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An Anthropological Approach

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An abstract of

a thesis submitted to the Faculty of Emory College of Arts and Sciences

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Abstract

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Sleep Medicine has evolved rapidly over the past six decades, reflecting increased understanding about and prevalence of sleep disorders. One of those disorders, obstructive sleep apnea (OSA), is particularly common. It disproportionally affects veterans; up to 48% of them may have the disorder. Yet, despite improvements in OSA diagnosis and treatment, adherence to that treatment is poor and tools to enhance it remain elusive. There is a paucity of medical anthropological research identifying ecological and cultural factors that could lead to poor treatment adherence. To better understand differing adherence patterns in rural north Georgia veterans with OSA, we conducted quantitative and qualitative analyses based on standard questionnaires and phone interview scripts. Analysis of veterans' narratives generated from those interviews identified key predictors of treatment adherence. Notably, more adherent patients reported higher satisfaction with life, slept longer, and were more likely to co-sleep with a bed partner compared to less adherent patients. These findings could help guide the development of more effective interventions to promote OSA treatment adherence.

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Introduction

Research Questions

Sleep medicine has emerged as a rapidly evolving field over the past six decades. Its practice has established the importance of sleep and probed intricacies of sleep disorders. The multifaceted interplay between sleep symptoms and a patient's daily functioning and sense of well-being has made sleep disorders an indicator for development of serious psychiatric and medical comorbidities. One of the most common sleep disorders is obstructive sleep apnea (OSA). It is estimated that 26% of adults between the ages of 30 and 70 years have OSA (Peppard et al, 2013). This high prevalence translates to millions of individuals who experience negative health consequences such as cardiac disease, stroke, cognitive decline and premature death. Nasal continuous positive airway pressure (CPAP) is currently the most effective and most commonly prescribed treatment for OSA, which involves loud snoring and frequent arousals (Cartwright et al., 2008). Unfortunately, acceptance and long-term commitment to CPAP treatment, for enough hours during the night to be effective, remains a challenge. Compounded by the stigma associated with a common perception that people with OSA are obese, middle-aged men, with a large neck, many patients may also find it difficult to accept the large ventilated CPAP mask, which may cause nasal discomfort, congestion, mask leak, and claustrophobia.

Despite the ubiquity of OSA and the stigma against sleeping with a ventilated CPAP mask, there is a paucity of medical anthropological research that addresses how treatment adherence is affected by distinct sleep ecological patterns, such as the physical arrangements of sleeping space, bedtime behaviors, distribution of sleep over the day, or beliefs about sleep. Western scientific and clinical understandings of sleep may be limited by narrow conceptual and empirical data; the implications of sleep ecology in post-industrialized modern Western societies remain ambiguous, as do its interrelationship with treatment adherence for patients with OSA.

To investigate the sleep ecological patterns of patients with OSA, this study aimed to explore determinants of treatment adherence among veterans with OSA by comparing the sleep ecological patterns and sleep beliefs of American veterans with outstanding treatment adherence to those characteristics of veterans with poor treatment adherence. A key question is: If CPAP treatment is so effective for this debilitating condition, why is treatment adherence so poor? The objective behavioral and clinical features of OSA and its treatment were considered in light of structured interviews that documented the experiences, practices, and ideals of veterans' sleeping. The goal was to capture the ecological and cultural aspects of sleep behavior among veterans with OSA—i.e. what are the sleeping arrangements of veterans with OSA with outstanding treatment adherence contrasted with poor treatment adherence? Are the veterans with OSA satisfied with their lives? What do they consider as the ideal amount of sleep? Why did they sustain or discontinue the treatment? This study not only probes veterans' sleep patterns, but also aims to inform delivery of clinical care to participants currently enrolled in a telemedicine intervention to enhance treatment adherence among veterans (primarily rural residents in North Georgia).

Medical anthropology is uniquely positioned to revolutionize the study of sleep in ways that both elucidate old paradoxes and raise new questions. This study took one more step towards utilizing a cultural ecological framework to better understand the plasticity of human sleep physiologies. The study examined the salient factors that are associated with OSA treatment adherence and probes the macro-ecological and micro-ecological aspects of veterans' sleep patterns. The results are relevant as they address the general dearth of investigation in sleep activity in the social and behavioral sciences domain.

Chapter 1:

Background and Literature Review

Obstructive Sleep Apnea (OSA)

Obstructive Sleep Apnea (OSA) is a sleep disorder characterized by sleep disruption due to partial or complete upper airway obstruction during sleep. A patient with OSA frequently stops breathing during his or her sleep. Aside from the immediate effects of OSA including intermittent hypoxia (low blood oxygen levels), regular arousals from fragmented sleep, and dramatic fluctuations in blood pressure, there are long-term debilitating health consequences, such as hypertension, cardiovascular disease, diminishment of cognitive abilities, and substantial reduction in quality of life (Garvey, Pengo, Drakatos, & Kent, 2015).

In addition to daytime fatigue, common OSA symptoms include snoring, choking, and gasping during sleep. Strong OSA risk factors include obesity and male gender; OSA is more prevalent in individuals who are older, male, are obese with a large neck circumference, and those smoke and drink alcohol (Frost & Sullivan, 2016). Obesity has profound implications in modifying breathing behaviors during sleep via different mechanisms, including alteration of upper airway structure, function, and disruption of balance between ventilator drive and load (Strobel et al, 1996). Many cross-sectional studies consistently have detected associations between increased body weight and risk of developing OSA. In particular, a four-year longitudinal study of the Wisconsin Sleep Cohort found a relationship between weight gain and increased sleep-disordered severity (See Figure 1). Weight loss, by contrast, was associated with a reduced sleep-disordered breathing severity and tendency to develop OSA (Peppard, 2000). Compared with participants with a stable weight, those who had a 10% increase in weight showed an average 32 % increase in OSA severity and six-fold higher risk of developing moderate to severe OSA.

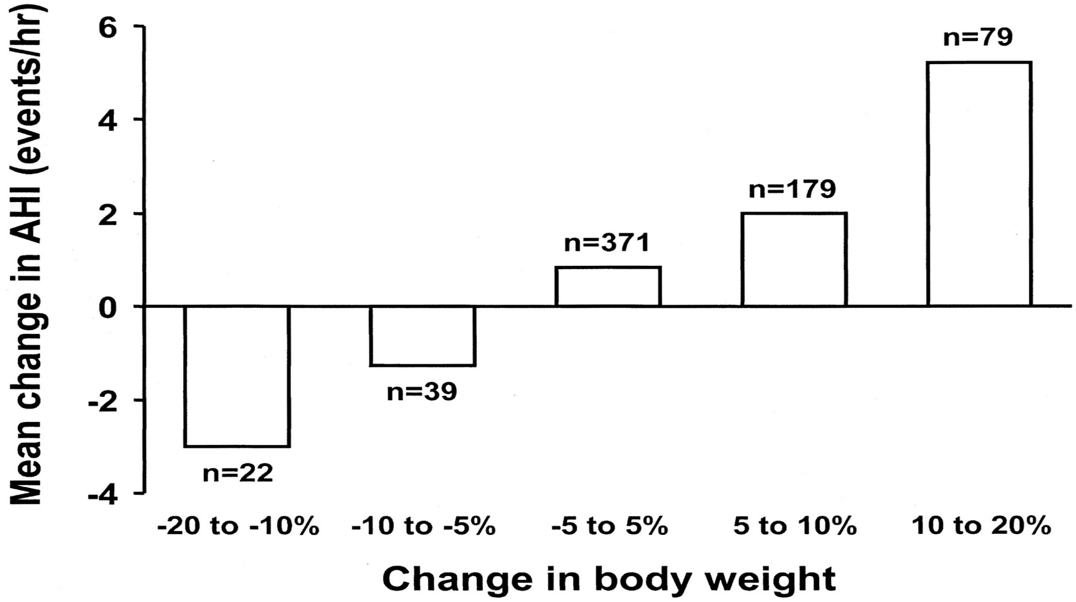

Fig 1. Mean change in apnea-hypopnea index (AHI) by weight change. Linear relationship between weight gain and risk of developing OSA. (From Peppard et al., 2002)

The health burden of sleep-disordered breathing strongly motivated this study. Extensive research has sought to elucidate the causal role of OSA in mortality. A prospective, 14-year community-based health investigation among residents of Western Australian town of Busselton showed that moderate-severe OSA is an independent risk factor for all-cause mortality (Marshall et al, 2008). When adjusted for age, gender, total cholesterol levels, body mass, diabetes, and smoking status, moderate-to-severe OSA at baseline was associated with 33% mortality by contrast with 7.7 % mortality in people without OSA. An 18-year mortality follow-up of 1522 people within the Wisconsin Sleep Cohort produced similar results. The study demonstrated that severe OSA is significantly associated with a 3-fold increase in all-cause mortality risk, independently of age, sex, BMI, and other potential confounders (Young et al, 2008). Additionally, a large observational cohort study indicated that OSA syndrome (OSA with excessive daytime sleepiness) is associated with an increased incidence of stroke or death from any cause and that the association is independent of other cardiovascular risk factors (Yaggi, Concato, & Kernan et al, 2005). The consistency of these population-based findings showing augmented mortality risk with OSA has underscored the impact of sleep-disordered breathing on overall health.

In spite of the increasing recognition of OSA as an important cause of medical morbidity and mortality, a majority of affected patients remain undiagnosed. It is estimated that despite a U.S. adult prevalence of OSA of 12 % (29.4 million people), approximately 80% of the afflicted are undiagnosed (Frost and Sullivan, American Academy of Sleep Medicine, 2016). The widespread under-diagnosis of OSA can be attributed to the generally dismissive attitude towards symptoms of sleepiness. Many patients fail to recognize that OSA is linked to life-threatening comorbidities.

The insidious effects of undiagnosed and untreated OSA not only pose great burden on the patients' quality of life but also has serious implications for the nation's health care budget. The American Academy of Sleep Medicine (AASM) has released a white paper entitled, "Hidden Health Crisis Costing American Billions" and revealed that the estimated cost burden of undiagnosed OSA among U.S. adults was $149.6 billion in 2015. Increased medical expenses and hospital visits due to comorbidities such as hypertension or diabetes, motor vehicle accidents, and the development of compensating behaviors such as substance abuse all account for the direct economic burden of OSA under-diagnosis. In addition, decreased productivity at work and reduced quality of life attribute to indirect economic costs. Specifically, the economic costs consisted of "$89.6 billion due to lost productivity and absenteeism; $30 billion due to increased risk of costly comorbidities such as hypertension, heart diseases, diabetes, and depression; $26.2 billion due to motor vehicle accidents; and $6.5 billion due to workplace accidents" (Frost and Sullivan, 2016, p.10). Given the economic impact of untreated OSA, early and accurate diagnosis is vital for improving patients' quality of life (QOL), reduce the risk of motor vehicle accidents, and lower the possibility of developing the aforementioned chronic health problems.

Prevalence of Obstructive Sleep Apnea Among Veterans

The relatively high prevalence of OSA among veterans presents a challenge for prevention and treatment that motivates this study. According to Max Hirshkowitz, director of the Sleep Disorder Center at the Houston Veterans Affairs Medical Center, veterans are four times more likely than other Americans to suffer from sleep apnea. While roughly 5% of Americans have sleep apnea, up to 20% of veterans suffer from this disorder (National Sleep Foundation, 2017).

Military personnel are especially vulnerable to sleep disturbances due to their erratic sleep/ wake schedules, extreme living conditions (noises, physical demands, temperature, etc.), and the need to stay vigilant under the stress of combat. These issues continue to challenge post-deployment psychosocial reintegration. Some residual effects are reflected in detrimental health consequences, such as substance abuse, hypertension, depression, post traumatic stress disorder (PTSD), or musculoskeletal pain (Alexander et al, 2016). In fact, veterans with PTSD have higher prevalence of OSA than the general population (Collen et al, 2012). Untreated OSA worsens the sleep-related symptoms of PTSD: frequency and intensity of nightmares, repeated awakenings, and increase in daytime fatigue (Pagel et al, 2010). In one study conducted among 264 veterans seeking PTSD treatment, 72 % had OSA (Forbus and Kelly, 2015).

Several studies have illustrated the extent of sleep disturbance in chronic military-related PTSD. In Vietnam War veterans, combat was most proximally related to nightmares (Neylan et al, 1998). Furthermore, among 195 Iraq and Afghanistan war veterans with PTSD, the rate of severe OSA was 69.2% (Colvonen et al, 2015). The connection between PTSD and elevated OSA risk remains ambiguous; correlation does not demonstrate causation.

Diagnosis and Treatment of OSA

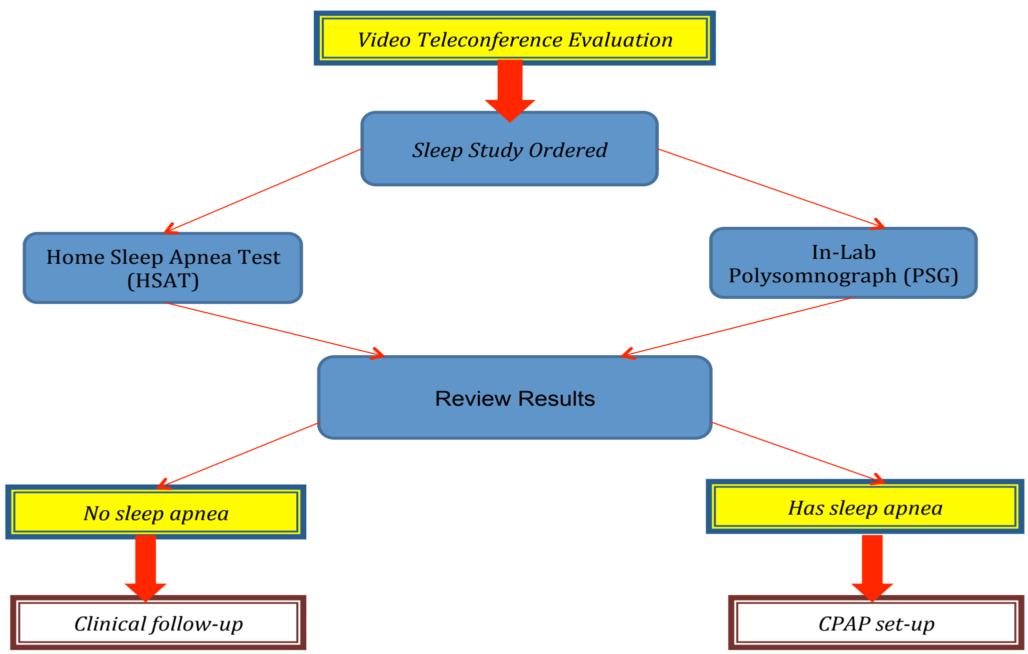

Fig 2. OSA Management at the Atlanta VA Medical Center

A comprehensive assessment of a patient's lifestyle can help inform the underlying medical problems that put the patient at increased risk for OSA. Fig 2 illustrates the clinical management process for veterans suspected of having OSA. Findings from physical examinations suggest that signs associated with the presence of OSA include increased neck circumference (> 17 inches for men; > 16 inches for women), elevated bodily mass index (BMI) ≥ 30 kg/m^2, or nasal abnormalities such as septal deviation (Epstein et al., 2009).

The diagnosis of OSA involves the measurement of breathing during sleep. The Practice Guidelines published by the Journal of Clinical Sleep Medicine established that polysomnography (PSG; overnight testing in the sleep laboratory) is the standard diagnostic test for diagnosis of OSA in adults (Kapur et al, 2017). PSG involves applying electrodes to the head, face, and chest and allows evaluation of sleep architecture (sleep stages). (Knutson et al, 2013). The number of times breathing is disrupted per hour is reported as the apnea-hypopnea index (AHI). The third edition of the International Classification of Sleep Disorders (ICSD-3) defines OSA as an AHI ≥ 5 events/ hour associated with the symptoms such as detectable breathing pauses during sleep or loud snoring (American Academy of Sleep Medicine, 2014). During sleep, the upper airway muscle tone of patients with sleep apnea tends to narrow and collapse temporarily. Therefore, disruption in breathing is accompanied by a decline in blood oxygen levels and intermittent arousal from sleep. Carbon dioxide levels also rise, resulting in morning headaches, fatigue, and restlessness during the day.

Several forms of treatment for OSA are available. Behavioral treatment options include weight loss, with the goal of attaining a BMI of 25 kg/m^2 or less; successful dietary weight loss may improve the AHI in obese patients with OSA. In addition to behavioral interventions, custom made oral appliances (similar to sports mouth guards) may improve snoring and upper airway patency during sleep by pushing the lower jaw forward, thus preventing the tongue and other soft tissues from obstructing the airway.

Continuous Positive Airway Pressure (CPAP) is the most effective and most commonly used therapy for OSA. The device gently pushes air into the upper airway via a facemask. In doing so, it creates a pneumatic splint that reduces airway closure during sleep. If used optimally and consistently, CPAP can reduce breathing disturbances and improve the user's quality of life and blood pressure (Luyster, 2017). However, a critical challenge is low CPAP adherence. Poor CPAP adherence is a strong limiting factor in treating OSA, because it leaves many patients at increased risk for impaired quality of sleep, debilitated quality of life, and heightened risk for comorbid health complications (Weaver & Grunstein, 2010). Adherence to CPAP treatment for OSA is a critical problem with adherence rates ranging from 30- 60% even among patients with severe OSA.

If CPAP treatment has such benefits in helping patients maintain a steady, healthy level of breathing and oxygen sufficiency through the night, why aren't patients adhering to the treatment? Many dimensions of patients' experiences and interactions with CPAP have been examined in attempts to identify CPAP usage patterns that predict the long-term efficacy and results of treatment. Although the criteria vary, most clinicians define adherence based on average hours of nightly use. The Centers for Medicare and Medicaid Services (CMS) has defined adherence as use of CPAP for at least 4 hours/ night on 70% of nights during a consecutive 30-day period for the first three months of initial usage (Schwab et al., 2013). When CPAP adherence is defined as greater than 4 hours of nightly use, 46% to 83% of patients with OSA have reported to be non-adherent to treatment (Weaver & Grunstein, 2010). The intrusive nature of CPAP therapy has often been cited as the primary reason for non-adherence. Earlier designs of CPAP masks involved attachment using silastic glue or rudimentary straps. However, both masks ("interfaces") and CPAP machines have undergone radical redesigns. Nevertheless, psychological reasons such as claustrophobia, social stigma against the mask, and interference with sleep and intimacy can deter patients from using CPAP.

Although CPAP machines may be considered noisy and cumbersome by patients, multiple studies have documented CPAP's beneficial impacts on patients' bed partners. OSA is a unique disorder in that it negatively affects both the patients' and their partners' sleep quality. Partners may also experience reduced quality of life due to sleep fragmentation when the patient snores loudly. In addition, partners may be anxious and develop insomnia by witnessing recurrent cessation in their partner's breathing (apneas). One study showed that, before CPAP therapy, up to 52% of partners reported symptoms of anxiety, and 18% of partners had symptoms of depression. After CPAP therapy, anxiety levels in partners improved significantly (Doherty, Kiely, Lawless, & McNicholas, 2003). These results reinforced the benefits of CPAP therapy beyond those for the actual patient and implicated the supportive role that partners can play in encouraging CPAP adherence.

The Advent of "Sleep Science" and the Medicalization of Sleep

Before delving into the ecological framework of human sleep, it is helpful to survey briefly the history of sleep medicine with respect to recognition of the prevalence and impact of sleep apnea, and development of its treatment. Although it is still in its infancy and many physicians advocate the need for more sleep education in the medical school curriculum, sleep disorders are no longer deemed an "experimental venture"; they have become an increasingly recognized public health epidemic (*Sleep and* Society, p. 149).

The clinical description of obesity hypoventilation syndrome in 1956 served as the harbinger to the discovery of OSA (Shepherd, 2005). Until then, it was mistakenly believed that excessive daytime fatigue was related to alveolar hypoventilation (failure of automatic respiration). In 1966, Gastaut documented repetitive episodes of upper airway obstruction as the cause of fragmented sleep. This revelation debunked the misconception of OSA as a primary lung disorder and helped establish its clinical guidelines. Consequently, it was determined that increases in upper airway resistance and reductions in breath volume give rise to daytime sleepiness and sleep fragmentation.

Almost a decade later, Colin Sullivan, a post-doctoral student at Sydney University, Australia, was studying the effects of respiratory control in dogs and more specifically, the effects of hypoxia (deficiency in oxygen levels) and hypercapnia (excessive carbon dioxide in blood) on REM and non-REM sleep. His study led to his idea for a mask that would fit over a dog's snout to deliver air or experimental gas. Sullivan then applied the positive results from his experimentation on dogs to test the use of a mask in humans who had noisy snoring and excessive daytime fatigue (ResMedica, 2011). In a renowned Lancet paper published in 1981, Sullivan reported results from the clinical trials and noted that, "Continuous positive airway pressure completely prevented the upper airway occlusion in each of the five patients. The upper airway occlusion could be turned off and on simply by increasing or reducing the level of positive airway pressure" (Sullivan, 1981, p. 5). Unfortunately, despite a flurry of sleep medicine studies that acknowledged the importance of CPAP therapy, there has been no published statistical report on the number of CPAP users across the nation.

Cultural Models of Sleep

Beyond the biomedical perspectives on OSA, there are far-reaching and under-recognized cultural influences on multiple domains of sleep, including sleep ecology, sleep quality, satisfaction and quality of life, and beliefs about sleep. Social and cultural factors play a role by not only dictating sleep-related behaviors but also in shaping attitudes and beliefs about sleep. Moreover, the understanding and information people receive from family and friends as to the nature of sleep apnea, its cause, and its implications shape patients' perceptions on health risks and medication adherence behaviors. Interestingly, social and cultural factors are rarely conceptualized as relevant determinants for sleep habits. The purpose of this research is to probe potential associations of cultural and social factors with patients' CPAP adherence.

For humans, a value of culture lies in its capacity to provide scripts that inform behavior, decision-making, interpretation of experience, and meaning making. Culture shapes both conditions of daily life, everyday practices, and the beliefs that provide meaning to experiences (Worthman and Brown, 2007). Therefore, shared cultural attitudes and meanings about what sleep is or does, and when, where, and how it is best done, may be powerful determinants of the regulation of sleep behaviors. The consideration of cultural models and morals related to sleep offers a basis from which to scrutinize American post-industrialized normative attitudes and practices of sleep.

Traditions, cultural values, and local conditions and environments define not only the physical but also the moral dimension of sleep and account for how we sleep, with whom we sleep, and where we sleep. In Western societies, there is a prevailing belief that having an appropriate amount of sleep is a reflection of meeting the balance between fulfilling different life demands and imposing self-discipline on oneself. Consequently, over-indulgence in sleep may be frowned upon, and the inability to sleep through the night may be regarded as a problem and pathologized as insomnia (Worthman and Brown, 2007). The management of sleep behaviors is ubiquitous throughout the life course. For example, during a child's formative years, many American parents seek to establish firm bedtime schedules and ensure that their children get the proper amount of sleep. Therefore, sleep is a "socially scheduled, socially organized, and socially institutionalized pursuit or practice" (*Sleep and Society,* p74) that is motivated by a sense of what constitutes "appropriate" or "inappropriate" sleep. Dominant American discourse commonly includes normative and moral aspects, such as sleeping at the right place and right time, with the act of sleeping being respected. By contrast, "illegitimate" sleep behavior might include falling asleep at important occasions, while driving, or during a meeting (p. 75).

Now, the question arises as to what is considered "normal" or adequate amount of sleep? The duration of sleep may not be the most effective measure of whether or not the person gets sufficient restful sleep. For example, 6 hours of sleep may have discrepant cognitive, physiological, and psychological outcomes among different individuals (Patel, Grandner, Xie, Branas, & Gooneratne, 2010). Therefore, assessment of human sleep adequacy involves multiple levels of analysis and dimensions. In particular, sleep can be evaluated across self-report and analyzed from behavioral, physiological, and genetic perspectives. Within each dimension, some of the parameters that could be considered in addition to sleep duration are: sleep continuity (the ease of falling asleep and returning to sleep after nocturnal awakenings), sleep timing, alertness/ restfulness after sleep (whether or not one feel refreshed upon waking up), and satisfaction of sleep (Buysse, 2014).

Roger Ekirch (2001, p. 101), a professor of history at Virginia Tech, argues that while the quantity of our sleep has diminished in comparison to sleep in pre-industrialized societies, the quality of our sleep may actually have improved over time. Based on historical records, he argued that pre-industrial slumber was characterized by "intermittent disruptions" and frequent "terrors, sights, noises, dreams, and pains" (p. 43). Consequently "Ordinary folks suffered some degree of sleep deprivation, feeling more fatigued on awakening at dawn than retiring at bedtime" (P45). If true, the observation raises an interesting conundrum: why do so many people today complain of sleep deprivation? According to the National Sleep Foundation in 2002, 37% of American adults reported that they are so sleepy during the day that the daytime fatigue symptoms interfere with their daily activities at least a few days a month or more. In addition, 16% experience this level of daytime sleepiness a few days a week or more (P102). Based on these figures, Americans would appear to be carrying a chronic sleep debt of between 25- 30 hours.

In this era of ceaseless deadlines, long work hours, and multiple commitments, the use of technological advancements may be a mixed blessing. Historically, the onset of sleep coincides with the arrival of sunset. On the contrary, the sleep schedule for modern society is greatly influenced by natural and artificial light (de la Iglesia, 2015). From a physiological perspective, light entrains a master circadian clock that regulates the timing of sleep in human bodies. Therefore, exposure to artificial light directly influences the length of sleep and the timing of sleep onset. In the past few decades, we have witnessed a steep increase in the availability and use of electronic devices, from mobile phones, television, computers, tablets, to video game players. As these devices evolved to be more portable, people started to use them more even in bed. The National Sleep Foundation's 2011 *Sleep in America Poll* found that 95% of respondents used electronic media, such as television, cell phone, or video game, at least a few nights per week within the hour before going to bed (NSF, 2011). The pervasive use of electronic devices suggests the need to investigate the effect of media use on sleep among adults. A study has demonstrated that extensive use of electronic media before sleep increased levels of self-perceived insufficient sleep (Suganuma et al., 2007). The use of a computer for watching television and movies in bed was positively correlated to the severity of insomnia symptoms. Furthermore, excessive use of mobile phone in the bedroom may disrupt the circadian rhythm and therefore a sleep phase delay. In particular, media use coincides with later bedtime and later rise time (Custers & Bulck, 2012). Exposure to the evening bright light emitted from the electronic screens typically postpone sleep onset and may, in turn, impair sleep quality ("A practical approach to circadian rhythm sleep disorders," 2009).

Evolutionary Ecology of Human Sleep

Human sleep is characterized by high plasticity, modulated by cultural values and societal norms. An important perimeter of human sleep is sleeping arrangements. The presence/ absence of a sleeping partner conveys important messages about one's gender, personality, emotional well-being, and emphases on family dynamics. Our understanding of post-industrial peoples' patterns and variability in sleep behaviors has been advanced by behavioral ecological studies of sleep in nonindustrial, semi-nomadic populations. For instance, a study on the Hazda hunter-gatherers in Northern Tanzania echoed the sentinel hypothesis, which proposed that all of the members in a group share the task of vigilance during sleep in order to reduce risks against potential aggressors and nighttime predation. Using wearable activity trackers, the researchers discovered that all subjects were simultaneously asleep for only 18 minutes over 20 days of observation, with a median of eight individuals awake throughout the nighttime period (Samson et al., 2017). Non-alignment among individuals' sleep schedules and sleep patterns ensured that at least one person in the group is awake at all times. These findings raise the question of how humans evaluate sleep security in the context of sleep-related social practices, such as co-sleeping.

From an evolutionary anthropological perspective, the geography of sleeping space and arrangements may directly affect quality of sleep, sleep architecture, vigilance and attentiveness to surroundings, and sense of security in relation to the environment (Samson & Nunn, 2015). For example, compared to postmodern industrial counterparts, more traditional societies put a large emphasis on co-sleeping, in which multiple individuals sleep within close proximity to facilitate sociality and security (Worthman & Melby, 2002). From an evolutionary perspective, sleeping with a partner may enhance the perceived physical and emotional security, which results in a reduction of arousal levels and improved quality and quantity of sleep.

Sleep settings offer rich and dynamic information towards a society's attitude towards sleep. They serve as historical reference points in people's lives and portray the actual conditions under which people sleep and define the remarkably diverse physical and cultural dimensions of sleep. An important aspect of sleep setting is bedding, which includes "substrate, covering on substrate, covers, pillow, and sleep garments" (Worthman & Melby, 2002). The constituents of bedding shed light on the interwoven histories of social, sexual, and even sanitary approaches that help construct a particular society. For example, the ancient Egyptians, Greeks, and Romans put a lot of emphasis on their beds. Egyptian beds were elegant reflections of high standards on craftsmanship (p. 58). Most notably, beds for the wealthy were often taken to the tomb. This tradition testifies to the Egyptian attitude that death serves as a transition point between life and the afterlife. Therefore, the beds of the privileged would symbolize dignity and nobility. As for the Greeks and the Romans, in a similar fashion, their beds were elaborately designed and manufactured. For instance, Roman beds were constructed from a plethora of materials, ranging from wooden beds made of oak and cedar to ivory feet decorated with a bronze frame (P58).

Additionally, the quantity and type of bedding may play an important role in the development and incidence of respiratory syndromes, such as asthma and inflammation. Bedding sheets can harbor pests and mites (Potter et al., 2012). Laundering keeps sheets relatively free of mites, but pillows, blankets, duvets, and mattresses are by no means so frequently cleaned and can be major harbors for mites, dust, allergens that act as respiratory irritants. Therefore, determining the optimal bedding type may be a factor in promoting better quality sleep.

The quest for grand or extravagant beddings gradually waned in the early nineteenth century due to the industrial revolution, an era known for its emphasis on functionality and simplicity (p. 60). Iron and brass bedsteads marked the introduction of spring mattresses in the 1850s (Martin 2003). Existing research on the trends in bedding usage mainly focused on children and adolescents. The American Academy of Pediatrics investigated the prevalence of bedding use and published recommendations on safe sleep interventions for infants (Shapiro-Mendoza et al., 2014). From 1993 to 2010, the most frequently reported types of bedding covers were thick blankets (37.6%) and quilts/comforters (19.9%). Blankets and cushions were the most frequently reported type of bedding placed under the infant. Overall, beds and bedding offer insights about social change and social order with implications for sleep hygiene.

There is a disjunction between the standardized laboratory-simulated sleep-testing environments and the actual conditions of one's bedroom. As noted earlier, most PSG studies are monitored in a laboratory-based setting. Such a context may be quite different from a patient's sleeping site at home (Goldberg, *Sleep Around the World*, p. 81). Therefore, beyond sleep behavior itself, it is important to consider the nature of the space in which it took place. The environment of sleeping space and the placement of the bed are the key elements in the subjective experience of sleep. While asleep, sensory input is reduced and the person is in a state of diminished consciousness. Therefore, a sleeping person is especially vulnerable to attack. For these reasons, humans' preferences of sleeping sites directly reflect our motivation to ensure safety and our ability to meaningfully relate interpretations of the environment.

Concurrent with a person's sleeping arrangements, sleep timing and perceived boundaries of sleep-wake states can vary widely across cultures. While sleep hygiene in Western society is defined in part by fixed bedtimes and rigid wake times, these norms contrast sharply with the documented sleep structure in hunter-gatherer societies. For communities that rely upon foraging and are characterized by insubstantial housing and more loosely defined work schedules, people go to sleep whenever they feel like it. A notable example is the !Kung hunter-gatherers in Botswana and Namibia. Their nights are rife with music, dance, festivities, and conversations. People participate in rituals late at night and no child is told to go to sleep. Therefore, the dichotomy between sleep and wake states in these traditional societies are fluid and sleep is characterized as companionable, communal, and social (Worthman and Melby, 2002).

Aside from the elasticity of sleep behaviors that emerge from cultural and historical comparisons, it is intriguing to witness the evolution of sleep beliefs and practices in Western societies over the past few centuries. The conventional belief that monophasic, consolidated sleep is contravened by growing evidence that some western European groups used to sleep in two distinct chunks. Before the Industrial Revolution, Western households experienced a biphasic pattern of sleep (Ekirch, 1998). The first segment of sleep began around 9-10 PM. After an hour or two, people awoke and stayed up for a few hours. Some of the activities that they engaged during this "break" involved gossiping, social activities, and even bedside praying. The second segment of sleep happened from 2AM until the morning. This form of segmented sleep is fundamentally different from the consolidated, monophasic sleep that most contemporary societies aspire to, and contributes to the growing evidence of cultural diversity in normative sleep practices.

Interestingly, in recent years, the sleep domain has seen a surge of new evidence that challenged the conventional wisdom about the sleeping habits of our pre-industrial ancestors. Through examining sleep duration, timing, and ambient temperature and seasons, in three preindustrial human societies (Hazda, Tsimané, and San subjects), Yetish, Siegel, and authors dispelled the myth that foragers/ hunter-gatherers went to bed at sundown. Rather, the subjects of the study stayed awake an average of 3 hours and 20 minutes after sunset and they slept for duration of 5.7 to 7.1 hours. More notably, nocturnal awakenings and napping intervals were also infrequent among the subjects, thereby illustrating that the bimodal sleep patterns seen in Western Europe were not present in traditional equatorial groups (Yetish et al., 2015). Therefore, the aggregation of Yetish's study and Ekirch's findings on bimodal sleep patterns remind us the need for contextualization in understanding individuals' sleep behaviors.

Sleep in the Military

Since September 11, 2001, approximately 2.4 million U.S. military personnel have served in Afghanistan and Iraq (Spelman, 2012). The unprecedented demands imposed on the U.S. military forces have drawn increasing attention to the prevalence and consequences of sleep problems for service members and veterans. The conditions for sleep may be as important as how much we sleep. Indeed, operational and combat environments are barriers to healthy sleep and expose military personnel to austere living conditions, harsh climate, immense stress, and sleep debt.

U.S. veterans and combat soldiers occupy a specialized niche, and their culture has been depicted as "the outlook of an estranged minority" (Wells, 2017). A salient feature common among the soldiers is their vulnerability to sleep deprivation. The notorious "four-hour rule" was imposed so that troops could survive and function on only 4 hours of sleep, given that they have to operate in fast-paced and high-tempo environments. Indeed, more than 40 percent of active duty military members report sleeping five hours or fewer per night (National Sleep Foundation, 2017).

Some studies have documented sleep patterns of military service members in relation to deployment. A large survey of deployed US Army soldiers, conducted by the Mental Health Advisory Team of the United States Army Medical Command, assessed the soldiers' reports of sleep needs (Mental Health Advisory, 2008). Across the entire cohort, soldiers reported that they needed 6.4 hours of sleep to feel refreshed and well-rested. On the other hand, these soldiers also reported an average of 5.6 hours of sleep per day. Both of these values are less than the recommended 7 to 9 hours of sleep recommended for optimal alertness and work performance (Watson, Badr, Belenky, & Bliwise, 2015).

Several other studies have documented the prevalence of sleep problems and consequent mental health disorders among U.S. soldiers and veterans. For instance, a study sampled 100 veterans from age 27 to 86 and revealed that a vast majority of the sample (84.54%) endorsed clinically significant insomnia and over half of the veterans (72.16%) used sleeping aids (i.e. prescription medications, over-the-counter medications, or alcohol and drugs). Another investigation showed results in line with the previous study: among a group of 156 deployed military personnel, 74% of participants rated their quality of sleep as significantly worse in the deployed environment and 42% had a sleep onset latency that exceeds 30 minutes (Peterson et al., 2008). Moreover, sleep disturbances commonly co-occur with mental health conditions. Research has found that sleep disturbances- insomnia, sleep apnea, nightmares, and periodic limb movements- act as common precursors and core features of PTSD (Spoormaker &

Montgomery, 2008). The VA Health Care Facts and Figures from 2013 indicated that among the 1.6 million veterans who receive healthcare from the VA system from FY 2002- FY 2012, 29% of veterans are diagnosed with PTSD (Bagalman, 2013). Certain factors may explain the unique sleep patterns in military soldiers and veterans. Because sleep is characterized by diminished consciousness and reduced capacity to respond to potential danger, it can be disadvantageous and infeasible to engage in sound sleep under combat environments. Therefore, the demand to sustain vigilance contributes to the ubiquity of sleep disturbances among those exposed to war and combat settings.

The pervasiveness of sleep deprivation, sleep problems, and health consequences among US soldiers draws attention to the overarching evolutionary underpinnings of human sleep. Some of the central questions include: How do we explain variations of sleep practices through analyzing the costs and benefits of being awake for military duty? What are the functional benefits of and challenges to sleep when people are exposed to intense stress? Ecology is the principle driver to study sleep. The appreciation of diversity in human behaviors and its relation to the intricacies between sleep disorders may be the key to unravel the role of sleep in health inequality. This domain of knowledge could tailor interventions to resolve and reinforce treatments.

Sleep is a complicated and nuanced aspect of human behavior that merits more than just biomedical study; perspectives and evidence from anthropology add more layers to understand this vital topic. Inquiry into culturally embedded meanings and rationales identify differences in sleep ecology and behaviors that exist among different populations. The systematic dissection of sleep perceptions and behaviors, cultural beliefs about sleep practices, and assessment of sleep ecology may be a valuable approach to gain a more holistic understanding of the factors that facilitate and hinder CPAP adherence among veterans with sleep apnea. Consequently, the pairing of explanations to the barriers to and motivators of CPAP treatment from a medical anthropological perspective and appropriate clinical management can better equip healthcare professionals to deal with the ponderous burden of OSA.

Research Questions and Hypotheses

Briefly, this research study was designed to provide insights to the following questions:

• What are the similarities and differences in sleep ecological patterns among veteran patients with outstanding treatment adherence and poor treatment adherence?

• What are the recurring themes between both groups of patients that pinpoint how biological, psychological, social, and behavioral factors influence their treatment adherence behaviors?

In addition, based on the information collected in the literature review, several hypotheses can be proposed:

1) **Patient characteristics:** Patients who are more overweight (higher BMI) are less likely to adhere to treatment due to wider facial outline and hence, more discomfort with the CPAP mask.
2) **Sleep and Bedtime practices:**
    - **a.** Adherent patients are more likely to adopt routine sleep schedules and are less likely to take naps that last over an hour.
    - **b.** Non-adherent patients are more likely to watch TV immediately before bed and keep the TV on in the background for the whole night. Screentime before bed would trigger frequent arousals during the night and render difficulties in putting the CPAP mask back on.

3) **Sleep beliefs**:

    a. Adherent patients are more likely to report satisfaction in sleep duration and will present lower differences between perceived sleep time and perceived sleep needs.

    b. Adherent patients are more likely to consider 8 hours of sleep as "normal" compared to non-adherent patients.

4) **Sleep ecology:**

    a. Non-adherent patients are more likely to sleep alone and are less aware of their snoring and related sleeping behaviors. In contrast, adherent patients are more likely to sleep with a bed partner and they are more aware of their snoring.

    b. Non-adherent patients are more inclined to sleep on a different substrate other than the bed. The switching of bedding substrates would result in hurdles in carrying the CPAP machine around.

    c. Non-adherent patients are more likely to sleep with heavier bedding. Since bedding sheets can harbor dust and allergens, heavy bedding can contribute to respiratory syndromes, which will interfere with CPAP treatment adherence.

5) **Subjective Well-Being:** More usage of the CPAP machine will be positively correlated with higher satisfaction with life scores. Therefore, outstanding adherent patients will express more satisfaction with their lives.

6) **Psychological Effects:** Physical comorbidities, such as cardiovascular diseases and psychiatric comorbidities such as depression, PTSD, and anxiety put patients at higher risk of treatment non-adherence because the complication of diverse psychiatric illnesses may compromise sleep continuity and reduce sleep quality.

Chapter 2:

Methodology

Sampling and Sample Characteristics

This thesis project is an extension to the Sleep Telemedicine Assessment and Response to Therapy (START) study carried out at the Atlanta VA Sleep Center. The study population is a cohort of patients already in the START study and consisted of sleep-disordered patients of Dr. Barry Fields seen remotely via telemedicine. To be included in this research cohort, the patient must 1) be over the age of eighteen (18), 2) be treated in the Atlanta VA Medical Center system, 3) receive care at a rural VA clinic in North Georgia (located in Rome, Blairsville, or Oakwood, GA), and 4) have a new OSA diagnosis and be new to the CPAP treatment.

Study Population and Recruitment

After determining the sample population, the participants to be recruited to this study were selected based on CPAP adherence. The study objective was to delineate and compare the sleep characteristics of patients having outstanding CPAP adherence with patients having poor treatment adherence.

Thus, two groups of veterans were identified based on CPAP adherence as determined by the following criteria. Patient adherence data were collected and analyzed using the AirView (usual care monitoring) and MyAir (active patient engagement), databases developed by ResMed, which is a global manufacturer of CPAP masks and machines. AirView is a HIPAA-compliant, password-protected wireless tele-monitoring technology (Malhotra, Crocker, & Willes, 2017). Patients create an account for themselves and both the patients and the clinicians can access the platform. The cloud-based website includes patient-entered data on average hours of use, mask seal, leakage levels, and residual breathing pauses per hour based on the detection of air flow to the patient. CPAP device data are transferred to the AirView platform on a daily basis to help clinicians remotely monitor sleep-disordered patients' treatment compliance.

CPAP usage data was monitored for all patients who have visited Dr. Barry Fields's office at the Atlanta VA Clinic in Decatur throughout 2014- 2017. In accordance with U.S. Medicare criteria for adherence, patients with outstanding treatment adherence used CPAP for ≥ 4 hours per night on at least 70% of nights during a consecutive 30-day period during the fist 90 days of initial usage. By contrast, poor adherence was specified as 0 to 20% days of device usage that exceeds four hours within the first 90 days of usage.

The target sample size comprised forty patients (n=20 in each group). To assure recruitment and retention of the requisite number of participants, sixty patients (n=30 in each group) were identified as candidates for recruitment. Contact information (telephone number and home address) was then compiled. Potential candidates for the phone interview were notified through mail. Each mail packet contained a cover letter, consent form, partial HIPAA (Health Insurance Portability and Accountability Act) waiver, and a research brochure about participation in VA research (all forms are attached in the Appendices). Five business days after sending out the mail packets, veterans were contacted by phone and their permission to take part in the study was requested.

Questionnaire and Interview Script Development

Once the research proposal was developed and the study population identified, the questionnaires and interview scripts were written (See Appendix III). The interviews and questionnaires were intended to assess both quantitative and qualitative data of veteran patients' sleep patterns and practices. Therefore, the interview was divided into 4 components: 1) Sleep Habits, 2) Sleep Ecology, 3) Satisfaction with Life Scale, and 4) Beliefs about Sleep Scale. The first two parts gleaned qualitative information about patients' sleep patterns, arrangements, and bedroom environment, whereas the second half of the interview collected quantitative data on patients' self-reported subjective scores on satisfaction with life and beliefs about sleep. Given that potential participants were widely dispersed geographically, it was determined that a structured phone interview lasting thirty to forty minutes would be the most appropriate method of data collection for this project.

Interview questions were slightly modified after conversations with 5 veterans. Veterans were asked why CPAP treatment was sustained or discontinued, the number of pillows used, the room temperature of the sleeping environment, and whether they would classify their bedrooms as quiet or noisy.

Preliminary Research and IRB Approval

This project was submitted for Emory Institutional Review Board (IRB) approval in the summer of 2017. The IRB addendum (approved on August 1st, 2017) included new questionnaires and surveys intended to probe the newly developed questions as written in the "Research Questions" and "Background" sections of the project.

Ethical Considerations

The names of the study participants were not recorded with patient data; rather, a study number was assigned to each patient for use on all study materials. All Personal Health

Information (PHI) collected and used for the purposes of this study was securely held using standard practices to guarantee its confidentiality, in accordance with applicable federal and/or local laws, rules and regulations governing PHI.

Data Collection

Data collected via wireless modem (cloud-based CPAP compliance data) were de-identified, such that no personal identifiers exist outside the VA firewall, in accordance with the VA-approved processes used in usual care. All data collected electronically were stored on a VA secure network, and as hard copies was kept in a locked file cabinet, in a locked office. Only the investigators and study coordinators had access to this information.

Data collected included demographic and anthropometric parameters, CPAP adherence data, and questionnaires about sleep ecological patterns included in the appendices. Due to the nature of Home Sleep Apnea Testing (HSAT), sleep latency cannot be determined. HSAT only gauges blood oxygenation levels and respiratory indices. Additionally, CPAP machines estimate respiratory indices but cannot estimate other sleep parameters, such as total sleep time.

Phone interviews were conducted during the period from September 28th, 2017 to December 10th, 2017. The semi-structured interview approach involved asking questions that explored the issues within the study's conceptual framework. The participants' feedback helped us identify appropriate language and phrases that would be understood by them. By using this approach, we ensured that the same topics were explored with each patient; however, we also had the ability to be responsive to the issues that arose during the interview and to ask patients to elaborate further through probing questions. We did not audio record interviews due to the

HIPAA Compliance regulations. The field notes were taken in real time on a computer during the interviews. The mean time for interviews was 30 minutes.

Data Analysis

Statistical analysis for quantitative results was performed using R Programming and Microsoft Excel. Outstanding adherent and poorly adherent patients were compared using Chi-square test for categorical values and 2-sample t-test for continuous variables. Multivariate analysis (MANOVA) and Principal Component Analysis (PCA) were also calculated in RStudio using the binary adherence level (outstanding or poor) as the dependent variable. Demographic tables presenting baseline characteristics of patients were also created in R using descriptive statistics. P statistic is pre-defined as < 0.05, with Bonferroni correction for multiple analyses, where appropriate.

A total of twenty-one (21) variables were individually examined using the univariate analysis. Then, the most significant variables that were associated with adherence were selected for in the multivariate model. The unadjusted and adjusted estimates of coefficients and p-values were reported.

Thematic Analyses

Inductive content analysis was employed, in order to capture patients' experiences of OSA and CPAP without projecting preconceived notions but rather allowing categories and themes to evolve from the data. To derive themes, we developed and refined a codebook through an iterative process after reading all 40 interviews multiple times and discussing possible themes. Several subcategories of the main themes were developed to illustrate the nuanced patterns found within the interview documents. Then, each transcript was independently coded using Dedoose version 4.5 (2013), a software program designed to facilitate the analysis of qualitative data. An initial list of themes was identified and coded. Using Dedoose, density estimates- the number of codes assigned to each category- were also performed.

Chapter 3:

Results

This research included both quantitative data from patients' medical records and the self-reported measures from the phone interviews, as well as qualitative data from the interviews' open-ended questions. I gathered data from 40 participants, 20 in the outstanding treatment-adherent cohort and 20 in the poor treatment- adherent cohort.

Quantitative Data

Demographic Information of Patient Participants

All participants' demographic information appears in Table 1 of patient baseline characteristics. At baseline, upon patients' initial visit to the sleep clinic, outstanding and poor treatment-adherent patients did not differ in terms of age, ethnicity, sex, body mass index (BMI), and apnea-hypopnea index (AHI).

Table 1. Patient Characteristics at Baseline. Values presented as mean ± standard deviation or n (%). AHI, Apnea Hypopnea Index. [1]n= 19.

	Outstanding (n=20)	Poor (n=20)	p-value
Age	65.20 ± 10.13	60.65 ± 12.67	0.2176
N (%) Caucasians	17 (85%)	15 (75%)	0.5793
N (%) Male	19 (95%)	20 (100%)	1
BMI (kg/m²)	30.81 ± 7.42	31.35 ± 6.32	0.8062
AHI (event/hour)	31.68 ± 24.10[1]	23.75 ± 15.84	0.2365

Sleep Practices: Daytime Nap Length vs. Adherence

When asked, "How long do your naps usually last," the reported daytime nap length between groups did not reach statistical significance.

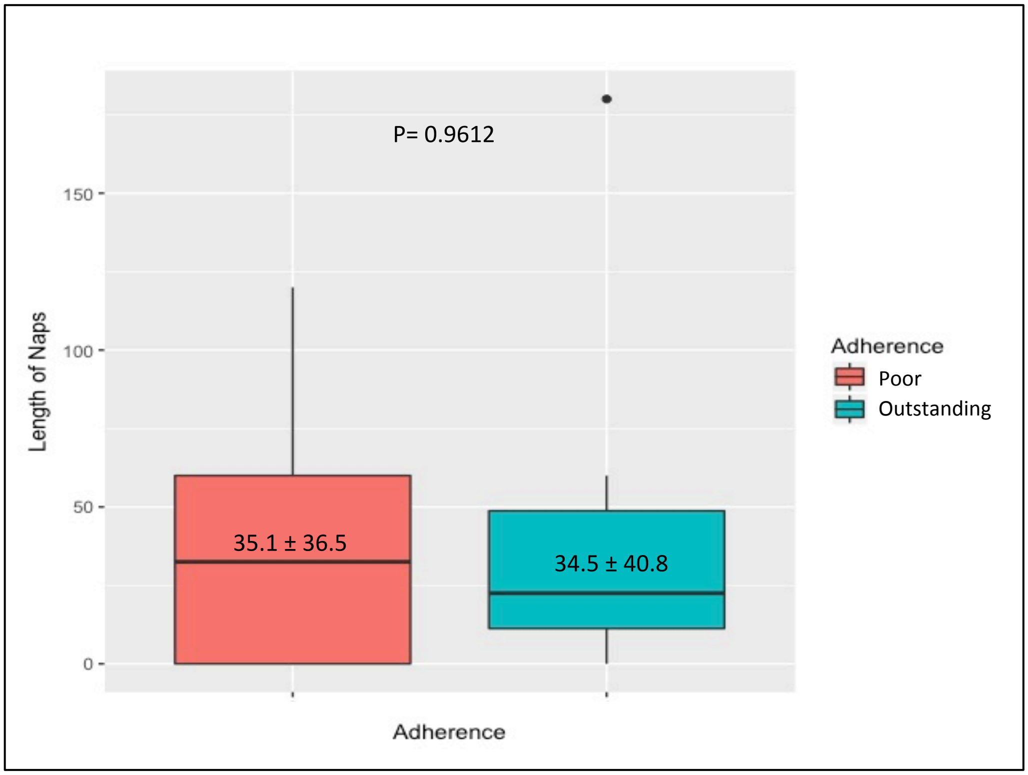

Figure 3. Boxplot comparing groups' daytime nap length.

Sleep Practices: Frequency of Naps Per Week vs. Adherence

There was no significant variation in respective cohorts' reported frequency of naps taken within a week.

Table 2. Comparison of Frequency of Naps Taken Per week Between Groups. P-value calculated from Fisher's Exact Test.

Frequency of Naps Per Week	Outstanding (n=20)	Poor (n=20)	P-value
N/A	5 (25%)	7 (35%)	0.7076
Rarely (< once a week)	4 (20%)	1 (5%)	
Sometimes (1-2 times a week)	4 (20%)	5 (25%)	
Usually (3-6 times a week)	3 (15%)	4 (20%)	
Everyday	4 (20%)	3 (15%)	

Sleep Practices: Napping Time During the Day vs. Adherence

When asked, "When did you usually nap during the day," the respective cohorts showed no statistically significant differences in their reported times in which they took naps.

Table 3. Comparison of groups' napping time during the day. P-value calculated from Fisher's Exact Test.

Nap Time	Outstanding (n=20)	Poor (n=20)	P-value
No naps.	5 (25%)	7 (35%)	0.3318
Morning	0	1 (5%)	
Mid-day to early afternoon	5 (25%)	8 (40%)	
Mid- late afternoon	7 (35%)	3 (15%)	
Evening	0	0	
Anytime	3 (15%)	1 (5%)	

Sleep Practices: Location of Naps vs. Adherence

There was no significant variation in respective cohorts' nap location.

Table 4. **Comparison of Nap Locations Between Groups. P-value calculated from Fisher's Exact Test.**

Location of Naps	Outstanding (n=20)	Poor (n=20)	P-value
No naps.	5 (25%)	7 35%)	0.8605
Bedroom	2 (10%)	4 (20%)	
Recliner	8 (40%)	6 (30%)	
Living Room/ Couch	3 (15%)	2 (10%)	
Anywhere	1 (5%)	1 (5%)	

Bedtime Practices: Screen Time (TV and computer) Before Bed vs. Adherence

Almost all of the patient participants engaged in screen time before bed. There was no statistically significant variation in groups' screen time before bed (engagement with TV and computer screens).

Table 5. **Comparison of Screen time Before Bed Between Groups. P-value calculated from Fisher's Exact Test.**

Screen time before bed	Outstanding (n=17)	Poor (n=17)	P-value
Screen always on	8 (47.1%)	4 (23.5%)	0.4872
Immediately before bed	6 (35.3%)	6 (35.3%)	
15-30 min	1 (5.9%)	0	
30- 60 min	1 (5.9%)	6 (35.3%)	
No screen time	1 (5.9%)	1 (5.9%)	

Bedtime Practices: Looking at clock by bedside vs. Adherence

When asked whether or not the participant looks at clock by bedside, the reports showed that there was no statistically significant variation in groups' bedtime habit in looking at clock at bedside.

Table 6. **Comparison of Bedtime Behavior in Looking at Clock by Bedside Between Groups. P-value calculated from Pearson's Chi-Squared Test.**

Look at Clock by Bedside?	Outstanding (n=20)	Poor (n=20)	P-value
Yes	12 (60%)	9 (45%)	0.3422
No	8 (40%)	11 (55%)	

Sleep Beliefs: Perceived Sufficiency of Sleep vs. Adherence

There was no statistically significant association between respective cohorts' perceived sleep sufficiency and CPAP adherence. Responses were collected in binary form (0= "NO", 1= "YES") from the interview question: "Overall, do you think you get sufficient sleep?"

Table 7. Comparison of Perceived Sufficiency of Sleep Between Groups. P-value calculated from Pearson's Chi-Squared Test.

Sufficient Sleep?	Outstanding (n=20)	Poor (n=20)	P-value
Yes	14 (70%)	11 (55%)	0.3272
No	6 (30%)	9 (45%)	

Sleep Beliefs: Self-Reported Sleep Duration vs. Adherence

Following the previous question of whether or not the participant thought he/she got sufficient sleep, I probed further with the question: "To be more specific, how sufficient is the sleep you get?" The results indicated that adherence groups differed significantly in their self-reported levels of sleep sufficiency and CPAP adherence. Specifically, outstanding adherent groups are more likely to indicate that they sleep just enough for their needs.

Table 8. Comparison of Self-Reported Duration of Sleep Between Groups. P-value calculated from Fisher's Exact Test and denoted statistical significance.

Self-Reported Duration	Outstanding (n=20)	Poor (n=20)	P-value
I sleep a lot more than I need.	0	1 (5%)	0.04616**
I get plenty of sleep.	3 (15%)	3 (15%)	
I sleep just enough for my needs.	11 (55%)	7 (35%)	
I don't get quite enough sleep.	6 (30%)	3 (15%)	
I get much less sleep than I need.	0	6 (30%)	

Sleep Beliefs: Differences in Perceived Sleep Needs and Perceived Sleep Time

At baseline, upon patients' initial visit to the sleep clinic, all patients were asked to indicate their perceived sleep time and perceived sleep needs. Differences between their self-reported sleep time and sleep needs were calculated and there were no statistically significant differences between respective cohorts.

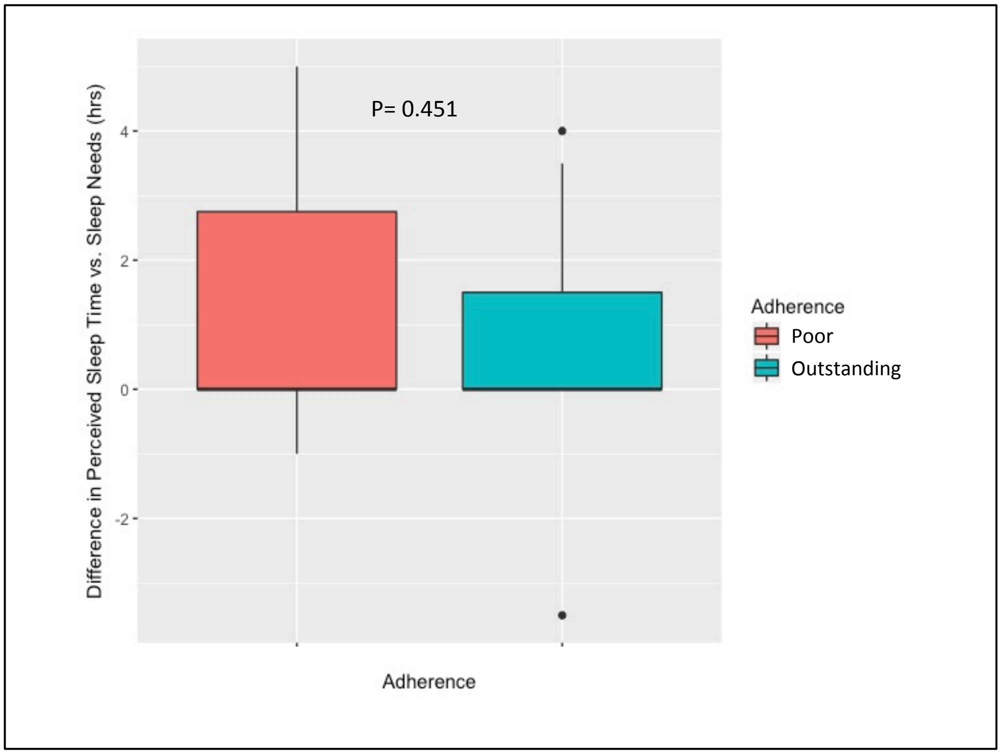

Figure 4. Boxplot comparing groups' differences in perceived sleep needs and sleep time at baseline.

Sleep Beliefs: Appropriateness in Sleep Duration

There was no statistically significant variation in groups' belief that 8 hours of sleep is essential to one's well-being. Responses were collected from the *Beliefs about Sleep* Questionnaire in which respondents were asked to rate the statement, "I need 8 hours of sleep to feel refreshed and function well during the day", on a scale of 0-10 (strongly disagree- strongly agree).

Table 9. Comparison of Groups' Evaluation of Appropriateness in Sleep Duration. P-value calculated from Pearson's Chi-Squared Test.

Rating (from 0-10)	Mean ± SD	P-value
Poor (n=18)	7.17 ± 2.64	0.3633
Outstanding (n=19)	6.37 ± 2.62	

Principal Component Analysis

In order to reduce the potential intercorrelation among the data generated from the 16 questions of the *Beliefs About Sleep* Questionnaire, we performed Principal Component Analysis (PCA). One of the most common phenomena in statistics is intercorrelation among item scores on a questionnaire. This means that response for one question would be expected to correlate significantly with response for another question. PCA is a useful method when many different explanatory variables are likely to be correlated. Through linear optimization, the analysis reduces a large number of correlated variables to a small number of components (Jellema and Rolland, 2011).

The first PCA model had an eigenvalue of Principal Component 1 that explains 40% of the variation and thus captures 40% of patients' sleep attitudes. For further multivariate analyses, we put Principal Component 1 (PC1) in the multivariate model, instead of the aggregation of the 16 questions. PC1 can be considered the weighted average of all the original questionnaire variables and the analysis demonstrated that it had positive loadings of all the individual questions. In other words, all of the questions are positively correlated with each other, and if there were a higher individual score on a particular question, a higher score on PC1 would be yielded. The PCA analysis was successful in disentangling the contribution of different questionnaire variables and identifying critical beliefs about sleep among the veteran patients.

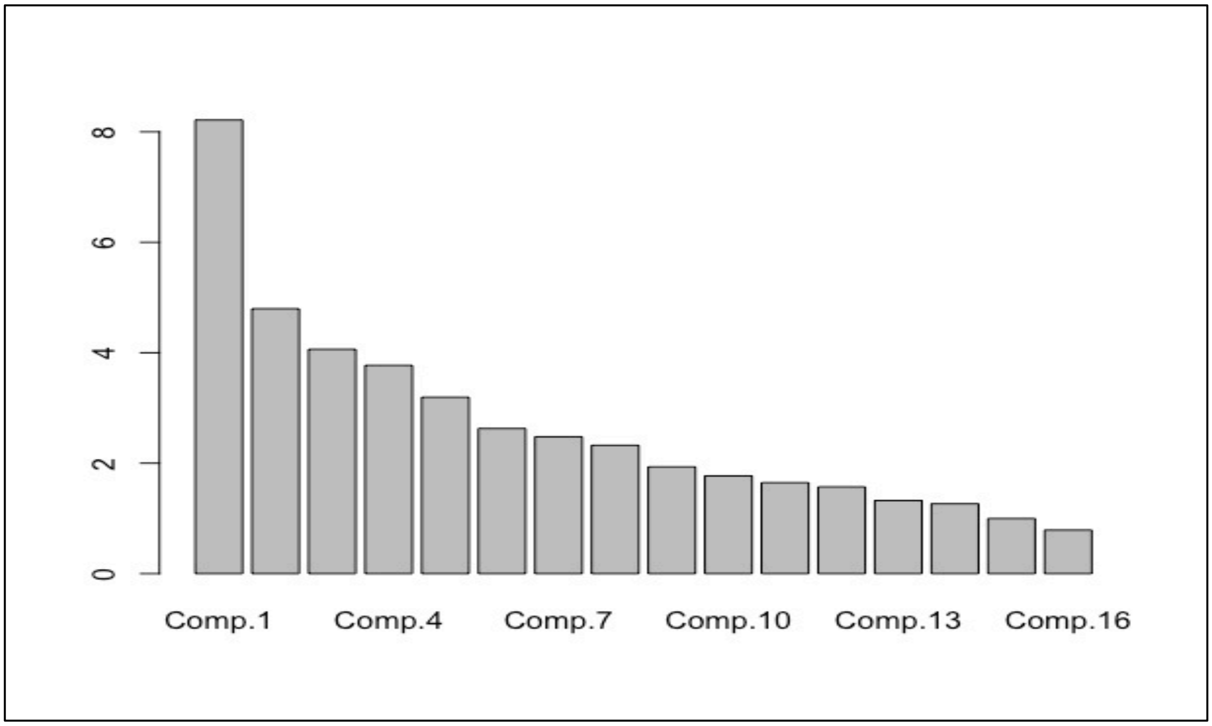

Fig 5. Scree Plot PCA. Visualizes eigenvalues and the level of variances explained by each principal component.

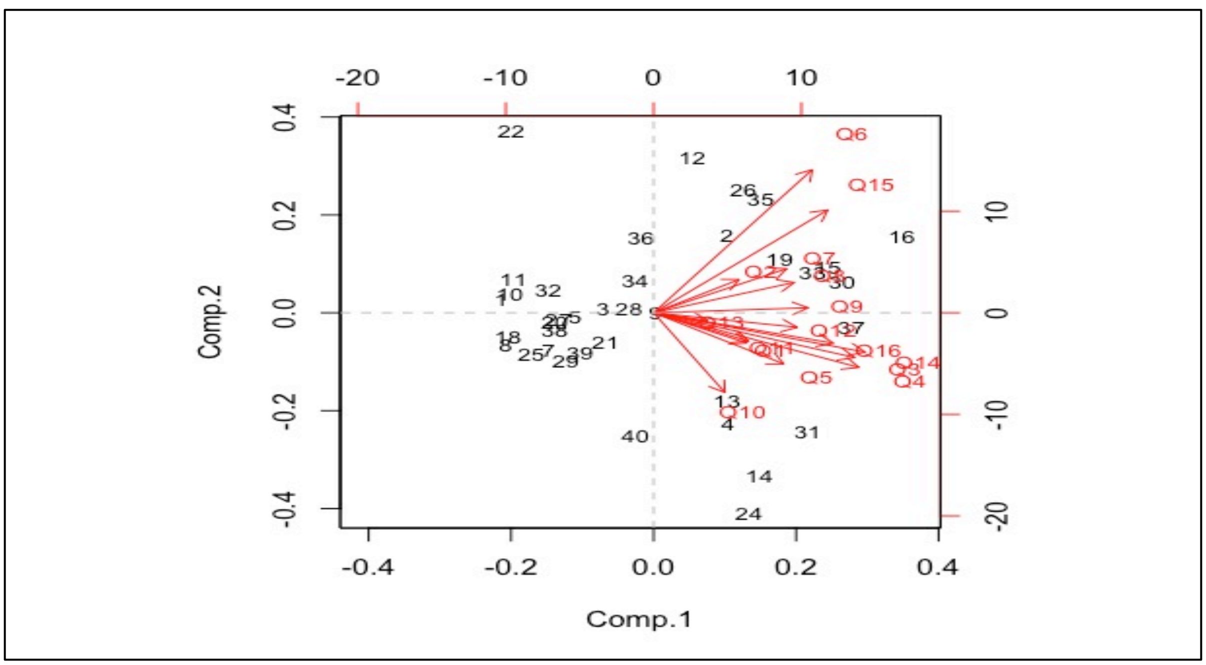

Fig 6. Graph of variables from the Sleep Belief Questionnaire. Positive correlated variables point to the same side of the plot. Negative correlated variables point to opposite sides of the graph.

Sleep Ecology: Social History at Baseline vs. Adherence

There was no statistically significant variation in groups' social history records, in terms of whether the patients lived alone or with spouse/ family at baseline. The responses were gleaned from patients' first diagnostic medical notes.

Table 10. Comparison of Groups' Social History: Self-Care/ Home Environment Assessment. P value calculated from Fisher's Exact Test.

Did patient live with someone else at baseline?	Outstanding (n=20)	Poor (n=20)	P-value
Yes	17 (85%)	15 (75%)	0.6948
No	3 (15%)	5 (25%)	

Sleep Ecology: Co-sleeping vs. Adherence

Outstanding treatment-adherent patients demonstrated higher incidence of bed-sharing and co-sleeping behaviors at the time of interview.

Table 11. Comparison of Groups' Nighttime Co-sleeping Behavior. P value calculated from Pearson's Chi-Squared Test and denoted statistical significance.

Co-sleep	Outstanding (n=20)	Poor (n=20)	P-value
Yes	16 (80%)	10 (50%)	0.0467*
No	4 (20%)	10 (50%)	

Sleep Ecology: Sleep Substrate vs. Adherence

There was no statistically significant variation in groups' use of bedding substrate.

Table 12. Comparison of Groups' Use of Sleep Substrate. P-value calculated from Fisher's Exact Test.

Substrate	Outstanding (n=20)	Poor (n=20)	P-value
Bed	19	18	0.4872
Bed and Sofa	0	2	
Recliner	1	0	

Sleep Ecology: Number of Pillows vs. Adherence

There was no statistically significant variation in groups' number of pillows used at night.

Table 13. Comparison of Groups' Number of Pillows Used at Night. P-value calculated from Pearson's Chi-Squared Test.

	Mean ± SD	P-value
Poor (n=19)	2.03 ± 1.06	0.6009
Outstanding (n=17)	1.82 ± 1.22	

Sleep Ecology: Padding/Cushions vs. Adherence

There was no statistically significant variation in groups' use of padding or cushion.

Table 14. Comparison of Groups' Use of Padding and Cushions. P-values calculated from Pearson's Chi-Squared Test.

Usage of Padding/ Cushions?	Outstanding (n=17)	Poor (n=19)	P-value
Yes	5 (29.41%)	9(47.37%)	0.2699
No	12 (70.59%)	10 (53.63%)	

Subjective Well-Being: Satisfaction with Life Scores vs. Adherence

The density plot below shows the distribution of respective cohorts' satisfaction with life scores (See Appendix III for interview questions). Scores were tallied from a total of five responses (total score= 35). Outstanding treatment-adherent patients expressed higher levels of life satisfaction and its distribution was more concentrated within the spectrum on the higher end. In contrast, poor treatment-adherent patients expressed lower levels of satisfaction with life and their scores were widely dispersed across the spectrum.

Figure 7. Density Plot of Distribution of Satisfaction with Life Scores in accordance to adherence levels.

Furthermore, Figure 8 illustrates the difference in satisfaction with life scores among the different adherence groups by depicting a boxplot of the groups' means and their standard deviation. The analysis of variance showed significant differences between groups' sense of life satisfaction and that outstanding adherent patients expressed relatively higher levels of life satisfaction.

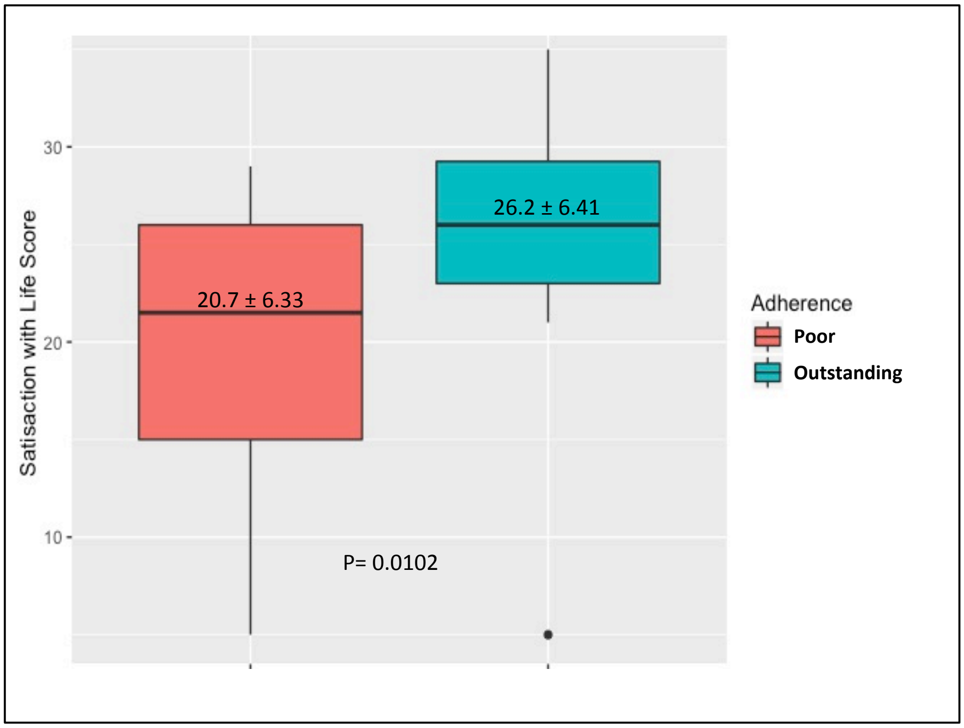

Figure 8. Boxplot comparing groups' satisfaction with life scores. P-value reflected mean satisfaction with life scores and denoted statistical significance.

Univariate and Multivariate Analyses

To identify what role, if any, the statistically significant univariate variables had on CPAP adherence, we performed a repeated measured Multivariate Analysis of Variance (MANOVA). This analysis examined the simultaneous contribution of multiple factors--cariables were retained in the model based on their unique and significant contributions to elucidating the differences in treatment adherence. Variables with very high p-value and thus, high correlations with other variables, were not useful for the logistical model and were eliminated.

Table 15. Predictors of CPAP Treatment Adherence Using Univariate and Multivariate Logistic Regression (N=40, n=20 outstanding adherent patients, n=20 poor adherent patients.

	Univariate		Multivariate	
Factors	Estimate	P-value	Estimate	P-value
Sex	-	1	-	-

Age	-	0.2176	-	-
Race	-	0.5793	-	-
BMI Baseline	-	0.8062	-	-
AHI Baseline	-	0.2365	-	-
Daytime Nap Length	-	0.961	-	-
Frequency of Naps Per Week	-	0.7076	-	-
Nap Time During the Day	-	0.3318	-	-
Daytime Nap Location	-	0.8605	-	-
Screen time Before Sleep	-	0.4872	-	-
Look at clock by bedside? (Yes/ No)	-	0.3422	-	-
Self-Reported Duration of Sleep	0.914	**0.04616***	0.694	0.5017
Difference in Perceived Sleep Time and Sleep Needs	-	0.451	-	-

Appropriateness in Sleep Duration	-	0.3633	-	-
Social History at Baseline: Did Patient Live with Someone Else? (Yes/No)	-	0.6948	-	**-**
Co-Sleep Behavior at Follow-Up (Yes/No)	4.000	**0.0407***	0.0581	**0.0388***
Sleep Substrate	-	0.4872	-	-
Number of Pillows	-	0.6009	-	-
Padding/ Cushions (Yes/ No)	-	0.2699	-	-
Satisfaction with Life Scores	1.0301	**0.0102***	1.1270	0.1124
PC1	-	0.191	0.9271	0.4533

In the single unadjusted linear regression model, factors such as self-reported sleep duration, co-sleep behavior, and satisfaction with life score yielded statistically significant associations with CPAP adherence levels. At baseline, when a patient has no sleep partner, reported the lowest duration of sleep, scored zero on the Satisfaction with Life scale and PC1, his/her probability of adherence is 5.49%. When adjusted for various covariates including PC1, co-sleep behavior, and satisfaction with life score, the adjusted p-value for the association between self-reported sleep duration and CPAP adherence is 0.5017, indicating the association is not statistically significant. The same statistical trend is seen in the variables, PC1 and satisfaction with life score. On the contrary, when adjusted for other covariates including PC1, satisfaction with life score, and self-reported sleep duration, the adjusted p-value for the association between co-sleep behavior and CPAP adherence is 0.0388, suggesting that the association is statistically significant. Therefore, participants who reported having a sleep partner at baseline had a 86.57% greater likelihood of CPAP adherence.

Qualitative Results

Participants generated the following 5 thematic clusters: 1) physical comorbidities; 2) psychiatric comorbidities; 3) benefits from CPAP use; 4) problems with CPAP use; and 5) relationship issues.

Table 16. Description of categories and subcategories/ concepts related to patients' health conditions and experiences with sleep apnea and the CPAP therapy.

Benefits from CPAP Use

Bed partner benefits

Less snoring

Sleep duration

Sleep quality

Problems with Use

Claustrophobia
Airway Drying
Inconvenience
Dislike of the CPAP machine
Complaints of nose and frequent awakenings
Ineffective communication with the VA
Lack of knowledge of the equipment
Mask Leaks/ Poor mask fit/ Mask Discomfort
Psychiatric Comorbidities
PTSD
Depression and anxiety
Physical Comorbidities
Cardiovascular disease
Disability
GI related digestive disorder
Lung diseases
Movement related disorders
Obesity-related comorbidities
Relationship Issues
Bed partner complained about unusual movements during sleep
Bed partner reports snoring
Bed partner witnessed periods of apneas
Snoring affected family members other than bed partners

Lack of sleep drives bed partners away

Table 17. Code Weight Statistics of the Derived Themes and Sub-themes. The values in the Count column represent the number of patients who had identified with the themes/ subthemes in the interviews.

Themes	Count
Benefits from use	21
Bed partner benefits	4
Less snoring	6
More daytime energy	9
sleep duration	6
sleep quality	16
Physical comorbidities	39
Cardiovascular disease	22
Disability	3
GI related digestive disorder	12
Lung Diseases	3
Movement related disorders	15
Obesity related comorbidities	19
Problems with use	29
Airway Drying	4
CPAP mask slides off; cannot hold it	7
Claustrophobia	4
Complaints of nose and frequent awakening	6
Dislike of CPAP Treatment	5
Inconvenience	3
Ineffective communication with the VA	4
Lack of knowledge on the equipment	2
Mask Leaks and sore eyes	3
Psychiatric comorbidities	19
PTSD	9
depression and anxiety	15
Relationship Issues	25
Bed partner complained about unusual movements during sleep	2
Bed partner reports snoring	17
Bed partner witnessed periods of apneas	17
Snoring affected family members other than bed partner	3
lack of sleep drives partners away	3

Psychological Effects

The Code Weight Statistics in Table 17 displayed the statistics of how the weights for each theme and sub-theme were distributed across code applications. The values in the code count cells represent the number of patients who had identified the themes/ subthemes in their interviews. A patient may allude to the themes multiple times in his/her interview; in this case, we would still consider it as 1 count. From the table, one can infer that 39 out of 40 patients have experienced physical comorbidities other than OSA, based on the analysis of their initial diagnostic notes.

Furthermore, based on patients' responses to the interview questions (see Appendices) and their medical diagnostic notes, 19 out of 40 patients have experienced psychiatric comorbidities, such as PTSD, depression, or anxiety. In particular, 11 poorly adherent patients were diagnosed with psychiatric comorbidities, while 8 outstanding adherent patients were diagnosed with psychiatric comorbidities. Out of the 11 poorly adherent patients, 4 patients have developed PTSD and 11 patients have developed anxiety or depression. Please notice a caveat: a patient may develop all of the three concomitant psychiatric comorbidities. On the other hand, out of the 8 outstanding adherent patients, 6 patients have developed PTSD and 4 patients have developed anxiety or depression. It remains unclear whether the two adherence groups show a statistically significant variation in the number of patients who experienced psychiatric comorbidities due to insufficient power to detect a difference.

Barriers and Drivers for CPAP Use

Patients cited lack of knowledge of the CPAP equipment, ineffective communication with the healthcare providers at the VA system about the logistical issues, dislike of the machine, panic attacks caused by the mask, and frequent awakening caused by the machine as barriers to CPAP adherence.

In particular, difficulties with the mask, which include poor mask fit, discomfort and claustrophobic attacks caused by the mask, and mask leakages were commonly reported obstacles to treatment adherence.

> ***Patient 1004 (poor adherence)****: I cannot use the CPAP machine because my gums are deteriorating and the CPAP mask always slides off. I cannot hold the CPAP mask.*
>
> ***Patient 1014 (poor adherence)****: I cannot handle the machine…It is not normal to have something on your face. When I wake up, I always slapped it off my face.*

A couple of patients also attributed their cessation of CPAP therapy to other ongoing health conditions and related medications, such as heart surgery, shoulder replacement surgery, or chemotherapy.

> ***Patient 2005 (outstanding adherence)***: *I was at the hospital for three weeks in July [of 2017]. I had an open-heart surgery (replace aorta valve). I stopped using the CPAP in July because of my surgery. My CPAP machine needed to be re-adjusted.*
>
> ***Patient 1042 (outstanding adherence)****: I am scheduled for a shoulder surgery and I am having a hard time with my sleep. I have been sleeping in a recliner for the past two months. If I lay down in my bed, I would roll over on my side and my shoulders would hurt…I absolutely cannot use the CPAP machine in a recliner chair.*

Patient 3010 (poor adherence)*: I am taking a lot of pain medications since I am on chemotherapy right now. So, I sleep longer and I don't bother using the CPAP machine.*

Patients also expressed annoyance with frequent arousals caused by the CPAP machine, reduced duration of sleep because of the treatment, and difficulties sleeping in preferred position or location due to the mask.

Patient 1042 (outstanding adherence)*: My sleep has been basically the same. I did use the CPAP machine for a while and I absolutely cannot use it in a recliner chair. I am scheduled for a shoulder surgery and I am already having a hard time with my sleep. I have been sleeping in a recliner for the past 2 months. If I lay down in my bed, I would roll over on my side and my shoulders would hurt. I just couldn't use the CPAP machine lately.*

Patient 1014 (poor adherence): *It kills my shoulders really bad when I try to sleep on my sides. Also, I cannot sleep on my stomach with the mask on my face.*

Insufficient knowledge about the different accessories and components of the machine and lack of effective communication with the health providers at the VA Medical Center also led to patients' frustration with the treatment.

Patient 1045 (outstanding adherence)*: I would suggest a follow-up when you order the CPAP accessories- like the extra hoses. I always receive a recorded message [when I call the VA]. It would be more assuring if I can get a follow-up phone call from someone. The VA tells you something and you never really know until [the machine] shows up at your door.*

Patient 1036 (Outstanding adherence): *How can I contact the VA Medical Center? I want to find out more [about the] CPAP heating element to its container.*

In contrast, the benefits of using CPAP such as improvements in sleep duration and sleep quality, less frequent snoring, less frequent arousals during the night, and more energy during the day were motivations for patients to sustain treatment.

Patient 1035 (Outstanding adherence): *Before [using CPAP] I was tired all the time. Now, I get more sleep. I was sleeping for an hour to 2 hours per night for 8 years. The CPAP has improved my sleep drastically.*

Patient 1036 (Outstanding adherence): *My wife goes to bed a little earlier than I do in most cases. She would make snoring noises, which I don't anymore with the CPAP.*

Bed partner also benefited from patients' usage of CPAP treatment. Encouragement, support, and reassurance from a partner can help patients' continue with their long-term adherence.

Patient 1011 (Outstanding adherence): *I was always restless before diagnosis of sleep apnea. Since using the machine, my wife has been feeling better and more comfortable.*

Chapter 4:

Discussion and Limitations

In this thesis I sought to explore patterns of sleep behaviors, sleep practices, sleep environment, and demographic information among OSA veterans that might serve as treatment adherence barriers or facilitators. To our knowledge, it is the first to examine CPAP adherence from a cultural anthropological perspective. The study demonstrated:

1) **Patient Characteristics**: Visual inspection of the demographic information of our sample (Table 1) indicated that there was no variation in baseline characteristics (BMI, AHI, race, age, and gender) between the outstanding treatment-adherent group and the poor treatment-adherent group.
2) **Sleep and Bedtime Practices**: Adherent patients and non-adherent patients show no statistically significant variations in their daytime napping patterns, including nap frequency per week, nap time during the day, and nap location. Additionally, there was no statistically significant variation in both group' use of screen time before bed.
3) **Sleep Beliefs**: The adherent patients and non-adherent patients showed no variation in their self-reported perceived sufficiency of sleep. However, upon further inquiry regarding the patients' level of sufficiency of sleep, groups demonstrated different self-reported duration of sleep. In particular, the outstanding adherent patients are more likely to answer, "I sleep just enough for my needs."
4) **Sleep Ecology**: Outstanding adherent patients are more likely to engage in co-sleeping behaviors in comparison with poor adherent patients. Upon reviewing the patients' proximate physical ecology of sleep, there was no variation in both groups'

bedding, which includes substrate, use of covering on substrate, covers, and numbers of pillows used.

5) **Subjective Well-Being**: Outstanding adherent patients reported significantly higher satisfaction with life scores.
6) **Psychological Effects:** Based on manual count of the codes, it was calculated that 39 out of 40 patients were burdened by other concomitant physical comorbidities, with cardiovascular disorders being the most common comorbidities that OSA veterans experienced. Also, it was calculated that 11 poorly adherent patients were diagnosed with psychiatric comorbidities, while 8 outstanding adherent patients were diagnosed with psychiatric comorbidities. It is unknown whether the two adherence groups show a statistically significant difference in the number of patients who experienced psychiatric comorbidities.

Why the Presence/ Absence of Differences?

Patient Characteristics

Age, sex, and socioeconomic status, and race have been examined as factors of CPAP adherence in several studies. In a large, retrospective cohort study among veterans with CPAP-treated OSA (n=266), adherence with CPAP was associated with higher census-derived socioeconomic status index, independent of other patient characteristics, such as race (Sawyer et al., 2011). The issues of whether race and gender play a role in treatment adherence also have been investigated. For instance, a retrospective study characterized differences in treatment adherence in sleep-disordered breathing between African Americans and Caucasians, and found that African Americans were 5.5 times more likely to be non-adherent than Caucasian patients, after controlling for sex and BMI (Scharf et al., 2004). Also, women were 1.72 times more likely to be non-adherent than men, adjusting for race, marital status, and age (Joo et al., 2007). Compounded to these findings about the association between patient characteristics and CPAP adherence, some other studies have also elucidated patterns of CPAP use based on weight/ BMI distribution. In this study, we hypothesized that patients with higher BMI were less likely to adhere to CPAP treatment, due to more discomfort with the mask. Our hypothesis was not supported by the findings.

CPAP adherence reflects other aspects of patients' lifestyle, which may involve management of other health problems, such as diabetes, cardiovascular diseases, and obesity. Previous investigations that used the health belief model as the conceptual framework for understanding CPAP adherence revealed the complex interactions between patients' perceptions of disease severity, outcome expectancies, and motivations of therapy use. The study showed that there was no significant direct relationship between adherence and BMI. However, inspection of intercorrelation matrices revealed that higher BMI at baseline was associated with greater functional limitations including greater perceived risk, lower activity levels, poorer vigilance, lower productivity throughout the day, and higher stress scores and depression (Olsen et al., 2008). Thus, the underlying relationship between BMI and CPAP adherence is nuanced and remains ambiguous.

In line with Olsen et al., a recent prospective, observational study conducted in Isfahan, Iran, found that patients with BMI > 35 showed greater adherence to treatment (Soltaninejad et al., 2017). Also, Gagnadoux and colleagues from France demonstrated that BMI is an independent predictor of long-term CPAP adherence, and increasing BMI was a significant determinant of the number of hours of use of the device per night. They suggested that higher perceived functional limitations in overweight and obese patients might contribute to higher CPAP usage.

However, in our study, outstanding and poorly adherent patients did not demonstrate differences in baseline BMI. The lack of correlation between BMI and CPAP adherence may be explained by our unique patient population. Data on demographic characteristics (Table I) revealed that both groups of patients had relatively high BMI values. Due to the rigorous medical evaluations required to enter military service and the strenuous physical fitness training mandated throughout one's military career, obesity might be expected *a priori* to be less common among veterans than non-veterans. Yet, veterans face uncommon challenges after their military experience, including homelessness, job challenges, PTSD, and other issues related to combat operations. Indeed, the obesity epidemic significantly affects the military (Almond et al., 2008). According to Almond et al., 73.3% of male veterans and 53.6% of female veterans were overweight (BMI≥ $25kg/m^2$). ; 25.1% and 21.2% were obese (BMI ≥ $30kg/m^2$), respectively. Therefore, since our study population consisted of more overweight and obese patients, definitive conclusions between body weight at baseline and adherence behaviors cannot be drawn.

Sleep and Bedtime Behaviors

We had hypothesized that non-adherent patients would adopt less routine nighttime bedtime practices and nap for a longer duration during the daytime in comparison to adherent patients. Our hypothesis was supported by a study showing that longer CPAP treatment duration is associated with reductions in nap frequency and daily nap duration among adults aged 60 and older who have OSA (Hsieh et al., 2016).

However, there were no significant variations between groups' nap frequency, duration, and location. Interestingly, qualitative interviews revealed that some male veteran patients begrudged napping behavior and considered it as unnecessary. For example, Patient 1010 (outstanding adherence) said, " Even though I feel cheated when I don't get sufficient sleep, I never do naps. I see them as a waste of time. When I was in the military…. If possible, I would not even sleep at all and I would be up 24/7." Another patient attributed his absence of napping to his previous military training: Patient 1011 (outstanding adherence) pointed out, "I don't do naps because I am a warrior and I always got something to do." The above anecdotal evidence may explain why over 50% of the participants do not engage in daytime napping behaviors.

Another intriguing point raised from our analysis was the locations in which the veterans chose to nap: in particular, 40% of outstanding adherent veterans and 30% poorly adherent veterans napped in recliner chairs. Even though there is very limited understanding in why veterans prefer sleeping in recliner chairs, our qualitative interviews may help us identify veterans' lifestyle behaviors and individual experiences. Based on the Code Weight Statistics (Table 17), one could infer that 39 out of the 40 patients were experiencing concomitant health problems other than OSA. Cardiovascular diseases (e.g. hypertension and coronary artery disease) are the most common comorbidities among the veterans. The complications of the veterans' health conditions may lead to their discomfort lying down in bed during the daytime. Questions regarding how pain and discomfort interfere with CPAP adherence need further investigations.

Sleep Beliefs

The assessment of the attitudes and beliefs toward sleep among OSA patients is scant in the sleep medicine literature. There is ample evidence that an individual's health outcomes are shaped by his/her illness attitudes, perceptions, and beliefs . For example, in response to the Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), researchers found that stoic attitudes towards sleep related to helplessness and hopelessness could be used to differentiate between good and poor sleepers (Carney et al., 2006). Therefore, it is plausible that the identification of maladaptive beliefs about sleep could have important clinical implications for predicting CPAP adherence behaviors. Recent research has elucidated the effects of healthy sleep practices on health-promoting behaviors. In a study done on 120 community-dwelling African American adult men, researchers found that participants at high risk for OSA endorsed dysfunctional beliefs towards sleep and also reported higher dissatisfaction with sleep (Williams et al., 2017).

In agreement with my hypothesis, adherent patients were more likely to report self-perceived sufficiency in their sleep duration. Our results are nuanced, however. When we asked whether or not the veterans believed he/she was getting sufficient sleep, there was no significant variation in their responses. Yet, the veterans demonstrated a more refined perception of their sleep sufficiency when we followed up with a scaled answer. In essence, the outstanding adherent patients were more likely to believe that they were getting sleep just enough for their needs. This disparity underscores the challenge of binary choice questions and their inadequacy to capture patients' perceptions towards sleep. Therefore, ethnographic qualitative interview questions are well positioned to help us gauge patients' sleep attitudes and sleep-related beliefs.

Sleep Ecology

Humans are unique in that culture and sociality play central roles in our sleep behaviors, experiences, and processes. Pair bonding and family-kinship configurations arrange the social interactions and conditions of everyday life in which sleep is structured. This study confirmed the positive influence that family formations have on human sleep niche and CPAP treatment adherence. Since OSA is a shared problem affecting both partners with disturbed sleep at night, excessive daytime fatigue during the day, and reduced quality of life, it seems plausible that CPAP adherence in men (please see Table I for gender distribution in research cohort) is associated with their co-sleeping behaviors. Indeed, a common reason veterans visit the sleep clinic is complaints from their bed partners. More times than usual, the partner's own sleep is disrupted by the patient's frequent movement arousals during the night, loud snoring, and sudden choking or gasping. This is manifested through some anecdotes from patients' diagnostic and phone interviews: for example, Patient 1014's (poor adherence) wife has told him that he chokes, snores, and jerks in his sleep and encouraged him to get tested at the VA Sleep Center. In other instances, the symptoms of OSA patients put strain on family members' routine sleep schedules and the family members have to adjust their bedtime practices accordingly. Patient 2033 (outstanding adherence) expressed, "My snoring was so bad that my children had to go to bed earlier. My wife doesn't go to bed the same time as I do due to my snoring as well." These pieces of anecdotal evidence endorsed OSA's common label as the "disease of listeners" (Schmaling & Afari, 2000). Such an identification not only denotes the importance of including the bed-partner as a key source of collecting data in patient's initial sleep evaluation, but also signifies that OSA is a disorder that imposes a burden on both partners.

Literature on couple sleep in nonclinical settings is scarce. Our finding that adherent patients are more likely to engage in co-sleeping behaviors at follow-up furthers our understanding of the nature of social support and therapy use. Indeed, Ye et al. reported that married participants used CPAP more than those who were not married. In line with Ye, Cartwright and researchers highlighted a central role of wives in husbands' adherence to CPAP. That is, treatment adherence to CPAP in married men is strongly associated with the frequency with which his partner sleeps with him during his initial home treatment (Cartwright et al., 2008).

More notably, our research unearthed an important observation. As previously described, patients' social history assessments during their initial diagnoses manifested no statistically significance by adherence in patients' responses to the question, "Do you currently live alone or with someone else?" The results showed that 85% of outstanding adherents patients and 75% of poorly adherent patients lived with a spouse or a partner. It was assumed that the patients co-sleep with a partner if they reported living with a spouse/ partner at baseline. Interestingly, our qualitative findings revealed more nuanced explanations in comparing patients' social histories at baseline and their co-sleeping patterns after a minimum of 3 months of CPAP usage. As noted earlier, outstanding adherent patients were more likely to co-sleep with a bed partner in comparison to poorly adherent patients at the time of follow-up. Therefore, a compelling enigma emerges: Had some poorly adherent patients given up the conjugal bed due to their lack of treatment adherence and persistence in OSA symptoms? Some anecdotes from the patients' interviews may help address this conundrum: Patient 3008 (poor adherence) said, "My wife and I don't sleep in the same room anymore because I wake up so often." In parallel with what Patient 3008 expressed, Patient 1060 (poor adherence) indicated that his wife has been encouraging him to get more sleep since he could not fall asleep until the early morning hours. Due to the incompatibility in between his and his wife's sleep schedules; they have been sleeping in separate beds. Thus, the anecdotes and the statistical analyses further probe the question of whether co-sleeping improves adherence or vice versa.

Yet, there are some exceptions to patients' rationales about their "sleep divorce." For example, Patient 1006 (poor adherence) expressed, "My life has changed dramatically after my wife passed away in January, 2017. We pretty much were compatible in terms of sleeping. I miss my wife and life has been pretty hard lately…I just cannot tolerate the CPAP; the average sleep that I could get with it was 4 hours." Therefore, the above excerpts suggested that the quality of close personal relationships has notable implications for individuals' health and well-being. The cultural beliefs in an association between bed sharing and sleep disorders may be an assumption that merits critical examination.

Subjective Well-Being

One of the cognitive variables with the most influence on health behaviors is the individual's sense of well-being and satisfaction. Even though medical literature has established that optimal usage of CPAP strongly enhanced patients' and family members' quality of life, I have not found empirical research that examined the association between patients' perceived level of life satisfaction and CPAP adherence behaviors. To the best of our knowledge, this study was the first to use the 5-item Satisfaction with Life Scale (SWLS; Diener, Emmnos, Larsen, & Griffin, 1985) to measure OSA patients' global cognitive judgmental component of his/her subjective well-being. This questionnaire is suitable for OSA patients as it meets requirements for test reliability and validity. A systematic review of the Satisfaction with Life questionnaire showed good convergent validity with other scales and with other types of assessments of subjective well-being. Moreover, life satisfaction as assessed by the scale illustrated a degree of temporal stability, which is 0.54 for 4 years (Pavot & Diener, 1993).

Despite the lack of groundwork investigating life satisfaction and therapy adherence in the sleep medicine arena, other domains of medicine have aimed to analyze the relationship between treatment adherence and subjective well-being in patients with chronic illnesses. For example, an empirical study conducted at two Portuguese hospitals in Porto and Lisbon sampled 197 outpatients diagnosed with HIV/ AIDS administered on antiretroviral medication during a 6-month period. The researchers used the Portuguese versions of Diener's Satisfaction with Life Scale to evaluate patients' emotional responses psychological demands. The study results showed a positive and significant correlation between satisfaction with life and treatment adherence (Reis et al., 2013).

As initially hypothesized, this study discovered that outstanding adherent patients reported significantly higher levels of life satisfaction in comparison to poorly adherent patients. It remains unclear as to whether or not the association is causational. The results indicated that quality of life and subjective well-being are relevant considerations in the treatment of patients with chronic illnesses. All aspects of life are compromised when OSA is inadequately treated.

Our analysis also begged the question of how social support may interact with subjective well-being. In fact, according to the Social Cognitive Theory, Bandura (1977) already suggested that human behavior is the aggregation of interactions between the internal self-system (personal variables such as self-efficacy) and external sources of influence (such as interpersonal relationships and social support network). Since individuals operate within a set of socio-cultural influences, interpersonal relationships and self-efficacy can have strong impact on patients' emotional adjustment to OSA and their related health behaviors (Bandura, 1977). Therefore, it seems plausible that interpersonal relationships can mediate one's cognitive judgment on subjective well-being.

Psychological Effects

Long-term adherence to CPAP may be affected by comorbid medical and psychiatric conditions. The complication of diverse medical illnesses may compromise sleep continuity and reduce sleep quality. Even though our study has not found a correlation between presence of psychiatric comorbidities and CPAP adherence, other studies have shown a significant association between presence of depression and anxiety and diminished CPAP usage.
Previous research studies suggested that medical and psychiatric conditions may influence CPAP adherence. For example, Budhiraja and colleagues collected study participants' medical history information, pertaining to symptoms of sleep disorders and other medical and psychiatric conditions such as cardiovascular diseases, nasal congestion, and depression. The results showed that the presence of cardiovascular diseases was associated with higher CPAP adherence. The findings may be explained by heightened healthcare provider awareness of the cardiovascular outcomes among OSA patients, and the potential of CPAP therapy to alleviate these symptomatic outcomes. In addition, more frequent patient-provider interactions, as seen in many patients with cardiovascular diseases, may be another significant factor in facilitating CPAP adherence behaviors (Budhiraja et al., 2016). Of note, Budhiraja and authors also suggested a significant association between presence of depression or anxiety and diminished CPAP adherence.

Similar associations between the presence of psychiatric comorbidity and CPAP usage were documented among OSA veterans with PTSD. In particular, among soldiers with OSA, comorbid PTSD was associated with significantly decreased CPAP adherence (Collen et al., 2012). Since concomitant insomnia tended to be more common among patients with PTSD, patients may experience greater difficulties initiating and maintaining sleep. Some of the symptomatic markers of PTSD, which include sleep fragmentation, frequent arousals, and nightmares; all served as potential barriers to CPAP adherence.

The association between PTSD and OSA has been recognized across the literature. CPAP therapy has appeared to benefit most patients with PTSD. Non-adherence to CPAP has been associated with worsened and more visual nightmare recall through frequent arousals (Lettieri et al., 2017). Indeed, Patient 2033 (outstanding adherence) pointed out, "Since I found CPAP for sleep apnea, I have gotten much longer sleep. It also went from 0 percent to 100 percent quality. The CPAP was the savior because the PTSD was once one of my biggest concerns. A restful sleep does great things to the mind." Therefore, the conundrum remains as to why would patients not be motivated to adhere to CPAP if the therapy could improve both the PTSD and OSA symptoms? This topic is in need of continued exploration.

Limitations

There were several limitations to this study. First, due to the limited sample size, the study may not have been powered enough to detect statistical significant differences between groups that actually existed. Second, the results may not be generalizable to a larger population because our research subjects were drawn from a specific sub-population, namely veterans who live in rural areas of the southern US and are seen through telemedicine. It also is important to recognize that 39 patients out of the 40 interviewed patients (See Table 17) experienced a number of other concomitant physical conditions. Both patients' and family members' burden from adjusting to CPAP therefore may be exacerbated by the presence of comorbidities. These extra layers of burden can complicate the clinical care and disease management trajectories of patients with OSA.

Another limitation to the study was inherent in our sampling methods. In particular, the results could have been biased because only the veterans who answered the phone were included in this study. As noted earlier, 30 patients were identified as potential research candidates for each corresponding adherence group and 20 patients were included in the study. Perhaps those who responded to calls were inherently more outgoing and satisfied with their lives. Therefore, response bias is possible. Also, we did not obtain information on certain psychosocial factors that could have impacted adherence. For instance, social factors like socioeconomic status, occupation, and educational level may have affected adherence.

Additionally, the results from the qualitative interviews suggest slight discrepancies in CPAP adherence between data collected from 90 days after initial diagnosis and upon long-term yearly follow-up. Out of the 40 interviews conducted, there were 2 poorly adherent patients who reported that they had used CPAP committedly for the past few months (at the time when the interviews were conducted) and 1 outstanding adherent patient who highlighted that he stopped using CPAP because he absolutely could not tolerate it. These discrepancies pointed out the study's limitation in accurately stratifying patient populations based on long-term CPAP adherence behaviors detected remotely and urged for future studies in evaluating long-term CPAP adherence several years after initial diagnosis.

Chapter 5:

Conclusion and Future Directions

Conclusion

Most sleep studies to date have ignored the sociocultural context and circumstances within which humans maintain sleep and develop distinct sleep behaviors. This study provides a novel and innovative analysis of what ecological, social, and behavioral factors best account for rural Georgian veterans' treatment adherence. The key findings are as followed: More adherent patients reported 1) higher satisfaction with life, 2) slept longer, and 3) were more likely to co-sleep with a bed partners compared to less adherent patients. Among the above predictors, the practice of co-sleeping emerged as the most significant cultural ecological factor that facilitates CPAP adherence.

That patient's subjective well-being positively correlates with CPAP usage draws attention to the importance of emotional-cognitive factors as potential mechanisms driving treatment adherence patterns. Our findings suggest potential avenues for intervention to increase CPAP adherence among veterans in rural Georgia. For example, clinicians may wish to collect Satisfaction with Life Scale data prospectively. Patients could fill it out at their initial visit to the sleep clinic (at baseline). Those individuals with lower scores could be identified as higher risk for treatment non-adherence and, therefore, receive additional clinical monitoring and encouragement. Then, 3 months after patients start CPAP treatment, clinicians could ask them to respond to the questionnaire again. The difference in scores indicated on the questionnaires would help clinicians identify whether or not increased CPAP adherence have changed patients' sense of subjective well-being.

Examination of patients' co-sleeping habits also warrants clinical attention. Mechanisms linking co-sleeping behaviors with health have been largely neglected in the sleep domain. This seemingly intimate human action can be fraught with conflicts, distress, and tension. While many sleep problems and relationship issues co-occur, this study introduces appraisal of co-sleeping behaviors to elicit and modulate CPAP adherence behaviors. It may be useful to evaluate potential links between sociality and sleep disorders. Therefore, one intervention strategy may be to include the spouse/ bed partner in the education about risks of untreated OSA, CPAP instructions, and provision of interactive sessions on troubleshooting CPAP masks and tube management. Also, it may be beneficial to ask patients upon their first visit whether or not they engage in co-sleeping behaviors. This may assist healthcare practitioners better monitor treatment pathways and clinical counseling endeavors and potentially, help identify patients who are at higher risk of developing non-adherent patterns.

In conclusion, the results of this small study are important and could be replicated in larger studies. That is, the observation that more adherent patients were more likely to co-sleep with a bed partner deserves more attention in terms of cause and effect. Therefore, future studies should include more subjects and a longer follow-up period to investigate the influence of social support and spousal involvement in patients' CPAP experience and use. They may aim to measure bed partners' involvement and support with CPAP and investigate its influence on adherence behaviors.

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Appendix I: Department of Veterans Affairs Research Recruitment Form

Department of Veterans Affairs
Atlanta VA Medical Center
1670 Clairmont Rd
Decatur, GA 30033

Date START Study

Dear Mr. :

The Atlanta VA Medical Center's Sleep Medicine Center is participating in a research study. As a Veteran who has been treated for obstructive sleep apnea (OSA) through our sleep telemedicine program, you may qualify.

Dr. Octavian Ioachimescu is the Principal Investigator for this research study, and **Dr. Barry Fields** is the Co-Investigator. The study's purpose is to better understand Veterans' sleep habits and environment while they are being treated for OSA. A pamphlet and an "Information About the Study" sheet are enclosed for your review. <u>You do not have to send anything back to us.</u>

The study team may contact you by phone approximately 5-10 business days after sending this letter to assess your interest, eligibility, and to answer any questions. If you are interested in learning more about the study or have any questions, please contact the study team at 404-321-6111 ext. 6627. If you know you are not interested in this study, you may leave a message at that number.

If you have any questions or concerns about research conducted at the Atlanta VA, please call the Research Compliance Officer at 404-321-6111 x6964. Specific questions about participating in this study should be directed to the **study team at 404-321-6111 ext. 6627**.

Thank you for considering VA research.

Sincerely,

Steven Gorbatkin, PhD, MD
Assistant Chief of Medicine
Atlanta VA Medical Center

Octavian Ioachimescu, MD, PhD
Principal Investigator
Atlanta VA Medical Center

Barry Fields MD, MSEd.

Barry Fields, MD, MSEd
Co-Investigator
Atlanta VA Medical Center

Appendix II: Oral Consent Form

Atlanta VA Medical Center
Script for Oral Consent

Study Title: Sleep Telemedicine Assessment and Response to Therapy (START)
Principal Investigator: Octavian Ioachimescu, MD, PhD
Co-Investigator: Barry Fields, MD, MSEd
Funding Source: None

Thank you for your interest in our sleep medicine research study. We would like to tell you everything you need to think about before you decide whether or not to join the study. It is entirely your choice. If you decide to take part, you can change your mind later on and withdraw from the research study.

1. The purpose of this study is to collect information about Veterans' sleep habits and environment while they are being treated for obstructive sleep apnea (OSA).

2. The study is not funded by any source.

3. This study will be conducted over a time of up to 6 months, but your involvement in the study will be approximately 1 hour in total.

4. Procedures: Our research assistant will contact you 5-10 days after sending this information to ask your permission to take part in the study. You will review this form with her over the phone.

   If you agree to take part in the study, our research assistant will arrange a convenient time for a phone interview. The interview will last 1 hour or less. She will write down your answers to her questions as you say them. When she is done asking all of her questions, you will be given the chance to add anything else you would like. Your participation in the research study will be over at that time.

5. You may not benefit from participating in this research study. You will be contributing to information that may help us develop sleep program across all VAMCs.

6. Your privacy is very important to us.

7. Your health information that identifies you is your "protected health information" (PHI).

8. The PHI for this study includes personal information from your such as name, address, telephone numbers, social security/medical record number, dates, medical history and physical exams, progress notes, hospital discharge summaries, list of medications, sleep test results and answers to questionnaires.

9. To protect your PHI, we will follow federal and state privacy laws, including the Health Insurance Portability and Accountability Act (HIPAA).

10. The following persons or groups may use and /or disclose your PHI for this study:
    - The Office for Human Research Protections
    - The Government Accountability Office (GAO)
    - The Office of Research Oversight (ORO)
    - The Inspector General
    - The Emory University Institutional Review Board and other offices in Emory University that help run and/or oversee studies
    - The Atlanta Research and Education Foundation (AREF)
    - The Atlanta VA Research Compliance Officer
    - VA research staff within the VA Hospital
    - Any appropriate state or federal government agencies that make rules and policy about how research is done that are not listed above

11. We will disclose your PHI when required to do so by law in the case of reporting child abuse or elder abuse, in addition to subpoenas or court orders.

12. You may revoke your authorization at any time by calling the Co-Investigator, Dr. Fields at (404) 321-6111 ext. 6627, or by mailing the study team at 250 N. Arcadia Ave, Sleep Medicine Center, Decatur, GA 30033

13. If identifiers (like your name, address, and telephone number) are removed from your PHI, then the remaining information will not be subject to the Privacy Rules. This means that the information may be used or disclosed with other people or organizations, and/or for other purposes.

14. We do not intend to share your PHI with other groups who do not have to follow the Privacy Rule, but if we did, then they could use or disclose your PHI to others without your authorization.

15. If you do not give your authorization, your treatment will not be affected.

16. We will put a copy of this informed consent form for the research study into any medical record that you may have with the Atlanta VA Medical facilities.

17. Your authorization will not expire because your PHI will need to be kept indefinitely for research purposes.

Contact Information

If you have questions about this study, your part in it, your rights as a research participant, or if you have questions, concerns or complaints about the research you may contact the following:

Dr. Barry Fields at (404) 321-6111 ext.6627

Emory Institutional Review Board: 404-712-0720 or toll-free at 877-503-9797 or by email at irb@emory.edu

Consent

Do you have any questions about anything I just said? Were there any parts that seemed unclear?

Do you agree to take part in the study?

Participant agrees to participate: ☐ Yes ☐ No

If Yes to the study consent:

____

Name of Participant

______________________________________ ______________

Signature of Person Conducting Informed Consent Discussion Date Time

____

Name of Person Conducting Informed Consent Discussion

Appendix III: Interview Script

Sleep Habits

1. Think about the number of hours you sleep on average each weeknight and each weekend night. Please tell me when do you go to bed and wake up on weekdays and weekends? How long have you slept this amount? [Note: Be sure that participant distinguishes weeknights and weekend nights.]
    a. How has the amount of your sleep changed after you had been diagnosed with OSA?
    b. Probe: Do you now sleep more or less after this change?
    c. Probe: Has the amount of your sleep changed after you had a change in any other health problems or some major life event?

2. Think about your family's sleep patterns, either the blood relatives you grew up with or the blood relatives you live with now. Compared to other members in your family, how would you describe your sleep pattern? By sleep patterns, both the amount of sleep and the time of day that you go to bed…
    a. Probe: Are your sleep patterns similar or different to those of other people in your family growing up or now?

3. Do you have a spouse who uses CPAP machine when he/she sleeps?

4. Sometimes a person's work or family schedule, care giving responsibilities, etc. influence peoples' sleep. How do you think your daily activities affect your sleep pattern?

    a. Do you do any special volunteer activities or jobs?

5. Why do you go to bed at the time that you do?
    a. Probe: Do you stick with your regular bedtime whether or not you are sleepy?
    b. Probe: Do you often feel like you have nothing else to do at night?

6. How important is it to that you sleep your ideal number of hours?
    a. Why is sleep important to you?
    b. How much do you value sleep?

7. What is the ideal amount of sleep that you need for good physical and mental health?
    a. Probe: Have you heard you should sleep that amount?

8. What information or knowledge about sleep did you get from the Atlanta VA clinic?
    a. Did you receive any sleep educational pamphlet?

9. How do you feel when you cannot sleep your ideal number of hours?
    a. Probe: Do you feel worried or guilty that you did not get the amount of sleep you wanted?
    b. Probe: Do you feel the need to sleep in or take a nap?

   c. Probe: Do you try to make up for lost sleep?

10. If you could sleep as little or as much as you wanted, how many hours would you sleep every night?
    a. Probe: Does sleep help you avoid everyday stressors and hassles?
    b. Probe: Would you rather be doing something else if you could sleep less?

11. Is there anything else you would like to say about your sleep pattern?

Sleep Ecology

Please think **over the past month**, and answer the following questions based on what has happened during that time.

• How many pillows do you usually use?

• Do you use any padding/ cushion on your bed?

• What sort of covers do you use?

Where do you usually sleep at night? _____

1 = own bedroom
2 = bedroom shared with others
3 = common room (living plus sleeping)
4 = porch/outside
5 = not in home
6 = variable

• Would you describe your sleeping environment as quiet?

• If not, what are some noises?

• Would you describe your room temperature as cold, hot, or pleasant?

What do you usually sleep on at night? _____

1 = bed
2 = sofa, divan
3 = mat, ground
4 = hammock
5 = other

Does anyone else sleep in the same bed (or mat, hammock, etc.) with you? _____
0 = no
1= yes

If yes, who sleeps with you in the bed? (*Each time they mention a name, ask them to specify the relationship and list. When that is done, ask if there is anyone else, specify relationship and list, and repeat until they say there is no one else.)*

	0 = nobody
________________________________	1 = spouse
	2 = sister
________________________________	3 = brother
	4 = daughter
________________________________	5 = son
	6 = mother
________________________________	7 = father
	8 = grandparent
________________________________	9 = grandchild
	10 = other relative
________________________________	11 = non-relative
	12 = pet

Besides anyone who shares the bed with you, does someone else sleep in the same room with you?

0 = no
1= yes

If yes, who else sleeps in the same room with you? (*Each time they mention a name, ask them to specify the relationship and list. When that is done, ask if there is anyone else, specify relationship and list, and repeat until they say there is no one else.)*

	0 = nobody
________________________________	1 = spouse
	2 = sister
________________________________	3 = brother
	4 = daughter
________________________________	5 = son
	6 = mother
________________________________	7 = father
	8 = grandparent
________________________________	9 = grandchild
	10 = other relative
________________________________	11 = non-relative
	12 = pet

Do you have any light source where you sleep? _____

0 = no
1 = yes

What kind of light do you have? _____

0 = no source of light where you sleep
1 = lamp/candle/torch in room

2 = lamp/candle/torch in other room/nearby space
3 = firelight

Do you keep a fire at night? _____
0 = no
1 = sometimes
2 = yes, almost every night

Is there a fire in the sleeping space? _____
0 = no
1 = sometimes
2 = yes, almost every night

Do you keep pets in/around the house during the night? _____
0 = none
1 = in house at night
2 = next to house at night
If so, what type are they (dog, cat, chicken…etc)?

During the last month, did you take naps? _____
0 = no
1 = yes

If so, how often did you rest or nap? _____
0 = NA
1 = rarely (<once a week)
2 = sometimes (1-2 times a week)
3 = usually but not everyday (3-6 times a week)
4 = every day

When did you usually take your rest or nap? _____
0 = NA
1 = morning
2 = mid-day to early afternoon
3 = mid-late afternoon
4 = evening
5 = any time

When resting, do you usually: _____
1 = sleep soundly
2 = doze
3 = just relax

How long do your naps or rests usually last?
____

Where did you usually nap? _____
0 = does not nap or rest during the day
1 = usual sleeping space, place
2 = common sleep space
3 = workplace (field, truck, etc)
4 = anywhere

Overall, do you think you get enough sleep? _____
0 = no
1 = yes

To be more specific, how sufficient is the sleep you get? _____
1 = I sleep a lot more than I need
2 = I get plenty of sleep
3 = I sleep just enough for my needs
4 = I don't get quite enough sleep
5 = I get much less sleep than I need

Do you have Internet access at home? _____
0 = no
1 = yes
If so, do you access the Internet before you sleep? ____
0 = no
1 = yes

How soon do you access it before you sleep?

Do you look at the clock by the bedside? _____
0 = no
1 = yes

Satisfaction With Life Scale

Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- 7 - Strongly agree
- 6 - Agree
- 5 - Slightly agree
- 4 - Neither agree nor disagree
- 3 - Slightly disagree
- 2 - Disagree
- 1 - Strongly disagree

____ In most ways my life is close to my ideal.

____ The conditions of my life are excellent.

____ I am satisfied with my life.

____ So far I have gotten the important things I want in life.

____ If I could live my life over, I would change almost nothing.

Beliefs About Sleep

Several statements reflecting people's beliefs and attitudes about sleep are listed below. Please indicate (by circling the number) to what extent you personally agree or disagree with each statement. There is no right or wrong answer. For each statement, **circle a number that best reflects your personal experience**. Consider the whole scale, rather than only the extremes of the continuum.

1. I need 8 hours of sleep to feel refreshed and function well during the day.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
2. When I do not get proper amount of sleep on a given night, I need to catch up on the next day by napping or on the next night by sleeping longer.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
3. I am concerned that chronic insomnia may have serious consequences for my physical health.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
4. I am worried that I may lose control over my abilities to sleep.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
5. After a poor night's sleep, I know that it will interfere with my daily activities on the next day.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
6. In order to be alert and function well during the day, I am better off taking a sleeping pill rather than having a poor night's sleep.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
7. When I feel irritable, depressed, or anxious during the day, it is mostly because I did not sleep well the night before.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
8. When I sleep poorly on one night, I	*Strongly*												*Strongly*

know that it will disturb my sleep schedule for the whole week.	*Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Agree*
9. Without an adequate night's sleep, I can hardly function the next day.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
10. I can't ever predict whether I will have a good or poor night's sleep.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
11. I have little ability to manage the negative consequences of disturbed sleep.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
12. When I feel tired, have no energy, or just seem not to function well during the day, it is generally because I did not sleep well the night before.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
13. I believe that insomnia is essentially a result of a chemical imbalance.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
14. I feel that insomnia is ruining my ability to enjoy life and prevents me from doing what I want.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
15. Medication is probably the only solution to sleeplessness.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*
16. I avoid or cancel obligations (social, family, occupational) after a poor night's sleep.	*Strongly Disagree*	0	1	2	3	4	5	6	7	8	9	10	*Strongly Agree*