RELATIONSHIP BETWEEN LIFESTYLE FACTORS, MEDICAL CONDITIONS, AND SLEEP QUALITY IN WOMEN

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ABSTRACT

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A descriptive approach was used to elicit lifestyle, socio-demographic and medical factors that are closely related to very poor subjective sleep quality in women. Subjective sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) in a sample of 678 women aged 25-58 years old who participated in the POUCHmoms (Pregnancy Outcomes and Community Health Moms) study. Overall, medical conditions were found to be most strongly related to sleep quality. Women who had Asthma and taking medication had an aOR (adjusted odds ratio) of 2.3 (95% CI = 1.3, 3.9) compared to those without the condition, while the odds was the same for both women with the condition but not taking medication and those without the condition aOR=1.1 (95% CI = 0.5, 2.2). Women who had Migraine, taking medication and not had aOR=1.8 (95% CI = 1.0, 3.4) and aOR = 1.9 (95% CI = 1.1, 2.8) respectively. For women with other conditions (Gastro-intestinal problems, Auto-Immune disorders and non-Rheumatoid Arthritis) and taking medication the odds was aOR=2.2 (95% CI = 1.4, 3.5), while for both women with any of the conditions not taking medication, and those without the conditions, the odds were the same aOR = 1.0 (95% CI = 0.5, 1.7). Also, current smokers had increased odds of having very poor sleep quality aOR = 1.8 (95% CI = 1.2, 2.8) compared to non-smokers while the odds was the same for both former and non-smokers aOR = 1.4 (95% CI = 0.8, 2.4). Medicaid users/uninsured women had an increased odds of having very poor sleep quality compared to private insured aOR = 2.0 (95% CI = 1.3, 2.9). Finally tea consumption (cups/day) was also strongly associated with very poor sleep quality aOR=1.1 (95% CI = 1.0, 1.3).

This thesis is gratefully dedicated to my late selfless and loving mother, Rakiya Victoria Adaji

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KEYS TO ABBREVIATIONS

aOR	Adjusted Odds Ratio
BMI	Body Mass Index
CDC	Center for Disease Control
CIDI	Composite International Diagnostic Interview
CVD	Cardiovascular Diseases
EPSS	Epworth Sleepiness Scale
KSQ	Karolinska Sleep Questionnaire
MEQ	Horne and Ö stberg Morningness– Eveningness Questionnaire
NHANES	National Health and Nutrition Examination Survey
PSQI	Pittsburgh Sleep Quality Index
REM	Random Eye Movement
SWAN	Study of Women’s Health Across the Nation
WHO	World Health Organization

INTRODUCTION

Sleep is an important, naturally occurring aspect of life; its benefits have been linked to metabolism, mental, physical, and emotional health. Over time, sleep has shown to be an important determinant of health and quality of life. Poor sleep has been seen to increase the risk of adverse cardiovascular events and diseases, diabetes, obesity and all-cause mortality (Healthy People 2020).

According to statistics from a 2011 mortality and morbidity weekly report, about 50 to 70 million Americans report chronic sleep and wakefulness disorders (CDC MMWR, 2011), and about 35 percent of adults report poor or fair sleep quality (National Sleep Foundation, 2014). Another report by the National Health Interview Survey (NHIS) notes nearly 30 percent of adults reporting less than six hours of sleep (Schoenborn and Adams, 2010). The National Sleep Foundation recommends seven to nine hours of sleep for younger adults and adults, and for older adults, seven to eight hours. In addition, the following lifestyle practices known as sleep hygiene were also recommended for good sleep; same sleep and wake times, associating the bed with sleep alone, avoiding large meals, and stimulants such as caffeine, nicotine, and alcohol too close or prior to bed time, ensuring a good sleep environment, and avoiding napping during the day.

There is no universal definition for sleep health, it is often explained in many studies using several constructs like the absence of sleep problems, longer sleep duration and limited sleep disturbances. However, sleep health is a concept and applies to overall health. In a 2014 article, Daniel Buysse suggested that the same positive attributes used to define the health of a population should be used to define sleep health, i.e. wellness, performance and adaptation (Buysse, 2014). He further noted that sleep can be measured across multiple levels of analysis and along multiple dimensions, of which five appear to be most relevant: (1) Sleep duration-total amount of sleep obtained every 24 hours; (2) Sleep continuity or efficiency- the simplicity of falling and returning to sleep; (3) Timing- the placement of sleep within the 24-hour cycle; (4) Alertness/Sleepiness-the ability to remain alert and maintain wakefulness; and (5) Satisfaction/Quality-the subjective assessment of “good” or “poor” sleep.

Sleep quality has no generally accepted definition but can be assessed objectively using instruments like actigraphy and polysomnography, and subjectively using Karolinska Sleep Questionnaire (KSQ), Epworth Sleepiness Scale (EPSS) and Pittsburgh Sleep Quality Index (PSQI) These instruments have been developed as metrics for sleep quality. Of these indexes, the PSQI is commonly used, has undergone psychometric evaluations and shown good internal consistency with a Cronbach’s alpha of 0.83. It is a self-rated questionnaire that assesses sleep quality and disturbances over a one-month interval. Questions consist of 19 individual items which generate seven component scores (0-21), with a score of 5 and above indicating poor sleep. This is different from sleep quantity/duration which by itself is a part of the seven components (Buysse et al., 1988).

Some studies have found a correlation between poor sleep and depression, anxiety, hormonal changes in women,, an unhealthy lifestyle, race , high body mass index, age and the presence of a chronic disease or condition (Grandner et al, 2010; Chang et al, 2010; Okun et al, 2010, Monk et al, 2003). Furthermore, sleep quality may vary by gender (Prather et. al., 2013; Liu et al, 2014). One study reported poorer sleep quality in men compared to women, based on social roles (Basner et al, 2007), while other studies have shown that disturbed sleep and poor sleep quality are more frequent in women than men (Hislop and Arber, 2003; Venn et al, 2008). Most studies of sleep quality among women have focused only on work life, reproductive health pre and post-partum, and mental health; as a result there is paucity in the understanding of women's sleep health and associated factors. In light of these issues, the objective of this study was to assess the relationship between lifestyle factors, comorbidities and subjective sleep quality in women using the global PSQI. In addition, lifestyle factors and comorbidities were assessed in relation to components of the PSQI.

BACKGROUND

Lifestyle Factors and Sleep Quality – A review

The causes of poor sleep appear to be multifactorial and studies that have assessed this topic from a lifestyle perspective have used several constructs and sleep dimensions. Many studies tend to focus on sleep disorders as an indicator of poor sleep, most common are insomnia and sleep apnea. However, the concept of poor sleep does not only constitute having a form of sleep disorder that affects one's health (Buysse, 2013). Few studies have distinctively focused on sleep quality in women. To understand the relationship between lifestyle factors, comorbidities and sleep quality in women, it is useful to review some hypothesized factors and their role on sleep health.

Body Mass Index and Sleep Quality

Short sleep duration has been associated with increased BMI (Taheri et al., 2004). The authors noted that short sleep duration may be an important regulator of body weight and metabolism. They also observed a U-shaped curvilinear association between sleeping less than eight (8) hours and BMI. Although the mechanism of action remains unknown, individuals with short sleep were seen to have reduced leptin levels and elevated ghrelin levels, possibly explaining their increased BMI. Another study by Owens and Matthews 1998 found an association between sleep disturbance and higher waist to hip ratio, an indicator for obesity.

However, Asplund and Aberg, 1994 observed that sleep disturbances were more common in women with a BMI less than 20kg m^{-2} compared to those with BMI greater than 30, and that this decreased with age. Another longitudinal study from NHANES I data considered the effects of inadequate sleep on BMI and found that inadequate sleep was associated with obesity (Gangswisch et al, 2005).

These studies however focused on specific dimensions of sleep, thus findings may differ when other dimensions are considered. Secondly, with differences in study designs (e.g cross-sectional, longitudinal and clinical), it is important to apply caution when making causal inferences or making a case for reverse causality.

Social Role and Sleep Quality

There continues to be disagreements on whether men get better sleep than women and vice-versa. Clinical and population based studies have shown that women on average report longer sleep times than men (Burazeri, Gorfine and Kark, 2003; Krueger and Friedman, 2009). Many studies report on sex differences in sleep duration but not on overall sleep quality. Research on more qualitative dimensions of sleep has shown that although women sleep longer than men overall, their sleep quality is poorer than that of men (Lindberg et. al, 1997). One reason that may be responsible for differences in findings is that studies do not consider specifically how social role may influence sleep quality in an individual. In their study, Burgard et. al., 2010 argue that for a woman, family roles like being a spouse and a mother greatly influenced sleep quality; they also found that the probability of having interrupted sleep substantially increases for caregiving women when children are young. In the Krueger and Friedman study the authors found that parents sleep less than adults without children, and Burgard et al, 2010 and Venn et al, 2008 also argue that providing night time care for young children and breastfeeding activities also contribute to poor sleep in women. The idea of time use, household physical and emotional obligations and in some cases paid work is the premise on which many studies argue for poor sleep quality in women when considering social role as a factor.

Work Life and Sleep Quality

The negative effect of work life is one of the causes of disturbed sleep (Akerstedt et al. 2002). Shift work especially, has been seen to be a source of disturbed or shortened sleep (Akerstedt, 1998; Harma et al. 1998). Work life and social role effects on sleep quality most often go together, with obvious gender differences (Burgard et. al., 2010). In a study assessing the relationship between disturbed sleep and work stress, shift and overtime work, physical work load, and sedentary and solitary work, Akerstedt et al. 2002 found that the risk of reporting disturbed sleep was related to high work demands, low social support at work, high physical work load, being unmarried, being female, and doing most of the household work. In another study of a large cohort of Australian women, employment status was found to be an important determinant of sleep quality (Soltani et al, 2012). Very poor sleep quality defined as having a global PSQI score of 10 and above was associated with being unemployed. Job satisfaction has also been reported to influence sleep quality in women, with many studies focusing on Nurses (Cimete et al, 2003 and Ruggiero, 2005). One study assessed poor sleep in female Nurses on different work shifts (Ulla et al, 2002). A total of 154 women aged 20-54 were sampled and it was found that 34 percent were dissatisfied with their jobs and exhibited worse sleep outcomes. In comparison to men, Basner et al, 2007 note that the waking activity that competes most with sleep time is paid work, and that men spend more hours working for pay thus have poorer sleep compared to women. The cross-sectional nature of most of these studies makes it difficult to draw causal inferences and the multi-pathway nature of variables contributing to sleep quality continues to breed uncertainties in findings.

Alcohol, Smoking, Caffeine and Sleep Quality

Estimating the role of smoking, caffeine and alcohol on sleep quality may not always be clear cut because of possible effects of interactions. In one study, Zhang et. al, 2006 sought to characterize the differences in sleep architecture between current and never smokers. They found that cigarette smoking was independently associated with sleep architecture, including a longer latency to sleep onset and a shift toward lighter stages of sleep, even after controlling for alcohol and caffeine consumption. However, exposure to second hand smoking was not considered, and the study was restricted to sleep architecture which is more focused on sleep stages (Non-Random Eye Movements and Random Eye Movements). Lexcen and Hicks, 1993 also assessed the role of cigarette smoking on sleep quality using sleep diaries. They found that smokers were more likely to experience poor sleep but noted that individuals who smoked also used significantly greater amounts of caffeine and alcohol; therefore results should be interpreted with caution.

There is the general assumption that alcohol improves sleep based on its sedative effects which can induce rapid onset of sleep (Vitiello, 1997). However, studies have shown that with acute alcohol intake, after about 60 to 120 minutes of sleep where an individual transcends from light to deep sleep, a period of increased REM sleep follows which is a consequence of sleep disturbance (Eckardt et al, 1998 and Vitiello, 1997). It was noted in a 2001 review article by Landolt and Gillin, that severe sleep disturbances were common in alcohol-dependent patients. Individuals showed decreased sleep efficiency, shorter sleep duration, reduced amounts of slow wave sleep and took longer time to fall asleep when compared to healthy controls. The mechanism of action of alcohol on sleep has not yet been fully explored, however one suggestion states that alcohol selectively controls neurochemical processes in specific areas of the central nervous system (Little, 1999).   Eckardt et al, 1998 propose that alcohol exerts its effect on sleep through interaction with lipophilic domains of γ-aminobutyric acid (GABA), serotonin (5-hydroxytryptamine; 5-HT), adenosine, glutamate, acetylcholine or glycine receptors, which may play an important role in the regulation of alertness and sleep. To be able to make causal inferences on the relationship between alcohol intake and sleep quality, it will be useful to have many studies that prospectively focus on the context of dose-response, time-order and several dimensions of sleep while appropriately controlling for potential third variables.

Caffeine is present in a variety of dietary sources like tea, soft drinks, coffee and chocolate. It is known to be one of the most commonly consumed behaviorally active substances (Fredholm et al, 1999), with coffee being the main source (Frary et al, 2005). Caffeine has hydrophobic properties which allow rapid absorption into biological membranes (Fredholm et al, 1999). According to Bonati et al, 1982, more than 99 percent of caffeine consumed in humans is absorbed from the gastrointestinal tract in about 45 minutes. Many use caffeine as a stimulant to enhance mood and alertness, hence its relationship with sleep. The proposed mechanism of action by many studies is that caffeine functions as an antagonist of the adenosine receptors A1 and A2a, thus increasing energy metabolism in the brain and at the same time decreasing cerebral blood flow (Nehlig et al, 1992). Caffeine binds to the adenosine receptors; Adenosine A1 located in all areas of the brain, and Adenosine A2a located in the dopamine rich regions (Fredholm et al, 1999) and creates an adenosine blockage to the neurons, impeding sleep promoting effects and causing neurons to slow down instead of speed up (Ferré, 2008). In one study, Shilo et al, 2001 found that drinking regular caffeinated coffee resulted in a decrease in total amount of sleep, sleep quality, and an increase in the time to sleep induction when compared to drinking decaffeinated coffee. In addition, caffeine was found to decrease the urine concentration of 6-sulphoxymelatonin (6-SMT) (melatonin metabolite) in individuals. Excessive coffee intake has been seen to detrimental to sleep health; the National Sleep Foundation considers three 8 oz. cups of coffee (250 milligrams of caffeine) per day a moderate intake of caffeine.

Mental Health and Sleep Quality

The relationship between poor sleep and mental health has shown to be a complex one as it has not been sufficiently established whether poor sleep causes poor mental health, or it is the other way around. For many studies the focus is on the relationship between insomnia and depression and anxiety (Breslau et al, 1996; Ford et al, 1989; Taylor et al, 2005). In their study, Taylor et al compared depression and anxiety in people with insomnia and those without insomnia. They found that people with insomnia were 9.8 and 17.3 times as likely to have clinically significant depression and anxiety, respectively. It has been noted that of all the psychiatric disorders associated with insomnia, depression appears to be the most common (Tsuno et. al, 2005). Hypersomnia has also been associated with depression (Breslau et al, 1996), although less prevalent than insomnia, it is a significant feature of the atypical subtype depression (Thase, 2006). In addition, Gillin, 1998 suggested that insomnia is not only a risk factor for depression, but also for anxiety and other addictive disorders.

Several hypotheses have been proposed regarding the pathophysiology of sleep disturbance in depression. One of them states that the regulatory features of sleep are intricately linked to mechanisms that are implicated in the pathophysiology of depression (Thase, 2006). This hypothesis stems from the homeostatic function of sleep which is based on findings from neuroimaging methods (Thase, 2006). The proposed mechanism of sleep homeostasis states that endogenous substances like adenosine build up in the cerebrospinal fluid during wake hours; blood flow and glucose metabolism decline thus increasing the pressure to enter into deep nonREM or slow-wave sleep. The pressure is then released by a period of nonREM sleep (Borbely, 2001). According to the hypothesis, sleep homeostasis is dysregulated in individuals with primary insomnia. There is a sharp increase in blood flow and glucose metabolism during the transition from waking to nonREM sleep which leads to the onset of REM sleep (Nofzinger et al. 2015). This pattern has also been observed in studies using neuroimaging methods to assess individuals with depression (Germain et al, 2014; and Nofzinger et al, 2005).

An important aspect to also note is the role of seasonal differences on sleep and behavioral changes. Temperature and light play a role in harmonizing the circadian rhythms and also affect moods (Friborg et al. 2012). For example, individuals tend to sleep more and be depressed in the winter season compared to summer. It is useful to consider Seasonal Affective Disorders (SADs) and the role of season in the pathway of sleep and mental health.

In general, findings from several epidemiologic surveys have reported that individuals with insomnia tend to be women, older, and report many symptoms of anxiety and depression. However sleep quality is not solely characterized by insomnia (sleep disturbance) and studies focused on assessing the relationship between sleep and mental health should pay close attention to other sleep quality measures.

Medical Conditions and Sleep Quality

Poor sleep has been seen to increase the risk of cardiovascular (CVD) disease and CVD events, diabetes, obesity and all-cause mortality (Healthy People 2020). Comorbidities may involve direct causality or reverse causality; research has not sufficiently made a case for either. The National Sleep Foundation, 2003 conducted a survey on sleep disturbances and chronic diseases in older adults (55-84) and found that multiple chronic diseases and other medical conditions significantly reduced quality of sleep even after adjusting for age, gender and an existing diagnosis of a sleep disorder (Foley et al, 2004). However, individuals of ages 55-84 does not adequately represent the general population and several other factors may have contributed to their findings. Medication use in individuals with comorbid conditions has also been seen to affect sleep quality (Elder et al, 2007). Some studies have also found that comorbid conditions and medication use are independently associated with poor sleep (Brown et al, 2002 and Monk et al, 2003). Therefore it is important to consider both interactive and independent effects of these variables on sleep when conducting studies.

Other Factors – Age, Race, and SES

Age, race and socio-economic status are important factors to consider when assessing any outcome. Age is an important predictor of several health outcomes. Studies assessing sleep health have shown varying effects of age on sleep quality. In a recent study by Luca et. al, self-reported sleep quality and daytime functioning improved with aging, especially in women. This finding is contrary to other studies which have found that increasing age is associated with greater sleep problems (Middlekoop et al, 1996 and Ohayon et. al, 2001). Studies assessing the relationship between race and sleep quality have produced conflicting results. Often race is categorized as; White, African-American, Asian, Hispanic and Native American. In their 2010 study, Patel et al sought to assess social determinants of sleep attainment and found that among a population of Whites, African-Americans, and Latino's, impoverished Whites had the highest odds (OR=4.20) for poor sleep when compared to the other racial/ethnic groups. However, Mezick et. al.(2010) in a community-based cross-sectional study noted that Blacks documented shorter sleep duration and lower sleep efficiency.

Socio-economic status (SES) is measured using several constructs including education, employment, finances, and health insurance. Several studies have reported significant associations between low SES, ie. lower education, lower income, lack of employment, and absence of health insurance, and sleep quality (Hall et al, 2009). However, findings are dependent on what covariates are considered and how they affect these associations. For example, in their study, Hall et. al used poverty status based on census data, education and employment status to measure SES. There is no one factor or combination of factors that sufficiently measures SES, therefore results may vary depending on the index or indices used.

Race and SES often go together, however, independent associations have also been observed, and in some cases the roles they each play differ. For example, Friedman et al, (2007) found that SES, specifically income, significantly predicted sleep latency and sleep efficiency even after adjusting for other demographic factors, health status and psychosocial characteristics. SES was strongly associated with both objective and subjective sleep quality. The authors also found that more years of education were associated with reduced sleep latency. In another study, Mezick et al, 2008, found that Blacks were more likely to have shorter sleep duration and longer sleep latencies; and that this effect persisted even after adjusting for SES variables. Another study by Van Cauter and Spiegel, (1999) suggested that the adverse impact of low SES on health is precipitated by sleep curtailment and poor sleep quality, suggesting that sleep plays a mediating role.

Conceptual Framework

Sleep is increasingly becoming vital to public health (Institute of Medicine, 2006). Suggestions for improving sleep health and reducing the prevalence of poor sleep quality have focused on several lifestyle modifications, for example, the recommendations from the National Sleep Foundation. However, little attention has been paid to gender differences and how these lifestyle factors may influence sleep outcomes. In women specifically, most of the focus has been on reproductive health, BMI and mental health. In addition, other factors like the presence of medical conditions and their role on sleep health have not been extensively studied.

The current literature on sleep health is skewed because it mainly represents certain groups like men, older ages, college students, and specific health conditions like depression and respiratory problems. Furthermore, many sleep studies tend to focus on sleep disorders or specific sleep dimensions like sleep latency and sleep duration, but use several instruments that have not been formally validated. In our study we seek to identify lifestyle and comorbid factors associated with poor sleep in women. We use the PSQI which allows for the assessment of several sleep dimensions. Other studies using the PSQI typically base their findings on the global sleep score. A distinct feature of our study is the assessment of each of the PSQI sub-components that make up the global sleep score

Research Question and Hypotheses

This study will assess the relationships between lifestyle factors, comorbidities and sleep quality in women. Sleep quality in this study is defined using the global PSQI score and each of the seven component scores. The guiding hypotheses are;

1. An unhealthy lifestyle (smoking, high alcohol and caffeine intake, increased work hours), high BMI, low SES, and the presence of medical condition(s) will be associated with poor sleep quality defined by the global PSQI score.
2. An unhealthy lifestyle (smoking, high alcohol and caffeine intake, increased work hours), high BMI, low SES, and the presence of medical condition(s) will be associated with poorer outcomes of each of the seven sub-components of the PSQI.

MATERIALS AND METHODS

Study Population

This study uses data from the Pregnancy Outcomes and Community Health Moms (POUCHmoms) study. The POUCHmoms study builds on the POUCH pregnancy study. Between 1998 and 2004, the POUCH pregnancy study prospectively recruited 3,019 women at 16-27 weeks of pregnancy. Inclusion was limited to English-speaking women ≥15 years of age who were screened for maternal serum alpha-fetoprotein (MSAFP) at 15-26 weeks, had a singleton pregnancy with no known congenital anomalies, and no pre-existing diabetes. The goals of the POUCH study were to identify pathways to preterm delivery (PTD) by assessing social and biologic factors. A sub-cohort of women (N=1,371) were further recruited using random stratified sampling design, sampling from among the POUCH study cohort and oversampling from eight strata. The strata were defined by race/ethnicity (African American, non-African American) MSAFP levels (high, normal) and pregnancy outcome (term, preterm). Data were ascertained using medical chart abstraction, placental examination, maternal blood assays and interviews conducted at enrollment. Sampling weights were assigned to account for the oversampling of women with certain characteristics including high MSAFP, PTD and African-Americans with term deliveries.

This study received approval from institutional boards at Michigan Department of Health and Human Services (MDHHS), Michigan State University (MSU) and nine community hospitals in Michigan.

The POUCHmoms study focuses on women’s health, lifestyles, and emotional health and well-being in the 7 to 15 years since the POUCH Study pregnancy. The goal was to explore connections between women’s health during pregnancy and in later life, with a special interest in pregnancy events and women’s later cardiovascular health. Participants were recruited from the sub-cohort of women who participated in the POUCH study. A total of 678 POUCHmoms participants between 25 and 58 years of age completed a structured in-person interview that included a modified PSQI comprising 9 major questions and sub-questions covering sleep habits over a one month period. The POUCHmoms study is funded by the National Heart Lung and Blood Institute.

Dependent Variable – Sleep Quality

The original PSQI comprises 10 questions and sub-questions however POUCHmoms sleep data comprises nine questions, excluding the tenth which asks about having a bed partner/roommate and how often they have noticed any problems associated with the individual’s sleep. This tenth question does not affect the scoring procedure because this question is not self-rated and therefore does not factor into the computation of sleep scores.

The main outcome for this study is sleep quality which is defined by the global PSQI score. This score comprises seven sleep components; sleep latency, overall sleep quality, habitual sleep efficiency, sleep duration, daytime dysfunction, sleep medication use, and sleep disturbances. The components are standardized versions of areas typically clinically assessed in patients with sleep/wake complaints (Buysse et al, 1989). Based on responses, each component is assigned a score ranging from 0 to 3, with 3 indicating a worse outcome. The seven components are then summed up to give the global score. According to the PSQI developers, a global score of 5 or greater indicates poor sleep. However, for this study, a cut-point of 10 (very poor sleep) was applied because our sleep data were skewed to the right with about 92 percent of the population having poor sleep based on the PSQI cut-point of 5. This cut point of 10 in our study was chosen in light of other studies using a score of 10 as cutpoint (Soltani et al, 2011; Carlson and Garland 2005). The global sleep score represented normal-poor (score <10) and very poor sleep (Score ≥10). We also considered individual sleep sub-components. Each sleep sub-component had four levels (0, 1, 2, 3) dichotomized as either a better or worse outcome based on a cut-point of 2, where ≥2 indicated a worse outcome. The PSQI questionnaire and scoring procedures are summarized in Appendix 1 and 2.

Sleep Associated Variables

The independent variables for this study were assessed as follows;

Body Mass Index (BMI): BMI at POUCHmoms enrollment was calculated based on measured height and weight in kilograms per meter-squared (Kg/M^2). Classification was based on cut-points recommended by the World Health Organization 1995, 2000 and 2004 expert consultation. Small numbers in some groups e.g. underweight, necessitated combining groups for analyses; normal/underweight (≤24.9 Kg/M^2), overweight (25-29.9 Kg/M^2) and obese which was categorized as obese I/obese II (≤39.9 Kg/M^2) and obese III (≥40).

Behaviors/Personal Habits: Behaviors or personal habits were assessed using the variables; alcohol intake, smoking status and caffeine intake. Caffeine intake was measured by number of cups of caffeine containing drinks consumed daily over the previous year (Soft drinks, coffee, tea and chocolate drinks). The number of alcoholic drinks consumed was measured by the frequency of use and number of drinks consumed in the past week and month; women were classified as never/infrequent, occasional, and heavy drinkers. Smoking was categorized as never, current and previous smoker. Second hand smoking was also assessed based on the number of hours per week that a woman was exposed to smoking from others smokers.

Work Life: Work life was defined using employment status and the number of hours worked per week. Information on work hours was correlated with employment status. Thus three categories were created to capture both employment and work hours; as part, full and others, e.g student, full time homemaker or disabled. Work hours were dependent on employment type and therefore the two variables were combined to measure work-life and time use.

Social Role: Information on whether or not a woman was living with her spouse/significant other, and number of children below and above age five were considered for assessment of subject's social role.

Comorbidities: To assess comorbidities, the question was asked; "Has a doctor, nurse practitioner or other health care provider ever told you that you have any of the following conditions?" Responses were recorded as "yes" or "no". Six categories of comorbidities were created; (1) *cardiovascular* comprising stroke, heart disease and hypertension; (2) *metabolic conditions* including diabetes, hyperactive and underactive thyroid, and high blood cholesterol; (3) *Asthma*; (4) *Migraine* (5) *Others* comprising gastrointestinal problems, auto-immune disorders and non-rheumatoid arthritis. (6) *Depression* was assessed based on a modified WHO Composite International Diagnostic Manual (CIDI). The CIDI is a comprehensive structured interview designed for non-clinically trained interviewers for the assessment of mental disorders according to the criteria of the Diagnostic Statistical Manual-IV (DSM-IV) and the International Classification of Diseases-10 (ICD-10) criteria for diagnosing depression. For each comorbidity reported, women were asked if they were currently taking medication related to that condition. This variable was assessed as "yes" or "no" and both prescribed and over the counter medication were considered. For each category of yes/no comorbidities, we created three groups; women who did not report any of the conditions (referent), women with a condition but not taking medication for the condition; and women taking medication for the condition. But for women with a history of clinical depression, we created four groups; women who were not diagnosed with depression (referent), women who were not diagnosed but taking medication, women who were diagnosed but not taking medication, and women who were diagnosed and taking medication.

<u>Socio-demographic Variables</u>

Other variables considered for analyses are age, race, and socio-economic status indicated by income, education and health insurance. Race was defined as White, African-American or other (Asian, Hispanic and Native Americans). For health insurance type, participants were assigned to one of two groups, those with no insurance or Medicaid, and those with private insurance. Education was grouped into three levels; high school/GED or less, vocational training/associate degree, and college degree. Based on data provided, participants were divided into quartiles of income; ≤$19,999, $20,000-$39,999, $40,000-$69,999 and ≥$70,000. Mean age was determined for subjects.

<u>Analytic Strategy</u>

In our preliminary analyses, characteristics of the sample are described using means (standard deviations) and proportions. Because participants in this study were part of a complex sampling scheme used to construct the original POUCH study sub-cohort, all analyses included sampling weights.

To determine factors associated with poor sleep quality, each potential covariate was evaluated with the outcome variable, and only variables marginally associated (p-value<0.20) with the outcome were retained for testing in the multi-covariate models. Selection procedures (forward, backward and stepwise) were then used to create a more parsimonious model with a criterion of p <0.15 for both entry and retaining in the model. Variables that met the criterion were further assessed and retained in the final adjusted model if they were significant at $p<0.05$. Because sleep quality and its subcomponents are binary outcomes, logistic regression models were used.

A list-wise deletion method consisting of discarding subjects with missing information on either the outcomes and/or the covariates was used for handling of missing data. For any given model, the number of missing data for either the covariates or outcome variable (very poor sleep) ranged from 4 to 16. All statistical analyses will be performed using survey procedures of SAS version 9.4 (SAS Institute).

RESULTS

Baseline characteristics for the study sample are presented in tables 1 and 2. The age range was 25 – 58 years, with a mean age of 37.7. The mean BMI was 31.6. Approximately 58% of the women were white (n=390), 37 % were African-American (n=250), and women of other races (Hispanic=20, Asian=10 and Native-American=8) accounted for 5% of the sample.

Sleep Quality

Table 3 summarizes the prevalence of the global sleep score and sub-component scores among women. Out of the 678 women, 627 (92%) had a global sleep score of 5 and above. However when a cut point of 10 (very poor sleep) was applied, about 62 percent (n=418) of women had normal/poor sleep (global sleep score <10), and 260 (38%) women had very poor sleep (global sleep score ≥10).

The same strategies used to select covariates for the global sleep score were also used for the sub-components of sleep quality. Sub-components are also presented in Table 3; the classification of each subcomponent defined as very good, good, bad and very bad (0, 1, 2, 3) respectively was dichotomized as <2 and ≥2. All findings for sleep sub-components are represented in table 5 and 6. Details of scoring for each sub-component are presented in Appendix 1. For each of the subcomponents, more women were in the group with better sleep sub-component scores, except for the HSE component which had about 77 percent of women having a sleep efficiency of 65 percent or less (n=519).

Global Sleep Score

Twenty one covariates were considered for analysis (Tables 1 and 2). In the unadjusted analyses using p-value <0.20, seventeen variables met the criteria for initial variable selection and were retained including age, race and indices of SES (education, income, and health insurance). Upon applying selection procedures using p<0.15 for variable entry and retain, 13 variables were significant but only 10 were retained at p<0.10. Inclusion criterion for the final model was p<0.05, this resulted in six variables which were assessed in relation to the global sleep score. Results from variable selection process were similar across all three methods (forward, backward and stepwise), with a few exceptions mainly in the backward selection modeling.

Table 4 shows the findings from the assessment of selected covariates in relation to the global sleep score dichotomized with threshold of 10. As noted earlier about 38 percent of women reported having very poor sleep. Overall, three groups of medical conditions (Asthma, migraine and other conditions), tea consumption, health insurance and smoking status were associated with very poor sleep. Women who had Asthma and were on medication had an adjusted odds ratio (aOR) of 2.3 (95% CI 1.3, 3.9) compared to those without the condition, while those who had the condition but were not on medication had the same odds as those who didn't have the condition aOR=1.1 (95% CI 0.5, 2.2). Similarly for women with conditions in the "other" category who were taking medication, the aOR of having very poor sleep was 2.2 (95% CI 1.4, 3.5) times higher compared to those without the conditions. But for women who had the conditions and were not on medication there was no difference in odds compared to women without the condition aOR=1.0 (95% CI= 0.5, 1.7). However, women who suffered from migraine both with and without medication had higher odds of having very poor sleep compared to those who did not suffer from migraine aOR=1.8 (95% CI 1.1, 2.8) and aOR=1.8 (95% CI 1.0, 3.4) respectively. Current smokers had 1.8 (CI: 1.2, 2.8) times higher odds of having very poor sleep compared to non-smokers while former smokers and non-smokers had the same odds of having very poor sleep aOR 1.4 (95% CI 0.8, 2.8). Finally, consumption of each additional cup of tea multiplied the aOR of having very poor sleep by 1.1 (95% CI 1.0, 1.3).

Sub-components of sleep quality

Overall Subjective Sleep Quality

Each woman was asked to rate their sleep quality as very good, fairly good, fairly bad or very bad. About 30 percent of the sample reported having very poor overall subjective sleep quality (table 3). As described in table 5; African-Americans, and others (Asian, Hispanics and Native-Americans) were more likely to report very poor sleep when compared to Whites, aOR= 1.5 (95% CI 1.0, 2.4) and aOR=2.7 (95% CI 1.3 and 5.2) respectively. Current smokers had an aOR of 2.4 (95% CI 1.5, 3.7 compared to non-smokers, while for former smokers and non-smokers, the odds was the same, aOR=1.3 (95% CI 0.8, 2.3). For all medical conditions listed in the "other" category, having any of the conditions and taking medication for it was associated with higher odds of very poor sleep aOR=1.9 (95% CI 1.2, 3.1) when compared to not having any of the conditions. However, there was no difference in odds for having any of the conditions and not taking medication when compared to not having any of the conditions; OR: 0.9; CI: 0.5, 1.6. Women who suffered from migraine and were on medication had a higher odds of having very poor sleep aOR =1.7 (95% CI 1.1, 2.7) compared to those without the condition. However those who were not on medication but had the condition had similar odds of having very poor sleep with those who did not have the condition aOR=0.8 (95 CI 1.5, 2.7).

Sleep Duration

Sleep duration assessed the average number of hours of actual sleep each woman got over the past month. However, this is different from the number of hours spent in bed. Based on the discretized version, a score <2 indicated an average sleep duration of six hours or more, while ≥2 indicated an average sleep duration of five hours or less. For this component, 28 percent of women had total sleep duration less than five hours. A lower income was associated with increased odds of having shorter sleep duration. Women who earned ≤$19,000 had a higher odds of shorter sleep duration aOR=5.4 (95% CI 3.1, 9.4) times odd of having shorter sleep duration compared to women who earned ≥70,000. A dose-response relationship was seen, the lower the income, the higher the odds. Women who consumed chocolate drinks that contained caffeine had high odds of having shorter sleep duration aOR=2.2 (95% CI 1.0, 4.6), with each additional cup consumed per day. Having migraine increased the odds of having shorter sleep duration, both with and without medication use by aOR=1.7 (95% CI 1.1, 2.8) and aOR=2.2 (95% CI 1.1, 2.9) respectively.

Sleep Latency

Time to sleep onset was measured as sleep latency. About 36 percent of women reported having a longer sleep latency defined as ≥60 minutes. A short time to sleep onset was defined as ≤30 minutes (about 64% of women). Medicaid insured and those with no insurance was marginally significant (p-value 0.01) while the category of other medical conditions was highly significant with p-value <.0001.Women who had any of the conditions listed in “other” and were taking medication for it had higher odds of having a longer sleep latency compared to those who did not have any of the conditions aOR=2.5 (95% CI 1.6, 3.8). However, women who had any of the conditions listed but were not taking medication for it had the same odds as those who did not have the conditions aOR=1.5 (95% CI 0.9, 2.7). Each additional increase in years of age reduced the odds of having longer sleep latency aOR=0.95 (95%CI 0.92, 0.99). Having no insurance or using Medicaid was associated with higher odds of having longer sleep latency aOR=1.6 (95% CI 1.1, 2.3). Finally, current smokers had higher odds of having longer sleep latency compared to women who had never smoked aOR=1.9 (95% CI 1.2, 2.9) while for former smokers, the odds was the same aOR=1.7 (95% CI 0.7, 2.9).

Habitual Sleep Efficiency (HSE)

This component evaluates an individual's average number of hours of actual sleep divided by the number of hours spent in bed. HSE is measured as a proportion with higher percentage scores indicating better outcome. Approximately 78 percent of women had poor habitual sleep efficiency (<65 percent). African-American women had lower odds of having poor HSE compared to Whites aOR=0.5 (95% CI 0.3, 0.7) while other racial/ethnic groups had the same odds aOR=0.9 (95% CI 0.3, 2.2) of having poor HSE compared to whites. Each additional hour per week of exposure to passive smoke reduced the odds of having poor sleep aOR=0.98 (95% CI 0.97, 0.99), although the effect was marginal (p-value 0.01).

Sleep Medication

This component assessed the individual's frequency of use of sleep medication or sleep aids. Medication use considered was both prescribed and over-the-counter; about 22 percent of women reported use of sleep medication. Medicaid insured and those without insurance had higher odds of using sleep medication compared to women with private insurance aOR=1.8 (95% CI 1.0, 3.5). Also, women who reported having migraine and using medication were more likely to use sleep medication frequently, compared to women without the condition aOR=2.2

(95% CI 1.1, 4.4), while the odds was the same for women who had the condition and were not taking medication, and those without the condition aOR=1.1 (95% CI 0.5, 2.5).

Sleep Disturbances

Several reasons for difficulties or trouble sleeping including waking up at night, disordered breathing, snoring, pain and dreams were assessed. The variable "sleep disturbance" was created to capture the sum of all reasons reported. Approximately 30 percent of women reported having a score of 18 which is considered the threshold for having frequent sleep disturbances, out of a score of 27. We found that the lower the income, the higher the odds of having frequent sleep disturbances. Women who earned between $40,000 and $69,000 had higher odds of having frequent sleep disturbances compared to women who earned ≥70, 000 aOR=2.1 (95% CI 1.1, 3.8). The other categories of income ($20,000-$39,000, and ≤19,000) also had increased odds of having frequent sleep disturbances aOR=2.1 (95% CI 1.1, 3.7) and aOR=3.7 (95% CI 1.9, 7.1), respectively. Women who had any of the conditions listed in "other" and were not taking medication were equally likely to have frequent sleep disturbances as those who did not have the conditions aOR=1.6 (95% CI 0.9, 2.9). However, the odds of having frequent sleep disturbances was higher in women who had the conditions and were taking medication compared to those who did not have the conditions aOR=3.1 (95% CI 1.9, 5.0). Likewise for Asthma, there was no difference in odds between those with the conditions and not on medication, and those without the conditions aOR=0.8 (95% CI 0.3, 1.6); while those who had the condition and were on medication had higher odds of having frequent sleep disturbances aOR=2.0 (95% CI 1.1, 3.5). Unlike Asthma and "other" conditions, having any of the medical conditions listed as cardiovascular was associated with frequent sleep disturbances. But women who had any of the CVD conditions and were taking medication were equally likely to have frequent sleep disturbances as those without the conditions aOR=1.6 (95% CI 0.9, 2.9). While those who had the condition but were not on medication had higher odds of having sleep disturbances compared to those who did not have the conditions aOR=2.2 (95% CI 1.2, 4.1). Similarly for migraine; the odds was the same for both women who had the condition and were on medication and those who did not aOR=1.1 (95% CI 0.7, 1.9) while for women who had the condition but were not on medication, the odds was 2.3 (CI: 1.2, 4.5) times higher. Interestingly, living with a spouse or significant other increased the odds of having frequent sleep disturbances by aOR=1.9 (95% CI 1.2, 3.1). Lastly, each additional cup of tea consumed per day increased the odd of frequent sleep disturbances by aOR=1.2 (95% CI 1.0, 1.5).

Daytime Dysfunction

This component assessed an individual's ability to maintain alertness and function effectively during the day. Women are questioned about their ability to stay awake while performing everyday activities, also about their level of enthusiasm. Only about 16 percent of women reported having daytime sleepiness and difficulties keeping up enthusiasm. Having Asthma with and without medication use was correlated with increased odds of daytime dysfunction aOR=2.6 (95% CI 1.4, 4.8) and aOR=2.6 (95% CI 1.3, 5.4) respectively. While for BMI, there was no difference in odds between overweight women and normal/underweight women aOR=1.5 (95% CI 0.7, 3.1). However for all three categories of obese women (I/II, and II), the odds was higher aOR= 2.3 (95% CI 1.2, 4.5; and aOR=2.5 (95% CI 1.2, 5.2) respectively.

DISCUSSION

In this study of women ages 25 to 58, years, we found that certain medical conditions (asthma, migraine, non-rheumatoid arthritis, gastro-intestinal disorders and auto-immune disorders), high consumption of tea, having no insurance or Medicaid insured, and smoking were associated with a greater prevalence of very poor sleep quality, defined by a global PSQI score of 10 or greater. When we assessed PSQI sub-components of sleep quality we observed variation in factors associated with each of the components. .

We began our analyses by first identifying all variables (demographic, behavioral and medical) related to sleep quality, then we conducted a variable selection process to elicit the variables most strongly related to sleep quality, global and subcomponent. This process can remove associations resulting from confounding but also may eliminate upstream variables. For example, we observed that race, education, income and BMI were independently associated with sleep quality and its sub-components in the bivariate analyses. However, their effects were attenuated when other variables, i.e. Medical conditions were included in the variable selection process. We did not test models with demographics and mediation by more proximate variables, e.g. medical conditions, smoking; this would be a logical next step using these data. It is worth noting that even after including all proximate variables selected, women who were Medicaid insured or without insurance were more likely to have very poor sleep compared to private insured women. This suggests that there may be other disparate routes of this health insurance type to poor sleep quality.

Our understanding of relationships between medical conditions and sleep quality is challenged by the question, which came first? For some conditions it seems plausible that causation could go in both directions. An example is migraines. Other clinical and community based studies of adults (Bioni, 2006; Kelman and Rains, 2005) also have shown poor sleep quality in relation to migraines. Some studies argue that migraine attacks are triggered by sleep deprivation or excessive sleep (Blau, 1990; Inamorato et. al, 1993), while others argue that Migraine is associated with sleep disorders. (Cevoli et. al, 2012). Migraines may be comorbid with depression and anxiety (Breslau et al, 1991) and sleep disturbances are important features of mood and anxiety disorders (Roth et. al, 2006). We grouped several medical conditions into the category of other, i.e. auto-immune disorders, non-rheumatoid arthritis and GI disorders, because the number of women affected by each condition was not large. Based on previous literature, (Edéll-Gustafsson et. al, 2002), we hypothesized that our observed association between ‘other medical conditions’ and poorer quality sleep was driven primarily by the GI disorders. To test this, we conducted a sensitivity analysis that removed women with GI problems from the ‘other medical conditions’ category. We found that there was no change in effect size, although the number of women with GI disorders was small (n=110).

In most of our analyses women with medical conditions who also were taking medication related to the condition had poorer sleep. Women with the same conditions but not taking medications did not experience poorer sleep. Unfortunately our study could not disentangle the effects of medication use from that of severity of the medical condition since they are highly correlated. Our study showing smoking was positively associated with very poor sleep is consistent with that of Zhang et. al, 2006. In their study, polysomnography was the measure used to characterize sleep architecture among 6,400 participants of the Sleep Heart Study. The authors found that cigarette smoking was independently associated with physiologic alterations in sleep architecture even after adjusting for alcohol and caffeine consumption, and the presence of respiratory and cardiovascular disease. As in our study, they also did not find significant differences in sleep quality between former and never smokers.

Perhaps surprising, we did not find an association between sleep quality and history of major depression, as measured by the CIDI. It is likely that the assessment of women's sleep health may have been conducted at a period where women were not experiencing depression, given that this is an episodic condition. However when women in our study were simply asked 'has a doctor or nurse ever told you that you have any of the following conditions..?' those who answered yes did have poorer sleep quality. It is possible that complaints of poor sleep to medical providers led to a diagnosis of depression (reverse association).

A unique feature of our study was the attempt to characterize factors associated with sub-components of sleep quality. To the best of our knowledge, very few studies using PSQI have considered all seven sleep sub-components distinctively from the global score. Our goal was to understand what factors were important at the sub-component level because effects may be lost when components are pooled to create the global score. Our results showed that medical conditions, especially migraine and 'other medical conditions', were associated with significantly poorer sleep quality defined by each of the sub-components.

Our study found that age was inversely associated with sleep latency. This finding is contrary to the findings of other studies that report longer sleep latencies in older females (Middlekoop et. al, 1996; Gianina et. al, 2015). A possible explanation for the inconsistency in findings may be the differences in age ranges considered in studies. These studies focused on the older population of men and women; 50 to 93 years and 40 to 80 years respectively while we considered women who were relatively young. We also observed that high consumption of tea and chocolate drinks were associated with shorter sleep duration and more sleep disturbance. It was surprising to see that high coffee consumption was not significant.

In our study, race was the only socio-demographic variable associated with habitual sleep efficiency. African-Americans had reduced odds of having poor habitual sleep efficiency compared to Whites. This contradicts the findings by Hall et. al, 2009 who used polysomnography assessed sleep efficiency compared with PSQI derived scores in the Study of Women's Health Across the Nation's Study (SWAN) and found that African-American women had lower sleep efficiencies (<80) compared to Caucasians and Asians in both the subjective and objective sleep measures. A possible explanation is the differences in sample characteristics, the considered mainly midlife women and the sleep study was conducted across 35 days, or an entire menstrual cycle. As we expected, higher household income was related to fewer sleep problems.

To date, the PSQI is the most comprehensive sleep questionnaire developed (Soltani et. al, 2012). Therefore, our study provides a comprehensive assessment of subjective sleep quality in relation to three important aspects; lifestyle, socio-demographics and medical conditions. An advantage of using a subjective sleep measure such as the PSQI is that it allows for the assessment of behavioral factors related to sleep health whereas the objective measures are more focused on the diagnosis of sleep disorders. Although, it is important to note that self-reported data are prone to recall bias.

Additional strengths of our study include the socio-demographic diversity of the sample which helps generalizable our results to a wide population of women. Also, questions on lifestyle factors (e.g cigarette smoking, alcohol and caffeine consumption) captured longer time periods (e.g one week)compared to other studies that used shorter time periods, (Lohsoonthorn et al,

2013) in some cases less than a week. Lastly, the POUCHmoms study comprises a rich data set with limited number of missing data among participants.

Study Limitations

Some limitations should be taken into consideration when interpreting our findings. The cross-sectional nature of this study does not allow for inferences on time order of associations, a necessary but not sufficient criterion for causality. Some variables were highly correlated, therefore limiting the possibility of disentangling independent effects. For example, medication use was dependent on the presence of medical conditions so its independent effect could not be estimated. We did not have a large enough sample of women to evaluate each medical condition separately in relation to sleep quality; hence some medical conditions are in a group labeled CVD or 'other'. Within these groups it may be important. Finally, at the time of our study, we did not have data on physical activity which is a key factor to consider in understanding sleep quality.

Study Implications

In light of sleeps importance to public health, our findings present a conceptual framework for better understanding of sleep associated factors, specifically in women. And although poor sleep affects every individual, women are reported to complain more of sleep problems as they reach midlife, with menopausal transition identified as the time period where sleep problems are heightened as a result of a decline in estrogen and progesterone (Polo-Kantola, 2011; and Kravitz et. al, 2003). Because of the multifaceted nature of sleep, more resources should be channeled into longitudinal studies that examine time order, and reciprocal relations between sleep and lifestyle, socio-demographic and medical factors.

Individual-level interventions are necessary to provide access to relevant information regarding sleep health. Economic interventions may also have an impact on sleep health. For example, better employment opportunities can provide better incomes to access better health insurance, perhaps leading to lower risks of medical conditions and enhanced sleep health. Other interventions might focus on disease prevention, care and treatment and smoking cessation programs. These interventions will ultimately improve health and quality of life in general.

APPENDICES

APPENDIX A: Results

Table 1: Distribution of Selected Characteristics in Study Sample and Association with Global Score (N=678)*

Variable	**(Mean±sd)**			**UnadjOR**
Age **Range:** 25-58yrs	(37.65±0.22)			0.9(0.93, 0.98)
Variable	**N**	**Weighted %**	**Weighted % Global Sleep Score ≥10**	**UnadjOR**
BMI				
Normal/Underweight (ref)	162	24.2	7.7	-
Overweight	159	23.3	7.5	1.6(1.0, 2.6)
Obese I/Obese II	231	34.2	15.1	1.4(0.8, 2.3)
Obese III	126	18.1	7.2	1.0(0.6, 1.6)
Race				
White (ref)	390	60.9	21.7	-
African-American	250	32.9	12.7	1.1(0.8, 1.6)
Others	38	6.1	3.1	1.9(0.9, 3.9)
Education				
HS/GED or less (ref)	147	21.3	9.9	-
Vocational or Associate	340	50.6	20.9	0.3(0.2, 0.6)
College degree	191	27.9	6.8	0.8(0.5, 1.2)
Insurance				
Medicaid/No insurance (ref)	307	44.3	22.2	-
Private insurance	371	55.6	15.4	2.6(1.8, 3.6)
Smoking status				
Never smoked (ref)	367	53.6	15.7	
Current smoker	190	27.5	14.2	2.5(1.7, 3.7)
Former smoker	121	18.8	7.6	1.6(1.0, 2.5)
Alcohol consumption**				
Never/infrequent (ref)	527	76.9	28.7	-
Occasional	102	15.7	5.7	0.9(0.6, 1.5)
Heavy	48	7.3	3.2	1.2(0.7, 2.4)
Employment/hours				
Part	122	17.7	15.7	0.4(0.2, 0.7)
Full	342	50.6	5.5	0.4(0.3, 0.7)
Other (ref)	214	31.6	16.4	-
Income				
<=$19999	179	25.7	13.8	2.5(1.5, 4.0)
$20000-39999	176	26.2	10.7	1.9(1.1, 1.3)
$40000-69999	127	19.4	6.8	4.1(2.6, 6.7)
>=$70000 (ref)	184	28.5	6.1	-

Table 1 (cont'd)

Distribution of Selected Characteristics in Study Sample and Association with Global Score (N=678)*

Variable	N	Weighted %	Weighted % Global Sleep Score ≥10	UnadjOR
Living w/spouse/sig other				
No (ref)	236	33.3	13.0	-
Yes	442	66.6	24.6	0.9(0.6, 1.2)
Living with children**				
No	20	3.1	1.8	-
Yes <=5yrs	464	68.5	25.5	0.4(0.1, 1.1)
Yes >5	194	28.2	10.2	0.4(0.1, 1.1)
Depression condition/meds				
Never diagnosed w/out meds	85	30.8	15.0	-
Diagnosed w/out meds	41	14.1	9.7	1.4(0.8, 2.7)
Never diagnosed w/meds	114	38.1	22.4	1.4(0.6, 3.1)
Diagnosed w/meds	45	16.7	9.7	0.7(0.3, 1.6)
Asthma condition/meds				
No (ref)	550	81.3	27.3	-
Yes w/out meds	43	6.5	2.9	1.6(0.8, 3.0)
Yes w/meds	85	12.1	7.3	3.0(1.8, 5.0)
Metabolic conditions/meds				
No (ref)	514	69.8	28.0	-
Yes w/ out meds	76	9.9	4.0	0.9(0.5, 1.6)
Yes w/meds	88	20.1	5.6	1.2(0.7, 2.0)
CVD conditions/meds				
No (ref)	506	68.5	26.2	-
Yes w/out meds	72	14.6	4.5	1.3(0.7, 2.2)
Yes w/meds	100	16.8	6.8	1.5(1.0, 2.4)
Migraine conditions/meds				
No (ref)	482	70.6	22.6	-
Yes w/out meds	70	10.6	5.3	0.9(0.5, 1.6)
Yes w/meds	126	18.6	9.6	1.2(0.7, 2.0)
Other conditions/meds				
No (ref)	402	59.7	22.2	-
Yes w/out meds	95	14.1	3.8	1.1(0.6, 2.0)
Yes w/meds	181	26.1	11.6	3.2(1.9, 5.4)

Table 1 (cont'd)

Distribution of Selected Characteristics in Study Sample and Association with Global Score (N=678)*

Variable	N	Mean±STD Global Sleep Score <10	Mean±STD Global Sleep Score ≥10	UnadjOR
Coffee drinks (cups/day)**	678	1.12±0.08	1.24±0.14	1.0(0.9, 1.1)
Tea (cups/day)	678	0.32±0.03	0.45±0.08	1.1(0.9, 1.3)
Chocolate drinks (cups/day)	678	0.08±0.01	0.11±0.02	1.3(0.8, 2.0)
Soft drinks (cups/day)	678	0.91±0.06	1.18±1.11	1.3(1.0, 1.2)
Passive smoking (hrs/wk)**	674	3.99±0.68	10.49±1.48	1.0(1.00, 1.04)

Notes: * Missing values for income, alcohol, depression and passive smoking.
****variables not retained for later model building based on their association with the global sleep score at p<0.20. Sampling weights were applied to reflect survey design.**

Table 2: Characteristics of Global Sleep Score and Sleep Subcomponents n (weighted %)

	<10	**≥10**
Global Sleep Score	418 (62.2)	260 (37.7)
Sub-component scores	**<2**	**≥2**
Overall subjective sleep quality	461 (69.8)	211 (30.2)
Sleep duration	477 (71.64)	201 (28.4)
Sleep latency	427(63.9)	251 (36.1)
Habitual sleep efficiency	159 (22.4)	519 (77.6)
Use of sleep Medication	525 (77.5)	153 (22.5)
Sleep disturbances	418 (61.9)	260 (38.1)
Daytime dysfunction	561 (83.1)	117 (16.9)

Table 3: Adjusted Odds Ratios of Global Sleep Score (PSQI≥10 vs <10)

Variable	N	adjOR (95% CI)
Insurance		
Medicaid/None	307	**2.0 (1.3, 2.9)**
Private (ref)	371	**-**
Smoking		
Never (ref)	367	-
Current	190	1.8 (1.2, 2.8)
Former	121	1.4 (0.8, 2.2)
Asthma condition w/meds		
No (ref)	550	-
Yes w/ out meds	43	**1.1 (0.5, 2.2)**
Yes w/meds	85	**2.3 (1.3, 3.9)**
Migraine condition w/meds		
No (ref)	482	-
Yes w/ out meds	70	**1.8 (1.0, 3.4)**
Yes w/meds	126	**1.8 (1.1, 2.8)**
Other conditions w/meds		
No (ref)	402	-
Yes w/ out meds	95	**1.0 (0.5, 1.7)**
Yes w/meds	181	**2.2 (1.4, 3.5)**
Tea (cups per day)		**1.1 (1.0, 1.3)**

Notes: Bold text indicates significant associations. Selection procedures were used to identify covariates associated with global sleep score. Adjusted ORs and 95% CI from weighted (inverse sampling probability) logistic regression models

Table 4: Adjusted Odds Ratios of Sleep Sub-components (Score = <2 vs ≥2)

	Overall sleep quality adjOR(95% CI)	**Sleep disturbance adjOR(95% CI)**	**Sleep duration adjOR(95% CI)**	**Use of Sleep medication adjOR(95% CI)**
Race				
White (ref) N= 390	-			
African-American N = 250	**1.5 (1.0, 2.4)**			
Others N = 38	**2.7 (1.3, 5.2)**			
Insurance				
Medicaid/None (ref) N = 307				1.8 (1.0, 3.5)
Private N = 371				-
Income				
<=$19999 N = 179		**3.7 (1.9, 7.1)**	**5.4 (3.1, 9.4)**	
$20,000-$39,999 N = 176		**2.1 (1.1, 3.8)**	**4.0 (2.3, 7.1)**	
$40000-$69999 N = 127		**2.1 (1.1, 3.7)**	**2.7 (1.4, 5.0)**	
>=$70000 (ref) N = 184		-	-	
Living w/spouse or sig. other				
No (ref) N = 236		-		
Yes N = 442		**1.9 (1.2, 3.1)**		
Smoking				
Never (ref) N = 367	-			
Current N = 190	**2.4 (1.5, 3.7)**			
Former N = 121	**1.3 (0.8, 2.3)**			
Chocolate drinks (cups per day)		**2.9 (1.3, 6.5)**	2.2 (1.0, 4.6)	
Tea (cups per day)		1.2 (1.0, 1.5)		
Migraine condition w/meds				
No (ref) N = 482	-	-	-	-
Yes w/ out meds N = 100	1.5 (0.8, 2.7)	2.3 (1.2, 4.5)	**2.2 (1.2, 3.9)**	1.1 (0.5, 2.5)
Yes w/meds N = 113	1.7 (1.1, 2.7)	1.1(0.7, 1.9)	**1.7 (1.1, 2.8)**	2.2 (1.1, 4.4)

Table 4 (cont'd)

Adjusted Odds Ratios of Sleep Sub-components (Score = <2 vs ≥2)				
	Overall sleep quality	**Sleep disturbance**	**Sleep duration**	**Use of Sleep medication**
	adjOR(95% CI)	**adjOR(95% CI)**	**adjOR(95% CI)**	**adjOR(95% CI)**
Cardiovascular conditions w/meds				
No (ref) N = 506		-		
Yes w/ out meds N = 72		**2.2 (1.2, 4.1)**		
Yes w/meds N = 100		**1.6 (0.9, 2.9)**		
Asthma condition w/meds				
No (ref) N = 550		-		
Yes w/ out meds N = 43		0.8 (0.3, 1.6)		
Yes w/meds N = 85		2.0 (1.1, 3.5)		
Other conditions w/meds				
No (ref) N = 465	-	-		
Yes w/ out meds N = 77	**0.9 (0.5, 1.6)**	**1.6 (0.9, 2.9)**		
Yes w/meds N = 136	**1.9 (1.2, 3.1)**	**3.1 (1.9, 5.0)**		

Notes: Bold text indicates significance associations. Adjusted ORs and 95% CI from weighted (inverse sampling probability) logistic regression models

Table 4 (cont'd)

	Adjusted Odds Ratios of Sleep Sub-components (Score = <2 vs ≥2)		
	Habitual sleep efficiency adjOR (95% CI)	**Sleep Latency adjOR (95% CI)**	**Daytime dysfunction adjOR (95% CI)**
Age		**0.95 (0.92, 0.99)**	
Race			
White (ref) N= 390			
African-American N = 250	**0.5 (0.3, 0.7)**		
Others N = 38	**0.9 (0.3, 2.2)**		
BMI			
Underweight/Normal (ref) N = 162			
Overweight N = 159			
Obese I/Obese II N = 231			
Obese III N = 126			
Insurance			
Medicaid/None (ref) N = 307		1.6 (1.1, 2.3)	
Private N = 371			
Smoking			
Never (ref) N = 367			
Current N = 190		**1.9 (1.2, 2.9)**	
Former N = 121		**1.1 (0.7, 1.8)**	
Passive smoking (hrs/wk)	0.98 (0.97, 0.99)		
Asthma condition w/meds			
No (ref) N = 550			
Yes w/ out meds N = 43			**2.6 (1.3, 5.4)**
Yes w/meds N = 85			**2.6 (1.5, 4.8)**
Other conditions w/meds			
No (ref) N = 402			
Yes w/ out meds N = 95		**1.5 (0.9, 2.7)**	1.2 (0.6, 2.3)
Yes w/meds N = 181		**2.5 (1.6, 3.8)**	2.2 (1.3, 3.7)

Table 5: Summary of Findings

Variable	Global Sleep	Overall subjective sleep	Sleep disturbance	Sleep duration	Sleep medication	Habitual sleep efficiency	Sleep latency	Daytime dysfunction
Age							**X**	
Race		**X**				**X**		
Insurance	**X**				**X**		**X**	
Income			**X**	**X**				
BMI								**X**
Living w/partner			**X**					
Smoking	**X**	**X**					**X**	
Passive smoking						**X**		
Chocolate drinks			**X**	**X**				
Tea	**X**		**X**					
Migraine	**X**	**X**	**X**	**X**	**X**			
Cardiovascular conditions/meds			**X**					
Asthma condition/meds	**X**		**X**					**X**
Other conditions/meds	**X**	**X**	**X**					**X**

Table 6: Examples of Studies Assessing Association of Selected Covariates with Poor Sleep Quality

Author	Index	Results	
		Poor Sleep (global and/or subcomponents)	**No Association**
Akerstedt et al. 2002	KSQ	Being female, **high BMI**, **work demands** and physical effort were risk indicators of poor sleep	**Smoking** was not related to disturbed sleep. **Sedentary, overtime** and **part time employment** were not related to disturbed sleep
Burgard et. al., 2010	Sleep diaries	Poor sleep quality in women; sleep disturbances from **children** and **caregiving**	
Basner et al, 2007	Computer Assisted Phone Survey	**Increased work time** was associated with short sleep duration	
Friedman et al, 2007	Nightcap Sleep System, PSQI	**Lower household income** was related to longer sleep latency and lower sleep efficiency	**Increasing Education** was not related to global PSQI scores
Foley et al, 2004	Standardized questionnaire	Comorbidities rather than ageing cause sleep problems in older adults	
Gianina et. al, 2015	PSG, PSQI, ESS, MEQ	Sleep latency **increased with age** in women	
Gangswisch et al, 2005	Longitudinal analyses	**Short sleep duration** was associated with increased risk of **HTN**	**Hypertension** was not related to sleep problems
Hall et al, 2009	PSQI	**African Americans** had poorer sleep and **financial strain** was associated with poor sleep quality and lower sleep efficiency	**Increasing education** was not related to sleep quality
Krueger and Friedman, 2009	Sleep question	**Binge drinking**, **living with children** and **long work hours** were associated with short sleep duration	
Klink and Quan, 1987.	Survey questionnaire	Sleep disorder problems **increase with age** and are greater in women with asthma	
Lexcen and Hicks, 1993	Sleep diaries	**Smokers** are more likely to experience sleep problems	
Middlekoop et al, 1996	Sleep questionnaire	Overall women had poor sleep quality, disturbance, latencies (with **age**) and likely to use sedative drugs	**Medical health status** was not associated with subjective sleep quality
Mezick et. Al, 2008	Actigraphy and PSG	**African-Americans** had shorter sleep duration and lower sleep efficiency	
Soltani et al	PSQI (cut off 5 and 10)	**Unemployment** and **Lower education** were associated with poor sleep	

Table 6 (cont'd)

Summary of Major Studies Showing an Association of Selected Covariates with Poor Sleep Quality			
Author	**Index**	**Results**	
		Poor Sleep	**No Association**
Shilo et al, 2001	Clinical trial	**Regular intake of caffeine** increased latency and decreased sleep duration, and sleep quality	
Zhang et. al, 2006	PSG	**Cigarette smoking** was independently associated with disturbances in sleep architecture, longer latency and a shift toward lighter sleep stages.	

Notes: KSQ – Karolinska Sleep Questionnaire

PSG – Polysomnograph

ESS – Epworth Sleepiness Scale

MEQ - Horne and Ö stberg Morningness– Eveningness Questionnaire

APPENDIX B: Pittsburgh Sleep Quality Index and Scoring Procedures

PITTSBURGH SLEEP QUALITY INDEX

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions

1. During the past month, what time have you usually gone to bed at night?

   BED TIME ___________

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

   NUMBER OF MINUTES ___________

3. During the past month, what time have you usually gotten up in the morning?

   GETTING UP TIME ___________

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

   HOURS OF SLEEP PER NIGHT ___________

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you . . .

a) Cannot get to sleep within 30 minutes

Not during the	Less than	Once or twice	Three or more
past month_____	once a week_____	a week_____	times a week_____

b) Wake up in the middle of the night or early morning

Not during the	Less than	Once or twice	Three or more
past month_____	once a week_____	a week_____	times a week_____

c) Have to get up to use the bathroom

Not during the	Less than	Once or twice	Three or more
past month_____	once a week_____	a week_____	times a week_____

past month_____ once a week_____ a week_____ times a week_____

d) Cannot breathe comfortably

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

e) Cough or snore loudly

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

f) Feel too cold

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

g) Feel too hot

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

h) Had bad dreams

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

i) Have pain

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

j) Other reason(s), please describe____

____

How often during the past month have you had trouble sleeping because of this?

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

6. During the past month, how would you rate your sleep quality overall?

Very good ____________

Fairly good ____________

Fairly bad ____________

Very bad ____________

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all	__________
Only a very slight problem	__________
Somewhat of a problem	__________
A very big problem	__________

10. Do you have a bed partner or room mate?

No bed partner or room mate	__________
Partner/room mate in other room	__________
Partner in same room, but not same bed	__________
Partner in same bed	__________

If you have a room mate or bed partner, ask him/her how often in the past month you have had . . .

a)Loud snoring

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

b) Long pauses between breaths while asleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

c) Legs twitching or jerking while you sleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

d) Episodes of disorientation or confusion during sleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

e) Other restlessness while you sleep; please describe___________________________________

____

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

Pittsburgh Sleep Quality Index (PSQI)

<u>References and Scoring</u>

<u>Scores – reportable in publications</u>

On May 20, 2005, on the instruction of Dr. Daniel J. Buysse, the scoring of the PSQI was changed to set the score for Q5J to 0 if either the comment or the value was missing. This may reduce the DURAT score by 1 point and the PSQI Total Score by 1 point.

PSQIDURAT — **DURATION OF SLEEP**

IF Q4 ≥ 7, THEN set value to 0
IF Q4 < 7 and ≥ 6, THEN set value to 1
IF Q4 < 6 and ≥ 5, THEN set value to 2
IF Q4 < 5, THEN set value to 3
Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQIDISTB — **SLEEP DISTURBANCE**

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) = 0, THEN set value to 0

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) ≥ 1 and ≤ 9, THEN set value to 1

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) > 9 and ≤ 18, THEN set value to 2

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) > 18, THEN set value to 3

Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQILATEN — **SLEEP LATENCY**

First, recode Q2 into Q2new thusly:
IF Q2 ≥ 0 and ≤ 15, THEN set value of Q2new to 0
IF Q2 > 15 and ≤ 30, THEN set value of Q2new to 1
IF Q2 > 30 and ≤ 60, THEN set value of Q2new to 2
IF Q2 > 60, THEN set value of Q2new to 3

Next IF Q5a + Q2new = 0, THEN set value to 0
IF Q5a + Q2new ≥ 1 and ≤ 2, THEN set value to 1
IF Q5a + Q2new ≥ 3 and ≤ 4, THEN set value to 2
IF Q5a + Q2new ≥ 5 and ≤ 6, THEN set value to 3

Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQIDAYDYS **DAY DYSFUNCTION DUE TO SLEEPINESS**
IF Q8 + Q9 = 0, THEN set value to 0
IF Q8 + Q9 ≥ 1 and ≤ 2, THEN set value to 1
IF Q8 + Q9 ≥ 3 and ≤ 4, THEN set value to 2
IF Q8 + Q9 ≥ 5 and ≤ 6, THEN set value to 3
Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQIHSE **SLEEP EFFICIENCY**
Diffsec = Difference in seconds between day and time of day Q1 and day Q3
Diffhour = Absolute value of diffsec / 3600
newtib =IF diffhour > 24, then newtib = diffhour – 24
IF diffhour ≤ 24, THEN newtib = diffhour
(NOTE, THE ABOVE JUST CALCULATES THE HOURS BETWEEN GNT (Q1) AND GMT (Q3))
tmphse = (Q4 / newtib) * 100

IF tmphse ≥ 85, THEN set value to 0
IF tmphse < 85 and ≥ 75, THEN set value to 1
IF tmphse < 75 and ≥ 65, THEN set value to 2
IF tmphse < 65, THEN set value to 3
Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQISLPQUAL **OVERALL SLEEP QUALITY**
Q6
Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQIMEDS **NEED MEDS TO SLEEP**
Q7
Minimum Score = 0 (better); Maximum Score = 3 (worse)

PSQI **TOTAL**
DURAT + DISTB + LATEN + DAYDYS + HSE + SLPQUAL + MEDS Minimum Score = 0 (better); Maximum Score = 21 (worse)

APPENDIX C: Unadjusted Odds Ratios of Sleep Sub-components

Table 7: Unadjusted Odds Ratios of Sleep Sub-Components

Variable	Overall Subjective Sleep aOR(95% CI)	Sleep Duration aOR(95% CI)	Sleep Latency aOR(95% CI)	Habitual Sleep Efficiency aOR(95% CI)	Use of sleep Medication aOR(95% CI)	Sleep Disturbances aOR(95% CI)	Daytime Dysfunction aOR(95% CI)
Age (Mean±sd) **Range:** 25-58yrs	0.9(0.93, 0.99)	0.9(0.9, 0.99)	0.9(0.9, 0.9)	1.0(1.0, 1.07)	0.9(0.9, 1.0)	0.9(0.9, 0.99)	1.0(1.0, 1.0)
BMI							
Normal/Underweight (ref)	-	-	-	-	-	-	-
Overweight	1.3(0.8, 2.1)	1.4(0.9, 2.3)	1.2(0.8, 1.9)	0.6(0.3, 1.0)	1.5(0.9, 2.4)	2.0(1.2, 3.2)	2.8(1.4, 5.3)
Obese I/Obese II	1.1(0.6, 1.9)	2.6(1.5, 4.4)	1.1(0.7, 1.9)	0.4(0.2, 0.8)	1.3(0.7, 2.3)	2.1(1.2, 3.5)	3.2(1.6, 6.6)
Obese III	0.8(0.4, 1.4)	1.0(0.6, 1.8)	0.8(0.5, 1.4)	0.7(0.4, 1.3)	0.5(0.3, 1.1)	1.4(0.8, 2.3)	1.7(0.8, 3.5)
Race							
White (ref)							
African-American	1.5(1.0, 2.1)	1.9(1.3, 2.7)	1.3(0.9, 1.9)	0.4(0.3, 0.7)	1.3(0.9, 1.9)	1.4(1.0, 1.9)	1.3(0.8, 2.0)
Others	2.4(1.1, 4.9)	1.9(0.9, 4.1)	2.1(1.0, 4.4)	0.9(0.3, 2.1)	1.0(0.4, 2.3)	1.6(0.8, 3.2)	1.5(0.6, 3.6)
Education							
HS/GED or less (ref)	-	-	-	-	-	-	-
Vocational or Associate	0.5(0.3, 0.8)	0.2(0.1, 0.3)	0.3(0.2, 0.5)	1.4(0.8, 2.4)	0.4(0.2, 0.7)	0.4(0.2, 0.7)	0.6(0.3, 1.2)
College degree	0.8(0.5, 1.3)	0.6(0.4, 0.9)	0.8(0.5, 1.2)	1.0(0.6, 1.7)	0.7(0.5, 1.2)	0.7(0.5, 1.1)	0.9(0.5, 1.6)
Insurance							
Medicaid/No insurance	2.3(1.6, 3.3)	2.3(1.6, 3.3)	2.3(1.6, 3.3)	0.5(0.3, 0.8)	1.8(1.2, 2.7)	2.1(1.5, 2.9)	1.3(0.8, 2.0)
Private insurance(ref)	-	-	-	-	-	-	-
Smoking status							
Never smoked (ref)	-	-	-	-	-	-	-
Current smoker	2.3(1.6, 3.5)	2.2(1.5, 3,3)	2.6(1.8, 3.9)	0.5(0.3, 0.8)	1.9(1.2, 3.0)	1.9(1.3, 2.8)	1.3(0.8, 2.1)
Former smoker	1.2(0.7, 2.0)	1.1(0.7, 1.9)	1.2(0.8, 2.0)	0.8(0.4, 1.3)	1.6(1.0, 2.8)	1.5(0.9, 2.4)	0.8(0.4, 1.5)

Table 7 (cont'd)

Unadjusted Odds Ratios of Sleep Sub-Components

Variable	Overall Subjective Sleep aOR(95% CI)	Sleep Duration aOR(95% CI)	Sleep Latency aOR(95% CI)	Habitual Sleep Efficiency aOR(95% CI)	Use of sleep Medication aOR(95% CI)	Sleep Disturbances aOR(95% CI)	Daytime Dysfunction aOR(95% CI)
Alcohol consumption							
Never/infrequent (ref)	-	-	-	-	-	-	-
Occasional	0.8(0.4, 1.3)	0.6(0.3, 1.1)	0.9(0.6, 1.5)	1.4(0.8, 2.5)	0.9(0.5, 1.6)	1.9(1.3, 2.8)	0.7(0.3, 1.3)
Heavy	1.8(1.0, 3.4)	1.1(0.6, 2.2)	0.8(0.4, 1.6)	0.7(0.3, 1.3)	2.8(1.5, 5.3)	1.5(0.9, 2.4)	0.3(0.1, 1.1)
Employment/hours							
Part	0.8(0.5, 1.4)	0.4(0.2, 0.7)	0.6(0.3, 0.9)	1.1(0.6, 2.0)	0.5(0.3, 1.0)	0.9(0.6, 1.4)	0.7(0.3, 1.3)
Full	0.6(0.4, 0.9)	0.5(0.4, 0.8)	0.6(0.4, 0.8)	1.0(0.6, 1.5)	0.6(0.4, 0.9)	1.2(0.6, 2.3)	0.7(0.4, 1.1)
Other (ref)	-	-	-	-	-	-	-
Income							
<=$19999	2.6(1.5, 4.4)	4.0(2.2, 6.9)	2.2(1.3, 3.5)	0.4(0.2, 0.7)	1.5(0.9, 2.7)	2.0(1.2, 3.3)	1.8(1.0, 3.4)
$20000-39999	1.6(0.9, 2.9)	2.6(1.4, 4.9)	1.5(0.8, 2.6)	0.7(0.3, 1.3)	1.2(0.6, 2.3)	2.3(1.3, 3.9)	1.5(0.7, 3.0)
$40000-69999	3.8(2.3, 6.3)	5.6(3.2, 9.7)	3.5(2.2, 5.6)	0.3(0.2, 0.6)	2.4(1.4, 4.1)	4.4(2.7, 7.1)	1.6(0.9, 3.1)
>=$70000 (ref)	-	-	-	-	-	-	-
Living w/spouse/sig other							
No (ref)	-	-	-	-	-	-	-
Yes	0.8(0.5, 1.1)	0.6(0.4, 0.9)	0.8(0.5, 1.1)	1.6(1.1, 2.3)	0.7(0.5, 1.1)	1.1(1.2, 1.4)	0.8(0.5, 1.3)
Living with children							
No (ref)	-	-	-	-	-	-	-
Yes <=5yrs	0.5(0.2, 1.5)	0.5(0.2, 1.4)	0.4(0.1, 1.0)	1.4(0.5, 3.9)	0.5(0.2, 1.4)	0.1(0.05, 0.5)	0.4(0.1, 1.1)
Yes >5	0.7(0.3, 2.0)	0.6(0.2, 1.7)	0.3(0.1, 0.8)	1.2(0.4, 3.5)	0.3(0.1, 0.9)	0.1(0.05, 0.5)	0.3(0.1, 1.0)
Depression							
Never diagnosed w/out meds (ref)	-	-	-	-	-	-	-
Diagnosed w/out meds	1.2(0.6, 2.3)	1.4(0.8, 2.7)	1.4(0.8, 2.6)	1.0(0.5, 1.9)	3.3(1.7, 6.4)	1.3(0.7, 2.4)	1.6(0.8, 3.2)
Never diagnosed w/meds	0.8(0.3, 1.8)	0.7(0.3, 1.7)	1.1(0.5, 2.4)	1.3(0.5, 3.3)	2.6(1.1, 6.1)	1.9(0.9, 4.2)	0.9(0.4, 2.4)
Diagnosed w/meds	0.8(0.3, 1.8)	0.8(0.3, 2.0)	1.5(0.7, 3.5)	1.1(0.4, 2.9)	0.8(0.3, 2.3)	0.7(0.3, 1.5)	1.0(0.4, 2.5)

Table 7 (cont'd)

Unadjusted Odds Ratios of Sleep Sub-Components

Variable	Overall Subjective Sleep aOR(95% CI)	Sleep Duration aOR(95% CI)	Sleep Latency aOR(95% CI)	Habitual Sleep Efficiency aOR(95% CI)	Use of sleep Medication aOR(95% CI)	Sleep Disturbances aOR(95% CI)	Daytime Dysfunction aOR(95% CI)
Respiratory conditions/meds							
No (ref)	-	-	-	-	-	-	-
Yes w/ out meds	1.2(0.6, 2.5)	1.9(1.0, 3.8)	1.8(0.9, 3.4)	0.6(0.3, 1.3)	0.9(0.4, 2.2)	1.3(0.7, 2.6)	2.8(1.3, 5.8)
Yes w/meds	1.3(0.8, 2.2)	1.9(1.1, 3.2)	0.9(0.5, 1.6)	0.8(0.5, 1.5)	1.7(1.0, 2.9)	3.2(1.9, 5.3)	3.4 (2.0, 5.8)
Metabolic conditions/meds							
No (ref)	-	-	-	-	-	-	-
Yes w/ out meds	1.2(0.7, 2.0)	1.2(0.7, 2.1)	0.9(0.5, 1.5)	1.1(0.6, 2.1)	1.0(0.5, 1.8)	1.2(0.7, 2.0)	1.0(0.5, 2.0)
Yes w/meds	0.6(0.3, 1.1)	1.3(0.7, 2.1)	1.0(0.6, 1.7)	1.1(0.6, 2.0)	1.3(0.7, 2.3)	1.3(0.8, 2.1)	1.1(0.6, 2.1)
CVD conditions/meds							
No (ref)	-	-	-	-	-	-	-
Yes w/ out meds	1.4(0.8, 2.5)	1.3(0.8, 2.4)	0.9(0.5, 1.6)	1.0(0.5, 1.9)	0.9(0.4, 1.7)	2.3(1.3, 3.8)	2.6(1.5, 4.8)
Yes w/meds	1.1(0.7, 1.8)	1.7(1.1, 2.7)	1.4(0.9, 2.2)	1.0(0.6, 1.8)	2.0(1.2, 3.3)	2.1(1.3, 3.3)	1.7(1.0, 3.0)
Migraine conditions/meds							
No (ref)	-	-	-	-	-	-	-
Yes w/ out meds	1.7(1.0, 2.9)	2.0(1.1, 3.4)	1.7(1.0, 2.9)	0.6(0.3, 1.1)	1.7(0.9, 3.1)	2.4(1.4, 4.2)	1.4(0.7, 2.8)
Yes w/meds	1.9(1.2, 2.9)	1.8(1.1, 2.8)	1.4(0.9, 2.2)	0.9(0.5, 1.5)	2.5(1.6, 4.0)	1.6(1.0, 2.5)	1.5(0.9, 2.6)
Other conditions/meds							
No (ref)	-	-	-	-	-	-	-
Yes w/ out meds	1.1(0.6, 2.1)	1.2(0.6, 2.3)	1.6(0.9, 3.0)	1.0(0.5, 2.2)	1.8(0.9, 3.5)	1.2(0.7, 2.1)	1.2(0.5, 2.6)
Yes w/meds	2.9(1.7, 4.8)	2.3(1.4, 3.9)	3.0(1.8, 4.9)	0.5(0.3, 0.9)	3.6(2.1, 6.1)	1.3(0.7, 2.1)	4.3 (2.5, 7.3)

Table 7 (cont'd)

Variable	Unadjusted Odds Ratios of Sleep Sub-Components						
	Overall Subjective Sleep OR(95% CI)	Sleep Duration OR(95% CI)	Sleep Latency OR(95% CI)	Habitual Sleep Efficiency OR(95% CI)	Use of sleep Medication OR(95% CI)	Sleep Disturbances OR(95% CI)	Daytime Dysfunction OR(95% CI)
Coffee drinks (cups/day)	0.9(0.8, 1.1)	0.9(0.8, 1.1)	0.9(0.8, 1.0)	1.0(0.8, 1.1)	1.0(0.9, 1.1)	1.0(0.9, 1.1)	1.0(0.8, 1.1)
Tea (cups/day)	1.0(0.8, 1.2)	1.0(0.8, 1.2)	1.0(0.8, 1.2)	1.2(0.8, 1.7)	1.1(0.9, 1.3)	1.1(0.9, 1.3)	1.0(0.8, 1.3)
Chocolate drinks (cups/day)	0.8(0.3, 2.7)	2.3(1.2, 4.4)	1.2(0.8, 1.9)	0.6(0.3, 1.3)	1.5(1.0, 2.4)	3.4(1.6, 7.2)	1.3(0.7, 2.4)
Soft drinks (cups/day)	1.0(0.8, 1.1)	1.0(0.9, 1.2)	1.0(0.9, 1.1)	0.8(0.8, 0.9)	1.0(0.9, 1.1)	1.1(1.0, 1.2)	1.1(0.9, 1.2)
Passive smoking (hrs/wk)	1.0(1.00, 1.02)	1.0(1.00, 1.02)	1.0(1.00, 1.03)	0.9(0.97, 0.99)	1.0(1.00, 1.02)	1.0(1.01, 1.05)	1.0(1.00, 1.02)

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