within the survey to allow the researcher to hear participants' voice and to further understand the quantitative findings of the study. It is worth noting that the lack of knowledge theme was the only one that appeared across all five questions. The participants' responses to the benefits of early treating of OSA indicated a knowledge deficiency about the benefits of treating this disorder. Most of the responses can be categorized under general health improvement or preventing negative health consequences. In addition, few of the participants had enough knowledge to link treating OSA to avoiding some cardiovascular complications. Similar responses were reported in other qualitative studies that explored patients' and partners' experiences before and after CPAP (Luyster et al., 2016).

Moreover, the ambiguity of the responses might also explain the participants' scores on the perceived benefits construct.

The second question asked the participants about the negative effects of delaying OSA treatment. The majority of responses lacked specificity and were categorized as either negative health consequences of OSA or physical effects of OSA. The nonspecific responses can be explained by the knowledge deficiency of OSA complications. However, 26 participants linked delaying the treatment of OSA with death, which indicates high perceived severity.

The third question asked the participants what would motivate them to seek medical attention for OSA. The participants' responses indicated that they cared about their health and sleep as most of the responses were categorized under awareness of the condition and health consequences of OSA. Additionally, participants showed concerns about the effect of OSA on their interpersonal relationships. In fact, previous studies reported adverse associations between sleep apnea and relationship quality as reported by the patient and/or the bed partner (Cartwright, 2008; Virkkula et al., 2005).

The fourth question asked the participants what would motivate them to seek medical attention if they suspected they had signs of OSA. The number of participants that were confident they would seek medical attention if they were aware of the condition was higher than the number in question three. Surprisingly, the majority of those who claimed that awareness of the condition was enough for them to seek medical attention were under high risk of developing OSA according to the STOP-Bang questionnaire. It is possible that knowledge deficiency of OSA signs and symptoms is the reason for this discrepancy. In addition, these responses might explain the reasons that the perceived susceptibility score was low.

The last open-ended question addressed the barriers to seeking medical attention. The participants had a similar question when they were asked to rank the number of barriers that were retrieved from the literature. However, this type of question allowed the participants to share their perspective freely. In contrast to their answers to the ranking question, the participants' answers indicated that they believed that the cost of tests and treatment were the main barrier to seeking medical attention for OSA. In fact, previous study has reported the cost of the test is one of the main barriers (Frost & Sullivan, 2016). Apparently, the participants have not acknowledged the economic effect of untreated OSA on their live. Moreover, OSA patients that are treated with CPAP cost $2700-$5200 less per year, than OSA patients not receiving treatment (Hoffman et al., 2010).

Limitations

There were several limitations to this study that worth discussion. The first was related to the sampling methodology. Snow ball sampling gives the power of selection to the participants and make it impossible to control the geographic dispersion or the number of participants in any given group. This was clear in the non-equal groups of OSA risk level and in educational level of the participants. In addition, snow ball sampling tends to create homogeneous sample which can affect the external validity of the research. Second, the study tool offered limitations in measuring knowledge and health belief of OSA. Since it is a PI devolved tool and despite the psychometric measure it still need a further validity and reliability testing. Lastly, since a self-administered questionnaire was used to secure the data, we can only assume that the participants' responses were true, and accurate.

Future research

This study is a link in a chain of studies that aims to reduce the number of undiagnosed individuals. In fact, this study yielded many questions that create the basis for future scholarly inquiry. For example, the sampling technique used in this study resulted in geographical and demographic limitation. Therefore, expanding the geographical and demographical boundaries may improve the generalizability of the result. Furthermore, comparing OSA knowledge and health belief before and after the diagnosis of OSA may provide a better understanding of the level of knowledge and health belief the individual need to seek medical attention for OSA. Additionally, the OSA-KAB can be used to objectively to measure the effectiveness of OSA educational program.

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APPENDIX A

Obstructive Sleep Apnea Knowledge and Beliefs (OSA-KAB)

The purpose of this survey is to explore the individual's knowledge of and beliefs about obstructive sleep apnea.

Completing this survey does not place you at risk for any change in or withdrawal of care. In completing this survey, you are consenting to participate in this study.

Please note, as per the American Sleep Association, obstructive sleep apnea is referred to as OSA

Please check only ONE answer

1. **Have you ever been diagnosed with OSA?**
☐ **Yes** ☐ **No** ☐ **I do not remember**

2. **Have you received information or education about obstructive sleep apnea disorder? Check all that apply.**

☐ **Yes** ☐ **No**

☐ **Online**
☐ **College**
☐ **Consultation**
☐ **Face-to-face**
☐ **Handouts**
☐ **Other …….**

Please follow the instruction in each box.

A. Risk Factors

3. What are the risk factors for OSA? Check all that apply.	✓
Obesity	
Race	
Pneumonia	
Gender	
Genetics	
Alcohol Use	
Pregnancy	
Drug Use	
Postmenopause	
Structural deformities that obstruct the airways	
Reduction in muscle tone	
High cholesterol level	
I do not know	
Other	

B. Signs and Symptoms

4. What are the signs and symptoms of OSA? Check all that apply.	✓
Loud and chronic (ongoing) snoring	
Daytime sleepiness	
Morning headaches	
Fever	
Memory loss	
Waking up frequently for urination	
Choking or gasping during sleep	
Skin rashes	
Dry mouth when waking up	
I do not know	
Other	

C. Comorbidities

5. Untreated OSA can lead to, check all that apply.	✓
High blood pressure	
Motor and work accidents	
Diabetes	
Heart attack	
Stroke	
Abnormal heart rate	
I do not know	
Other	

D. Diagnosis

6. Which of the following is necessary for an OSA diagnosis? Check all that apply.	✓
Blood sample	
Chest X-ray	
Full night in lab sleep study	
Full night at home sleep study	
Physical examination	
Family medical histories	
I do not know	
Other	

7. Which medical professionals can diagnose OSA? Check all that apply.	✓
Family medicine physicians	
Internists	
Sleep specialists	
Pediatricians	
Nurse practitioners	
Physician assistants	
Dentists	
Surgeons	
I do not know	

Other	

E. Treatment

8. Which medical professionals can treat OSA? Check all that apply.	✓
Family medicine physicians	
Internists	
Sleep specialists	
Pediatricians	
Nurse practitioners	
Physician assistants	
Dentists	
Surgeons	
I do not know	
Other	

9. Which of the following can be used to treat the symptoms of OSA? Check all that apply.	✓
Oral appliances	
Behavior changes	
Surgery	
Positive airway pressure	
Weight loss	
Anti-allergy medication	
Oxygen nebulizers	
I do not know	
Other	

A. The following statements have been designed to explore your prospective of OSA perceived severity

10. OSA is a serious disorder.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

11. Untreated OSA can lead to death.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

12. Having a minimum of six hours of uninterrupted sleep is more important than treating OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

B. The following statements have been designed to explore your prospective of OSA perceived susceptibility

13. I am at risk for developing OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

14. It is likely that I have OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

15. It is possible that I will develop OSA if I gain more weight.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

C. The following statements have been designed to explore your prospective of OSA Perceived Benefits

16. It is important to talk with my health care provider about my sleep.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

17. Treating OSA can lower high blood pressure.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

18. Treating OSA will reduce the overall cost of my personal health care.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

19. Treating OSA will reduce my risk of getting into a traffic accidents.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

20. Treating OSA will improve my overall health.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

21. Treating OSA will only improve my sleep.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

D. The following statements have been designed to explore your prospective of OSA perceived barriers

22. I am willing to pay out-of-pocket to address my OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

23. I am worried that I cannot afford the diagnostic tests for OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

24. I am worried that I cannot afford the treatment for OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

25. I am unsure which health professional I should talk to if I experience signs and symptoms of OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

E. The following have been designed to explore your prospective of OSA Cues to Action

26. Please rank the following barriers that may impact the diagnosis of OSA from 1 to 5, 1 being most significant barrier and 5 being the least significant.

☐ **Lack of knowledge about OSA signs and symptoms**
☐ **The cost of the tests**
☐ **The cost of the treatment**
☐ **Embarrassment from wearing a mask**
☐ **Testing facilities are far away**

27. I believe that a positive experience with a friend or family member can motivate me to seek medical attention for OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

28. I believe that if my job required me to check for obstructive sleep apnea, I would be motivated to seek medical attention for it.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

29. I believe complaints from my partner about my snoring would motivate me to seek medical attention for OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

F. The following statements have been designed to explore your prospective of OSA self-efficacy

30. I believe that I can adhere to the OSA treatment.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

31. I believe that I can manage a full night sleep study for OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

32. I believe that some of the OSA treatments will make me look unattractive.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

33. I believe that I can recognize the signs and symptoms of OSA.

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

Open ended questions

Please answer each question in designated box below it, note there is no correct or wrong answer.

34. What are the positive effects of early treatment for OSA?

35. What are the negative effects of delaying the treatment for OSA?

36. What would motivate you to seek medical attention for OSA?

37. What would motivate you to seek medical attention if you suspect you have signs of OSA?

38. What would prevent you from seeking medical attention if you suspect you have signs of OSA?

Demographics

39. Please indicate your age in years.

☐

40. Please indicate your gender.

☐ **Male** ☐ **Female**

41. What is your highest educational level / academic degree? (Please place an *X* next to your answer.)

Grade School _____

Some High School _____

High School Diploma _____

Associate Degree _____

Bachelor's Degree _____

Master's Degree _____

Professional (MD, DDS, PhD, etc.) _____

42. Please indicate your field of study or profession

_____

43. Please place an *X* in the box under the description of your current marital status.

Single (Never Married)	Married	Separated	Divorced	Widowed
☐	☐	☐	☐	☐

44. What categories describe you, select all boxes that apply

- ☐ **White**
- ☐ **Hispanic, Latino, or Spanish origin**
- ☐ **Black or African Am.**
- ☐ **Asian**
- ☐ **American Indian or Alaska Native**
- ☐ **Meddle Eastern or North African**
- ☐ **Native Hawaiian or other Pacific Islander**
- ☐ **Some Other race, ethnicity, or origin**

Thank you for taking the time to complete this survey.

Mazen Homoud **mazen.homoud@student.shu.edu**

APPENDIX B

STOP-Bang Questionnaire

Is it possible that you have ...
Obstructive Sleep Apnea (OSA)?

Please answer the following questions below to determine if you might be at risk.

Yes ○ No ○ **Snoring ?**

Do you **Snore Loudly** (loud enough to be heard through closed doors or your bed-partner elbows you for snoring at night)?

Yes ○ No ○ **Tired ?**

Do you often feel **Tired, Fatigued, or Sleepy** during the daytime (such as falling asleep during driving or talking to someone)?

Yes ○ No ○ **Observed ?**

Has anyone **Observed** you **Stop Breathing** or **Choking/Gasping** during your sleep ?

Yes ○ No ○ **Pressure ?**

Do you have or are being treated for **High Blood Pressure** ?

Yes ○ No ○ **Body Mass Index more than 35 kg/m²?**

Body Mass Index Calculator
○ cm / kg ○ inches / lb

Height:

Weight:

Calculate

BMI:

Yes ○ No ○ **Age older than 50 ?**

Yes ○ No ○ **Neck size large ? (Measured around Adams apple)**

For male, is your shirt collar 17 inches / 43cm or larger?
For female, is your shirt collar 16 inches / 41cm or larger?

Yes ○ No ○ **Gender = Male ?**

See Result

For general population
OSA - Low Risk : Yes to 0 - 2 questions
OSA - Intermediate Risk : Yes to 3 - 4 questions
OSA - High Risk : Yes to 5 - 8 questions
or Yes to 2 or more of 4 STOP questions + male gender
or Yes to 2 or more of 4 STOP questions + BMI > 35kg/m^2
or Yes to 2 or more of 4 STOP questions + neck circumference 17 inches / 43cm in male or 16 inches / 41cm in female

Please use the "About Us" for more information

Modified from
Chung F et al. Anesthesiology 2008; 108: 812-821,
Chung F et al Br J Anaesth 2012; 108: 768-775,
Chung F et al J Clin Sleep Med Sept 2014.

APPENDIX C

UHN 2017-0358

UHN Toronto General Toronto Western Princess Margaret Toronto Rehab

Technology Development & Commercialization

NON-EXCLUSIVE ACADEMIC LICENSE

DEFINITIONS:

Organization name (**"Licensee"**): _Mazen Homoud_____

Address: Department of Interprofessional Health Sciences and Health Administration (IHSA), Seton Hall University, 400 S Orange Ave, South Orange, NJ 07079 USA

("Licensee Site") Seton Hall University

Contact person: Mazen Homoud Job Title: PhD student

Contact information: mazen.homoud@student.shu.edu

Proposed Use (check applicable):

☐ Paper questionnaire ☒ Website ☐ Downloadable app

Please elaborate on Proposed Use: I am in the process of conducting a mixed method study aiming to explore the participants' knowledge and health belief about obstructive sleep apnea. The tool will be used to identify participants that are at high risk of having obstructive sleep apnea and compare their knowledge and health belief about obstructive sleep apnea to other participants that are at differ risk level.

Language(s): English

(collectively, the **"Permitted Use"** means Proposed Use and Language,)

"Effective Date": 7/1/2017

License **"Term"**: One (1) year from the Effective Date.

Licensor: "UHN"
UNIVERSITY HEALTH NETWORK
having a business office at:
Technology Development & Commercialization
101 College Street, Suite 150,
Heritage Building, MaRS Centre,
Toronto, Ontario M5G 1L7
Canada

Notices. Notices must be sent to the attention of:
Director, Technology Development & Commercialization

This license agreement ("Agreement"; and as further defined herein) is made effective as the Effective Date and is between **UHN** and **Licensee** with a business address at **Licensee Site**.

(In this Agreement, UHN and Licensee may be referred to individually as a "Party", or collectively as the "Parties".)

Whereas, UHN owns and controls certain rights, title and interest in the STOP-Bang tool (version 2014) (the "Technology", as further defined herein) developed by UHN Principal Investigator, Dr. Frances Chung, and

Whereas, Licensee wishes to utilize the Technology for specific purposes (the "Permitted Use", as further defined herein), and as such, wishes to license the Technology from UHN for such purposes.

NOW THEREFORE in consideration of the mutual promises, representations, covenants and agreements of the Parties contained herein, the Parties agree as follows:

ARTICLE 1 – INTERPRETATION

1.1 **Further Defined Terms.** For the purposes of this Agreement, unless the context otherwise requires, the following terms shall have the respective meanings set out below and grammatical variations of such terms shall have corresponding meanings:

(a) "**Agreement**" means this license agreement, and all of its Schedules, and the terms "herein", "hereunder", "hereto" and such similar expressions shall refer to this Agreement;

(b) "**Confidential Information**" of a Party means any and all information of and disclosed by, a Party (a "Disclosing Party") which has or will come into the possession or knowledge of the other Party (a "Receiving Party") in connection with or as a result of entering into this Agreement and which is marked as confidential or is identified as confidential at the time of disclosure, including information concerning the Disclosing Party's past, present and future business, research and development, technology, customers and suppliers. Information shall not be considered "Confidential Information" to the extent that the information:

- (i) is part of the public domain at the time of disclosure,
- (ii) subsequently becomes part of the public domain through no act or fault of the Receiving Party or its agents or employees,
- (iii) can be demonstrated by the Receiving Party's written records to have been known or otherwise available to the receiving party prior to the disclosure by the Disclosing Party,
- (iv) can be demonstrated by the Receiving Party's written records to have been provided to the Receiving Party, without restriction, by a third party who is not under a duty of confidentiality respecting the information disclosed and who has a legal right to disclose it,
- (v) can be demonstrated by the Receiving Party's written records was independently developed by or on behalf of the Receiving Party by persons who had no knowledge of or access to the information disclosed,
- (vi) is required to be disclosed by law or an order of a court, tribunal, or government agency, provided that the Receiving Party gives to the Disclosing Party prompt notice of the required disclosure in order to allow the Disclosing Party reasonable opportunity to seek a confidentiality order or the like, or
- (vii) is identified in writing by the Disclosing Party as no longer constituting Confidential Information;

(c) "**Generated Data**" means all data, information and any other matter or deliverable arising from the performance of the Permitted Use by the Licensee;

(d) "**Intellectual Property**" or "**IP**" mean inventions (whether patentable or unpatentable), discoveries, written material, information, know-how, trade secrets, designs, formulae, algorithms, concepts, proprietary data, techniques, instructions, processes, procedures, flow charts, logic diagrams, manuals, specifications, instructions, or any copies of the foregoing in any medium, or the expression thereof;

(e) "**License**" shall have the meaning provided in Section 2.1;

(f) "**Licensed Technology**" means the Technology and the UHN Intellectual Property Rights;

(g) "**Technology**" means the processes, procedures and other relevant technical information pertaining to the STOP-Bang Tool (version 2014), including without limitation, the software, data, know-how, drawings, product specifications and other specifications, all as further described in Section II of Schedule "A";

(h) "**UHN Intellectual Property Rights**" or "**UHN IP Rights**" means any rights in which UHN owns, seeks to own and/or seeks to enforce in Technology, including without limitation those rights described in Subsections I(A), (B) and (C) of Schedule "A"

ARTICLE 2 - GRANT OF RIGHTS

2.1 **License Grant**. Subject to the terms and conditions of this Agreement, UHN grants to Licensee a non-exclusive license to use the Licensed Technology solely for the Permitted Use at Licensee Site(s) for the Term (the "License").

2.2 **Prohibited Uses**. Unless otherwise explicitly stated in this Agreement, the Licensed Technology may only be used for information purposes. Licensee shall not have any rights to grant sublicenses to any third party. Licensee shall not use the Licensed Technology in any product or service made available to a third party for purposes of consulting, sale, lease, license or transfer, other than as expressly allowed per the Permitted Use. THE LICENSED TECHNOLOGY MAY NOT BE USED FOR PURPOSES OF THERAPEUTIC OR DIAGNOSTIC USE.

ARTICLE 3 – REPRESENTATIONS, WARRANTIES, LIABILITY AND INDEMNIFICATION

3.1 **REPRESENTATIONS, WARRANTIES AND LIABILITY.** EXCEPT AS OTHERWISE EXPRESSLY SET OUT IN THIS AGREEMENT:

(A) UHN EXPRESSLY DISCLAIMS ANY AND ALL IMPLIED OR EXPRESS WARRANTIES AND MAKE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY, SAFETY OR FITNESS FOR ANY PARTICULAR PURPOSE OF THE LICENSED TECHNOLOGY AND IN RESPECT OF ANY GENERATED DATA;

(B) UHN SHALL PROVIDE LICENSED TECHNOLOGY "AS IS". UHN DOES NOT WARRANT OR REPRESENT THAT ISSUED PATENTS ARE VALID, OR PENDING PATENT APPLICATIONS WILL ISSUE, OR WHEN ISSUED WILL BE VALID, OR THAT THE PRACTICE OR EXPLOITATION OF ANY LICENSED TECHNOLOGY, TECHNICAL INFORMATION OR KNOW-HOW DISCLOSED TO LICENSEE PURSUANT TO THIS AGREEMENT DOES NOT, OR WILL NOT, CONSTITUTE INFRINGEMENT OF RIGHTS OF PERSONS NOT PARTIES HERETO;

(C) UHN SHALL NOT BE LIABLE TO LICENSEE FOR ANY DAMAGE, INCLUDING (WITHOUT LIMITATION) ANY DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGE SUFFERED BY LICENSEE RESULTING FROM THE USE OF THE LICENSED TECHNOLOGY, TECHNICAL INFORMATION OR KNOW-HOW DISCLOSED TO LICENSEE PURSUANT TO THIS AGREEMENT. FURTHERMORE, UHN MAKES NO REPRESENTATION THAT THE LICENSED TECHNOLOGY, TECHNICAL INFORMATION OR KNOW-HOW DISCLOSED TO LICENSEE PURSUANT TO THIS AGREEMENT, ARE FREE FROM DEFECT OR LIABILITY OF INTELLECTUAL PROPERTY INFRINGEMENT;

(D) LIMITED LIABILITY. UHN'S ENTIRE LIABILITY TO LICENSEE FOR DAMAGES OR ALLEGED DAMAGES HEREUNDER, WHETHER IN CONTRACT, TORT OR ANY OTHER LEGAL THEORY, IS LIMITED TO, AND WILL NOT EXCEED AN AMOUNT EQUAL TO THE SUM OF TOTAL AMOUNTS PAID TO UHN UNDER THIS AGREEMENT. LICENSEE ACKNOWLEDGES THAT UHN LICENSE FEE (IF ANY) REFLECTS THE ALLOCATION OF RISK UNDER THIS AGREEMENT AND THE LIMITATION OF LIABILITY SPECIFIED HEREIN.

3.2 **Indemnification**. Licensee assumes all risks associated with Licensee's use of, or inability to use, the Licensed Technology and in all respects associated with Generated Data. Licensee, for and in consideration of and as a condition to the granting of the License, agrees to indemnify, save harmless, and defend UHN and its directors, officers, research/clinical staff, employees, research trainees, students, and agents (collectively the "UHN Indemnitees"), against any and all claims, suits, losses, damages, costs, fees, liabilities and expenses (including reasonable legal expenses; collectively the "Indemnified Damages") arising from Licensee's use of the Licensed Technology and in respect of all matters associated with the Generated Data, and otherwise any material breach of this Agreement by Licensee, except and to the extent that such Indemnified Damages arise from the negligence or willful misconduct of the UHN Indemnitee(s). In no event shall UHN (and its directors, officers, research/clinical staff, employees, research trainees, students, and agents) be liable to Licensee for special, indirect or consequential damages, even if UHN has been advised of the possibility thereof, including but not limited to lost profits, lost revenues, failure to realize expected savings or any other commercial or economic loss of any kind.

ARTICLE 4 – FURTHER COVENANTS

4.1 **Licensee.** Licensee covenants and agrees for the benefit of UHN that it shall:

(a) exercise the License granted herein or otherwise use the Licensed Technology and the Generated Data in accordance with all applicable laws, statutes, ordinances, regulations, guidelines and rules, including, all applicable

statutes and regulations and applicable guidelines set forth by the Canadian Institutes of Health Research (CIHR), National Institutes of Health (NIH) or other governmental agencies where applicable; and

(b) cause to be applied to, where appropriate, any markings required by applicable government statutes and laws to maintain continued validity and enforcement of UHN Intellectual Property Rights in the Technology; and

(c) ensure that any of its research/clinical staff, employees, research trainees, students, and agents involved with the performance of this Agreement on its (ie. Licensee's) behalf are aware of any and all obligations under this Agreement, including any and all confidentiality obligations and Permitted Use obligations and restrictions, and have agreed to be legally bound by them.

4.2 **UHN.** UHN covenants and agrees for the benefit of Licensee that it shall ensure that any of its research/clinical staff, employees, research trainees, students, and agents involved with the performance of this Agreement on its (ie. UHN's) behalf are aware of any and all obligations under this Agreement, including any and all confidentiality obligations, and have agreed to be legally bound by them.

ARTICLE 5 - INTELLECTUAL PROPERTY

5.1 **UHN Ownership and Patent Prosecution**. Nothing contained in this Agreement shall be construed to convey any right, title or interest of UHN in the Licensed Technology to Licensee other than as specifically stated in this Agreement. Any registration, associated prosecution and maintenance of UHN IP Rights and all other legal rights in the Licensed Technology shall be managed solely by UHN in its discretion.

5.2 **Infringement**. The Licensee shall promptly notify UHN if it has knowledge of any third-party use and/or infringement of Licensed Technology. In the event that a third party brings or asserts a claim against Licensee or UHN that the use of the Licensed Technology infringes rights in Intellectual Property owned or otherwise controlled by such third party, the Parties shall mutually cooperate and/or otherwise provide reasonable assistance in connection to any defence against such claim.

5.3 **No Actions and Challenges**. Licensee agrees to not knowingly take any action which would jeopardize the obtaining or maintaining of UHN Intellectual Property Rights in the Technology. Licensee shall not challenge the validity of any UHN Intellectual Property Rights in the Technology or otherwise any right of UHN to the Licensed Technology.

5.4 **Generated Data.** Licensee shall own all Generated Data. Licensee agrees to furnish UHN with a written report encompassing the Generated Data arising from the Permitted Use on expiration or earlier termination of this Agreement.

5.5 **Translations**. Licensee agrees to provide UHN Principal Investigator and UHN with copies of any language translations of the Licensed Technology along with any relevant validation certificates. Licensee shall grant Dr. Chung and UHN a non-exclusive, perpetual, royalty-free license to use any such language translations for teaching and/or academic research purposes, with a further right to grant sublicenses to third parties for similar such purposes.

ARTICLE 6 – PUBLICATIONS

6.1 **Publications.** Licensee agrees to furnish UHN with a preprint of any publication, or an advance copy of any other disclosure encompassing the Generated Data or other research findings arising from the use of the Licensed Technology. Licensee shall acknowledge Dr. Frances Chung and UHN as the owner of the Licensed Technology in any publication or disclosure, and shall cite the following website www.stopbang.ca.

ARTICLE 7 - CONFIDENTIAL INFORMATION

7.1 **Use of Confidential Information**. The Parties agree that they will only use the Confidential Information of the other solely for the purposes contemplated and in accordance with this Agreement and for no other purpose. The Parties will ensure that their research/clinical staff, employees, research trainees, students, and agents to whom the Confidential Information is disclosed further to performance under this Agreement are informed of the confidential nature of the information and are legally bound to retain such information in confidence. The Parties further agree that, except as required to do so by applicable law or court order, they will not disclose the Confidential Information (or any part therof) of the other Party, and will promptly provide to said other Party written notice if said first Party is legally compelled or otherwise required by law or court order to disclose any part

of the Confidential Information, so that said other Party may seek a protective order or take other appropriate action. A Party in receipt of Confidential Information from the other shall maintain any such received Confidential Information in confidence for a period of **three (3) years** from the date of receipt of such Confidential Information.

ARTICLE 8 - TERM & TERMINATION

8.1 **Termination for Breach**. UHN may earlier terminate this Agreement in its sole discretion if the Licensee materially breaches any of its obligations under this Agreement, and upon written notification of such breach fails to, refuses, or cannot remedy the breach to the satisfaction of UHN within thirty (30) days of receipt of such written notice from UHN.

8.3 **Termination by Mutual Consent**. The Parties may earlier terminate this Agreement at any time by mutual consent, which consent shall be evidenced by a written agreement duly executed by the Parties.

8.4 **Post-Termination**. On the expiration or earlier termination of this Agreement:
(a) Licensee shall immediately stops any further use of, and otherwise cease to derive any benefit from, the Licensed Technology; and
(c) if and/or as required, the Parties shall take all necessary steps in a prudent business manner to effect the orderly earlier termination of this Agreement.

ARTICLE 9 – GENERAL

9.1 **Entire Agreement**. The Parties acknowledge that the Agreement and its Schedule is the entire agreement and understanding of the Parties as to the use of the Licensed Technology, and supersedes all prior discussions, agreements and writings in respect hereto.

9.2 **General Assurances**. The Parties agree to do all such things and to execute such instruments and documents as may be necessary or desirable in order to carry out the provisions and intent of this Agreement.

9.3 **Enure to Benefit**. This Agreement shall enure to the benefit of and be binding upon the respective Parties and, where the context admits or requires, their respective permitted successors or assigns.

9.4 **Assignment**. This Agreement cannot be assigned, sold, transferred or encumbered in any manner by Licensee without the expressed written consent of UHN, which consent will not be unreasonably withheld, but any such consent shall be subject to and conditional on the receipt by UHN of any payment owed to UHN.

9.5 **No Use of Names**. Except as required for the purposes of complying with the provisions of this Agreement, Licensee shall not use the name, logo, trade-mark or trade-name of UHN in connection with any publication, publicity, promotion news release, advertising or similar public statements or otherwise without the prior written consent of UHN.

9.6 **Waiver**. No amendment, supplement or waiver of any provision of this Agreement shall be binding on any Party unless consented to in writing by such Party. No waiver of any provision of this Agreement shall constitute a waiver of any other provision, nor shall any waiver constitute a continuing waiver unless otherwise expressly provided. Further, no failure or delay by any Party in exercising any right or remedy shall operate as a waiver thereof, nor shall any single or partial exercise or waiver of any right or remedy preclude its further exercise or the exercise of any other right or remedy.

9.7 **Severability of Provisions**. In the event that any provision of this Agreement is determined to be invalid or unenforceable by a court of competent jurisdiction in any jurisdiction, the remainder of the Agreement shall remain in full force and effect without said provision in said jurisdiction and such determination shall not affect the validity or enforceability of such provision or the Agreement in any other jurisdiction. The Parties shall in good faith negotiate a substitute clause for any provision declared invalid or unenforceable, which shall most nearly approximate the intent of the Parties in entering this Agreement.

9.8 **Survival**. Articles 1, 3, 6, 7 and 9 in their entirety, and Sections 2.2, 5.1, 5.4, 5.5, 8.4, 9.1, 9.3 through 9.6 and 9.8 shall survive expiration or earlier termination of this Agreement until such time as specifically stated in a particular Article/Section or until the Parties agree to the release of the obligations (in whole or in part) contained therein.

9.9 **Counterparts**. This Agreement may be executed in counterparts each of which shall be deemed an original but all of which together shall constitute one and the same instrument. The Parties further agree to the exchange of execution of the Agreement in electronic format (e.g. as a "pdf" document).

The Parties are executing this Agreement so as to be effective on the Effective Date.

UNIVERSITY HEALTH NETWORK

Per:

Name: Dr. Bradly Wouters

Title: EVP, Science and Research

Date:

18 MAI 2017

LICENSEE

Per: Mazen Homoud

Name: Mazen Homoud

Title: PhD student

Date:5/9/17

Genevieve Pinto Zipp PT, EdD

Genevieve Pinto Zipp PT, EdD

Professor, Department of Interprofessional Health Sciences & Health Administration
Director, Center for Interprofessional Education in Health Sciences
School of Health and Medical Sciences
400 South Orange Ave, South Orange NJ 07079
Genevieve.Zipp@shu.edu
TEL: 973-275-2457 FAX: 973-275-2171

SCHEDULE A

Licensed Technology

I. UHN Intellectual Property Rights

A. Patent Applications/Issued Patents:

United States Provisional Patent Application No. 61/974,319

Title: SYSTEM AND METHOD FOR SLEEP APNEA ASSESSMENT

Priority date: April 2, 2014.

B. Foreign & Domestic Dependent Applications:

All patent application(s) or issued patents claiming priority to the applications listed in Subsection I(A) of this Schedule A.

C. Continuations, Continuations-in-Part, Divisionals, Renewals, Extensions:

For greater certainty, the UHN Intellectual Property Rights of this Section I shall include:

(i) all continuations and continuations-in-part applications to the patent applications in Subsections I(A) and (B), and all patents issuing therefrom, with the proviso that ownership rights in any continuation-in-part applications and or patents shall only apply to issued claims containing subject matter which can claim the benefit of a priority date of any patent or patent application described in Subsections I(A) or (B);

(ii) all foreign counterparts of any of the foregoing (including without limitation, any European Supplementary Protection Certifications or equivalents);

(iii) all divisionals, patents of addition, reissues, renewals, and/or extensions of any of the patents, patent applications, continuation and continuation-in-part applications set out in any of the foregoing Subsections I(A), (B), (C)(i) and (ii).

II. Other Intellectual Property

Processes, procedures and other relevant technical information pertaining to STOP-Bang Tool (version 2014) including without limitation, the software, data, know-how, drawings, product and other specifications, and the like, regardless of format or media or mode or representation.

APPENDIX D

SETON HALL UNIVERSITY
1 8 5 6

Letter of Solicitation and Implied Consent

Dear Participant,

I am inviting you to participate in a research project **(Adults Knowledge and Beliefs about Obstructive Sleep Apnea)** I am a full time doctoral student at the department of Interprofessional Health Sciences and Health Administration, School of health and Medical Sciences, Seton Hall University. I am conducting this research as partial fulfillment of my PhD degree in Health Sciences.

This research study explores adult's knowledge and beliefs of obstructive sleep apnea in adults population that have never being diagnosed with OSA. Through the participants, I hope to obtain information that will ascertain public's baseline familiarity with OSA none the less in subjects that are at high risk of having OSA, and subsequently, develop educational strategies to address the knowledge gap and ultimately reduce the number of undiagnosed OSA individuals.

Your participation in this study is voluntary and anonymous, and there is no penalty if you do not participate or if you decided to stop at any time during your participation.

By completing the questionnaires, you are giving your consent to participate in this research study. Your answers are anonymous, and any reports generated will be reported in the aggregate. Your participation is voluntary, and there is no penalty if you do not participate. Please be aware while the confidentiality of your responses will be protected once the data are downloaded from the internet, there is always a possibility of hacking or other security breaches that could threaten the confidentiality of your responses. Please know that you are free to decide not to answer any question.

All data will be stored on a USB memory stick and will be kept in a locked physical location, accessed only by the principle investigator. No data will be available electronically.

Thank you in advance for your assistance in my continued research effort

Take the questionnaires: click here or https://www.surveymonkey.com/r/OSAKAB

As principle investigator, I should be contacted to answer any question about this study via email maten.homoud@student.shu.edu or via phone (573)639-1895 or my mentor Dr. Genevieve Zipp. Via email Genevieve.Zipp@shu.edu

Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to Seton Hall IRB at email irb@shu.edu or phone at (973) 313-6314.

School of Health and Medical Sciences
Department of Interprofessional Health Sciences and Health Administration
Tel 973 275 2076 Fax 973 275 2171 TDD 973 275 2169
400 South Orange Avenue, South Orange, New Jersey 07079 shms.shu.edu

APPENDIX E

Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
Treating OSA will reduce my risk of getting into a traffic accident.	.791					
I believe that I can recognize the signs and symptoms of OSA.	.680					
Treating OSA will improve my overall health	.639	.337	.409			
Treating OSA will reduce the overall cost of my personal health care.	.621	.402				
Treating OSA can lower high blood pressure	.540		.390			
I believe that I can adhere to the OSA treatment.	.470					.365
I believe that if my job required me to check for obstructive sleep apnea, I would be motivated to seek medical attention for it.		.782				
I believe that a positive experience with a friend or family member can motivate me to seek medical attention for OSA.		.703				
I believe complaints from my partner about my snoring would motivate me to seek medical attention for OSA		.701				
I believe that I can manage a full night sleep study for OSA.	.366	.520				
It is important to talk with my healthcare provider about my sleep		.489	.450			
OSA is a serious disorder.	.303		.738			
Untreated OSA can lead to death			.715			
Having a minimum of six hours of uninterrupted sleep is more important than treating OSA.			.621	-.403		
It is likely that I have OSA.				.834		
I am at risk for developing OSA.				.826		
It is possible that I will develop OSA if I gain more weight			.404	.535		
I believe that some of the OSA treatments will make me look unattractive.				-.364		.326
I am worried that I cannot afford the treatment for OSA.					.928	
I am worried that I cannot afford the diagnostic tests for OSA.					.919	
I am unsure which health professional I should talk to if I experience signs and symptoms of OSA	-.301		-.330		.464	
Treating OSA will only improve my sleep						.683
I am willing to pay out-of-pocket to address my OSA.	.321					.599

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 9 iterations.