

Sleep Characteristics and Cardiovascular Disease Risk Among Thai Women

BY

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THESIS

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LIST OF ABBREVIATIONS

CI	Confidence Interval
BMI	Body Mass Index
BP	Blood Pressure
CHF	Congestive Heart Failure
Coef	Coefficient
CVD	Cardiovascular Disease
FRS-BMI	Framingham risk score-BMI based
MI	Myocardial Infarction
MRS	Menopausal Rating Scale
OR	Odd Ratio
OSA	Obstructive Sleep Apnea
PROMIS	Patient-Reported Outcome Measurement Information System
PSQI	Pittsburgh Sleep Quality Index
SD	Standard Deviation
SE	Standard Error
SEM	Structural Equation Model
SL-ASIA	Suinn-Lew Asian Self-Identity Acculturation
STRAW	Stage of Reproductive Aging Workshop

SUMMARY

Sleep disturbances (i.e. poor sleep quality, low sleep efficiency, and risk of Obstructive Sleep Apnea (OSA)) have been implicated in cardiovascular morbidity and mortality among women in the transition to menopause. Although several studies have revealed the relationships of sleep disturbances and the risk of Cardiovascular Disease (CVD) in diverse racial/ethnic groups of women, the influencing factors of both sleep disturbances and CVD risk among Thai women living in the US have not been fully identified. Acculturation to the US culture may be an influencing factor in sleep disturbances and the risk of CVD among these women. The aim of this dissertation research was to investigate whether 1) sleep disturbances (e.g., poor sleep quality, and/or low sleep efficiency, and/or increased risk of OSA) are prevalent among Thai women; 2) acculturation is associated with sleep quality, sleep efficiency, and risk of OSA in Thai women; 3) acculturation mediates or moderates the association between the participants characteristics and health-related factors with sleep disturbances (article 1); and 4) sleep disturbances could mediate or moderate the relationships between (a) demographic factors and CVD risk, (b) socio-cultural factors and CVD risk, and (c) health-related factors and CVD risk (article 2).

One hundred and twenty Thai women aged between 40 to 65 years, living in Illinois, USA, were enrolled in this study. They were asked to complete a questionnaire containing demographic, socio-cultural, health-related, and sleep-related information. Lastly, their weight, height, and blood pressure were measured and used for calculating the 10-year CVD risk. The data was analyzed using multivariate linear regression with robust standard error estimation, logistic regression, and Structural Equation Model (SEM) analysis for article 1; and robust regression with SEM analysis for article 2.

SUMMARY (continued)

Overall, most Thai women had good sleep quality, were classified as good sleepers, had high sleep efficiency, and low risk of OSA. Acculturation was associated with sleep quality and sleep efficiency, but not with the risk of OSA. Moreover, the significant effects of acculturation as a mediator of the association between the participants characteristics and health-related factors with sleep disturbances (sleep quality and sleep efficiency) were detected. In article 2, only the risk of OSA had a positive association with CVD risk. The associations between demographic factors and CVD risk; and health-related factors and CVD risk were mediated and moderated by the risk of OSA, while sleep quality was found to be a moderator of the association between demographic factors and CVD risk.

The results of this research emphasize the association between sleep disturbances and acculturation and sleep disturbances associated with CVD risk. Providing support or intervention to Thai women in order for them to adjust to a different cultural environment may prevent the incidence of sleep disturbance; thus, improving their cardiovascular health.

I. A MEDIATION AND MODERATION ANALYSIS OF THE EFFECTS OF ACCULTURATION ON THE RELATIONSHIP BETWEEN DEMOGRAPHIC FACTORS, HEALTH-RELATED FACTORS, AND SLEEP CHARACTERISTICS AMONG THAI MENOPAUSAL WOMEN IN ILLINOIS

Introduction

Sleep disturbances are associated with an increased risk of chronic illnesses such as coronary heart disease (Lao et al., 2018) and Cardiovascular Disease (CVD) (Yin et al., 2022), as well as mortality (Cappuccio & Miller, 2017). Women have higher prevalence of sleep-related problems compared to men (Seicean et al., 2011) and more than 50% of women report poor sleep during their transition to menopause (Fetveit et al., 2019; Jones et al., 2018; Kalleinen et al., 2021). Peri-menopausal and post-menopausal women more often report sleep disturbances compared to pre-menopausal women (OR 1.60 and 1.67, $p < 0.001$ and $p < 0.001$, respectively) (Xu & Lang, 2014).

A progressive decline in estrogen and progesterone levels is frequently related to vasomotor symptoms such as night sweats, fatigue, mood alterations, irritability, headache, heart palpitation, and sleep problems during menopausal transition (Woods & Mitchell, 2016). These symptoms and hormonal changes may contribute to the suboptimal quantity and quality of sleep, as well as Obstructive Sleep Apnea (OSA), with numerous downstream consequences to health and functioning, including CVD, obesity, and mood disorders (Galvan et al., 2017). Previous studies have shown that the prevalence and severity of sleep apnea increase during menopause. Menopausal women were reported to have a higher prevalence of OSA due to weight gain and a decrease in estrogen and progesterone levels (Mirer et al., 2017). Sleep quality and efficiency

can also be affected by hormonal changes (Nowakowski et al., 2013) and were found to be lower in women in their transition to menopause compared to younger women (Ohayon, 2006).

Several factors can affect the reductions in sleep quantity, quality, and efficiency during transition to menopause including sociocultural, demographic, and health-related factors (Barot, 2021). Many studies investigating the effects of cultural influences on sleep reported that immigrants suffer from more insomnia symptoms and sleep disturbances than non-immigrants (Schneeberger et al., 2019; Seicean et al., 2011). Immigrant women in the US may be especially vulnerable to the combination of biological and environmental factors. For example, factors such as immigration status, acculturation (Chapagai & Martyn-Nemeth, 2022), length of stay in the USA (Grandner et al., 2016; Im et al., 2020), and psychosocial stress (Heilemann et al., 2012; Kim & Dimsdale, 2007) are correlated with sleep problems among immigrants. While several studies in the US have identified sleep problems among immigrant women, very few of them were conducted on Asian women (Young et al., 2013).

Immigrants may experience difficulties related to US acculturation, which may contribute to sleep-related symptoms and unhealthy behaviors and result in poor sleep (Ghani et al., 2020). Acculturation, the process in which individuals from one culture adapt to the characteristics of a host culture, such as customs, traditions, practices, or behaviors (Salabarria-Pena et al., 2001), has been found to be associated with short sleep duration, poor sleep quality, and higher numbers of sleep-related problems (Ghani et al., 2020; Hale et al., 2014; Heilemann et al., 2012; Whinnery et al., 2014). In the USA, Asian immigrants with higher acculturation levels reported shorter sleep duration compared to Asian Americans. The shorter sleep duration was especially associated with the length of their stay in the USA (Ryu et al., 2021). High acculturative stress was due to different beliefs and cultural values, as well as levels of stress in efforts to adjust to

the US lifestyle (Cook et al., 2022; Hale & Rivero-Fuentes, 2011; Kandula & Lauderdale, 2005), which may ultimately lead to increased sleep problems.

In the Chicago area, Carnethon et al. (2016) examined the discrepancies between sleep duration and sleep efficiency among African American, Hispanic, Asian, and White individuals. Asian adults were found to have a shorter sleep duration, lower sleep quality, and higher sleep problems compared to White individuals (Carnethon et al., 2016). Among the Asian immigrants, greater acculturation was associated with worse sleep outcomes (Young et al., 2013). It has been noted that poor sleep varies among immigrant women based on their level of acculturation and duration of residence in the US (Ghani et al., 2020); however, inconsistent results were reported, with high levels of acculturation being associated with a better sleep outcome (Martinez-Miller et al., 2019). While sleep may be altered by acculturative levels, the role of acculturation affecting sleep among Asian women in the US is unclear. Thus, it remains to be explored that acculturation may be a mediator or moderator in the relationship between socio-demographic factors and sleep.

The prevalence of OSA among Thai women living in Thailand was 6.3 % (Neruntarat & Chantapant, 2011). While Thai women have been relocating to the US since the early 1950s (Cutler, 2006), the prevalence of sleep disturbances among them has never been explored. These women may experience difficulties related to acculturation to the US culture, similar to other immigrants, which may contribute to the suboptimal quantity and quality of sleep. Therefore, this study aimed to investigate whether: 1) sleep disturbances (i.e. poor sleep quality, and/or low sleep efficiency, and/or increased risk of OSA) are prevalent among Thai women; 2) acculturation is associated with sleep quality, sleep efficiency, and risk of OSA in Thai women; and 3) acculturation mediates or moderates the association between the participants

characteristics and health-related factors affecting sleep (i.e. sleep quality, sleep efficiency, and risk of OSA). The study hypotheses corresponding to the three aims are as follows: 1) sleep disturbances (i.e. poor sleep quality, and/or low sleep efficiency, and/or increased risk of OSA) are prevalent among Thai women; 2) higher acculturation was associated with poor sleep quality, lower sleep efficiency, and/or the increased risk of OSA among these women; and 3) acculturation mediates and moderates the association between the participants characteristics and sleep (i.e. sleep quality, sleep efficiency, and risk of OSA).

Methods

Study Design and Sample

This study had a non-experimental, cross-sectional, descriptive design. It was performed in Illinois, USA from May to November 2021. The sample was recruited using convenient sampling methods.

This study included 120 Thai women between the ages of 40 to 65. Thai and English advertisements were utilized in the form of flyers and distributed at Thai churches, temples, and community centers in the Chicago area. Electronic flyers were posted on the ResearchMatch, Thai community website and social media (e.g., Facebook page: Thai Census in Chicago/Illinois; Line messenger; and Craigslist) to maximize sample size and the representativeness of potential subjects. The inclusion criteria included 1) ages between 40 to 65, 2) self-identified as Thai women, and 3) knowledge of English. Exclusion criteria were: 1) serious mental conditions (e.g. severe major depression) or serious health problems (e.g. cancer); 2) history of cardiovascular disease (e.g. stroke or transient ischemic attack, heart failure, myocardial infarction, angina, intermittent claudication, significant limb ischemia, aortic atherosclerosis, thoracic aortic aneurysm, or abdominal aortic aneurysm); 3) taking sleeping pills/ sleep aids (e.g. melatonin),

excessive alcohol intake (greater than 3 glasses per day) or drug abuse; and 4) pregnancy or breastfeeding.

Procedures

This study was approved by the Institutional Review Board of the University of Illinois Chicago (protocol #2020-0738). Once receiving information about the study, consent was obtained from all participants before enrolling in the study. All women were asked to fill out a questionnaire containing demographic data: age, length of stay in the USA, birthplace, education, household income, marital status, numbers of children, employment status, night shift work, and acculturation. In addition, the participants were requested to respond to the questions regarding anxiety score, menopausal symptoms, menopausal status, smoking status, alcohol consumption, exercise time, and chronic disease diagnosis (e.g. diabetes, hypertension, asthma/ pulmonary problems, epilepsy, renal disease, gastrointestinal problems, thyroid problems, immune system problems, and neurological conditions). Weight and height were measured to obtain Body Mass Index (BMI). Finally, sleep quality, sleep efficiency, and risk of OSA were also examined using the questionnaire. The participants were compensated \$10 after completing the study.

Measurements

Acculturation was assessed using the SuinnLew Asian Self-Identity Acculturation (SLASIA: Leong & Chou, 1998; Suinn et al., 1992)). The SLASIA is a well-validated instrument used among the Asian population. The score ranges from 1 to 5 with a higher score indicating a high level of acculturation or being more Americanized (Leong & Chou, 1998). The SLASIA for Thai women in this study had a test-retest reliability of 0.98, indicating good reliability.

Pittsburgh Sleep Quality Index (PSQI) consists of 19 self-rated questions (Buysse et al., 1989). It was used to measure habitual sleep quality and quantity over the previous month.

The PSQI is composed of 7 subscales assessing subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each subscale has a possible score between 0 and 3, with an overall global score of 0–21 with higher scores indicating poor sleep quality (Buysse et al., 1989). Participants with a score of ≥ 5 were considered as poor sleepers. Sleep efficiency was calculated from the habitual sleep efficiency subscale [(hours of sleep/ hours in bed)*100] and reported as the sleep efficiency percentage. The PSQI for Thai women in this study showed good reliability with Cronbach's alpha of 0.81.

Berlin questionnaire is a screening tool that identifies patients at high risk of having OSA (Netzer et al., 1999). It consists of 10 questions on the following components: snoring, tiredness, observed apnea, and high blood pressure. The questions are ranked into three categories related to the risk of sleep apnea. The questionnaire has been used and confirmed to be valid among premenopausal and menopausal women (Yazdi et al., 2013). A higher score indicates a higher risk of OSA (Thurtell et al., 2011). The Berlin questionnaire for Thai women in this study had a Cohen's kappa of 0.90, indicating good reliability.

Anxiety was measured using the PROMIS SF v1.0 – Anxiety 4a . It consists of 4 questions regarding fearfulness, difficulty to focus, feeling overwhelmed, and uneasiness. Each item has 5 scales (never, rarely, sometimes, often, and very often). The score is auto calculated with a higher score indicating a higher level of anxiety. The PROMIS SF v1.0 – Anxiety 4a had good reliability with Cronbach's alpha of 0.95 among Thai women in this study.

Menopausal symptoms were evaluated using the Menopause Rating Scale (MRS: Potthoff et al., 2000). It has 11 questions with 3 dimensions (psychological, somato-vegetative, and urogenital symptoms) and 5 rating scales (0-4). Total MRS ranges between 0

(asymptomatic) and 44 (highest degree of complaints). The severity of menopausal symptoms are: 5 - 8 = mild, 9 - 15 = moderate, and > 15 = severe. The MRS for Thai women in this study had a Cronbach's alpha of 0.73, indicating good reliability.

Menopausal status was assessed using the stage of Reproductive Aging Workshop (STRAW: Harlow et al., 2012). The criteria to define reproductive stages were classified in 3 stages: 1) Premenopause (still have regular periods), 2) Perimenopause (start to experience menopausal symptoms or changes in menstrual cycles), and 3) Post menopause (experience a consecutive 12 months without period).

Anthropometric measures. Height and weight were measured using a portable stadiometer and a weight scale. BMI was calculated using the formula of weight (kg) divided by height squared (m²) (Turbey et al. 2010).

Determinant variables included age, length of stay in the USA, education, household income, marital status, numbers of children, employment status, acculturation, anxiety score, menopausal symptoms, smoking status, alcohol consumption, exercise time, chronic disease diagnosis, and BMI.

Statistical Analyses

Stata 15.1 was used to perform the data analyses (Stata Corp, 2017). Descriptive statistics including frequency, mean, percentage, and Standard Deviation (SD) were used to check for normality, outliers, and missing data, and to examine the subjects' demographics. Bivariate Spearman's correlation analysis was performed to determine the associations among sleep, the participants characteristics, and acculturation. Any independent variable related to the dependent variables (at $p < 0.2$) in the bivariate analysis was included in the multivariable analysis as a potential predictor.

Separate multivariable linear regression analyses were conducted to examine sleep quality and efficiency. The predictors were determined based on bivariate analyses and used for all multivariable regression models. All relevant modeling assumptions were rigorously checked (e.g., linearity and normality, homoscedasticity of errors, and the multicollinearity test) and corrective measures were taken if necessary. Estimation was applied in Robust Standard Errors (SE). (Freedman, 2006; James et al., 2013). One of the dependent variables skewed toward maximum (ceiling effect) or minimum (flooring effect) score according to histograms, similar to censored normal distribution; thus, the Tobit regression was applied to estimate the coefficient for sleep efficiency (Long & Long, 1997; Tobin, 1958). Logistic regression was used to examine the categorical dependent variable, risk of OSA.

Mediation analysis (Structural Equation Models (SEM; Jenatabadi, 2015; Keith, 2014) was performed to explore the existing relationship between a dependent variable and independent variables through a mediating variable. The hypothesis assumes the effects of independent variables as the main cause of the mediator and, consequently, the mediator leads to the dependent variable (Jenatabadi, 2015). The model was drawn based on the bivariate analysis or actual data. The SEM was performed by creating path models and calculating postestimation to compute coefficients, SD, test statistics, and significant levels of the parameters for indirect effects. The mediating effect was considered to be present if the multiplicative equation (indirect effect) was statistically significant (Jenatabadi, 2015).

Lastly, moderation analysis was tested by entering the interaction terms into the multiple, Tobit, and logistic regression models. The interaction terms between demographic characteristics, health-related factors, and acculturation were investigated after the regression of

predictors and the moderator showed a significant association. The moderating effects were considered if the interaction terms were deemed statistically significant (Hayes, 2022).

The p-value of 0.05 was set to determine the statistical significance of the association among the studied variables.

Results

Characteristics of the Participants

The majority of Thai women in this study (90%) were recruited onsite at the Thai churches, temples, and community centers. The participants' characteristics have been presented in Table I. The mean age was 51.53 years ($SD = 7.73$). Their average length of stay in the USA was 21.77 years ($SD = 12.96$). The majority of the participants were born outside the US (96.67%). Among the participants, 77.50% had a college degree, 55.83% had household income over \$70,000 per year, 75.00% were married, and 88.33% had 1-2 children. Most participants were employed (70.83%) and 12.50% worked night shifts. The participants had a mean acculturation score of 1.90 points ($SD = 0.59$). Based on the characteristics, all variables (i.e. age, length of stay in the USA, education, household income, marital status, numbers of children, employment status, anxiety, menopausal symptoms, alcohol consumption, and exercise time) were included in the bivariate analysis except for birthplace due to high variability.

As shown in Table II, the average anxiety t-score was 44.60 ($SD=7.31$), and the menopausal symptoms score was 3.63 ($SD=4.71$). More than half of the participants had no menopausal symptoms (72.50%). According to the menopausal status, 31.67% of the women were pre-menopausal, 11.67% were perimenopausal, and 56.67% were post-menopausal. The majority of the participants were non-smokers (97.50%) and never drink/drink monthly or less (93.33%). More than half of the participants exercised daily for 30-60 minutes (59.17%).

Twenty-eight participants were diagnosed with chronic disease. Their average BMI was 24.13 (SD=4.01), systolic BP was 125.35 mmHg (SD=20/72) and diastolic BP was 79.09 mmHg (SD=12.72). Based on the health-related characteristics, the smoking status will not be considered as a predictor because only 2.50% of the participants smoked.

Sleep Characteristics of Participants

Sleep quality based on the PSQI score among Thai women was 4.18 (SD=3.03) of which 97 participants were good sleepers (80.83%). Sleep efficiency on average was 95.36 percent (SD=5.99). The majority of them had a low risk of obstructive sleep apnea (n=103, 85.83%).

Bivariate Analysis

In Table III, anxiety, menopausal symptoms, and chronic disease diagnosis positively correlated with sleep quality ($r=0.281$, $p=0.002$; $r=0.454$, $p<0.001$; $r=0.233$, $p=0.011$, respectively), indicating that women with higher anxiety scores, more menopausal symptoms, and chronic disease diagnosis experienced lower quality of sleep. On the other hand, menopausal symptoms and chronic disease diagnosis were found to have negative correlations with sleep efficiency ($r=-0.318$, $p<0.001$; $r=-0.224$, $p=0.014$). It can be interpreted as, the higher the menopausal symptoms and more diagnosed chronic diseases, the lower the sleep efficiency. The risk of OSA was positively correlated with BMI, menopausal symptoms, chronic disease diagnosis ($r=0.226$, $p=0.013$; $r=0.303$, $p=0.001$; $r=0.454$, $p<0.001$, respectively), indicating that higher BMI, more menopausal symptoms, and chronic disease diagnosis may increase the risk of OSA. However, the risk of OSA is negatively correlated with longer exercise time ($r=-0.226$, $p=0.013$).

The household income and length of stay in the USA were significantly associated with acculturation ($r=0.259$, $p=0.004$ and $r=0.250$, $p=0.006$, respectively) (Table III). The longer the

participants stayed in the US and the higher the household income, the more Americanized they became. Exercise time was found to have positive correlations with acculturation ($r=0.332$, $p<0.001$), indicating that the higher acculturation level, the more women engaged in daily exercise. Twelve variables related to sleep outcomes at $p < 0.2$ were included in the sleep model: age, length of stay in the USA, education, household income, marital status, numbers of children, employment status, BMI, anxiety, menopausal symptoms, alcohol consumption, exercise time, and chronic disease diagnosis.

Associations of Acculturation and Sleep

In unadjusted models, sleep quality and sleep efficiency were significantly associated with acculturation ($B=-1.105$, $p=0.019$ and $B=1.962$, $p=0.035$, respectively). After adjusting for the length of stay in the USA, education, household income, marital status, numbers of children, employment status, anxiety, menopausal symptoms, alcohol consumption, exercise time, and chronic disease diagnosis, the associations of sleep quality and sleep efficiency with acculturation remain significant (sleep quality $B=-1.086$, $p=0.027$; sleep efficiency $B=2.425$, $p=0.021$, respectively). Thus, acculturation is independently associated with sleep, in which the higher acculturation, the lower the sleep quality and the higher the sleep efficiency. In the regression model for the risk of OSA, chronic disease diagnosis and BMI were excluded due to their relation to the risk of OSA measure. None of the unadjusted or adjusted models for the risk of OSA showed significant effects of acculturation (Table IV). Heteroskedasticity tests revealed non-normality for sleep outcomes; therefore, the rest of the analysis was performed with robust SE estimation.

Mediation Analysis

Figures 1, 2, and 3 show the proposed model to estimate mediation and moderation paths toward sleep outcomes (i.e. sleep quality, sleep efficiency, and risk of OSA). The SEM analysis results were reported in Table V. While the length of stay in the USA had no direct effects on the sleep quality model (Table V), it had an indirect effect (coefficient=-0.022, $p=0.026$) (Table VI) as the length of stay in the USA significantly impacted acculturation. This result indicated that acculturation to be a mediator between the length of stay in the USA and sleep quality. Similarly, acculturation was also a mediator between the length of stay in the USA and sleep efficiency. Although the direct effect of length of stay in the USA on sleep efficiency was not significant, its indirect effect on sleep efficiency was positively statistically significant (coefficient= 0.051, $p=0.018$) (Table VI). The multiplicative approach revealed no indirect effects of acculturation on the relationships between either age or length of stay in the USA with the risk of OSA (Table VI). Finally, path diagrams for final models concerning the mediating effects of acculturation on sleep quality, sleep efficiency, and risk of OSA are shown in Figures 4, 5, and 6, respectively and the indirect effects among the participants' characteristics, socioeconomic factors, health-related factors, and acculturation on sleep outcomes are summarized in Table VII.

Moderation Analysis

Moderation analysis was performed with the interaction terms between demographic characteristics, health-related factors, and acculturation. Menopausal symptoms and alcohol consumption subscales (i.e. often (≥ 4 times/week)) were chosen to estimate the interaction with acculturation in the sleep quality model. In the sleep efficiency model, education subscale (some college or associate degree), menopausal symptoms, and alcohol consumption subscale (often (≥ 4 times/week)) were selected for the interaction terms analyses. Lastly, menopausal symptoms

and the exercise time subscale (30-60 minutes per day) were included in the interaction terms in the risk of OSA model. However, acculturation had no significant interaction effects on any sleep predictors, indicating that acculturation did not moderate the relationship between demographic characteristics, health-related factors, and sleep (i.e. sleep quality, sleep efficiency, and risk of OSA) (Table VIII and IX).

Discussion

According to current knowledge, this is the first study aiming at a better understanding of the potential role of acculturation on Thai women's demographic characteristics, health-related factors, and sleep (i.e. sleep quality, sleep efficiency, and risk of OSA). Thai women had high sleep quality, were mostly classified as good sleepers, had high sleep efficiency, and most of them had low risk of OSA. Acculturation had a significant impact on sleep quality and sleep efficiency among Thai women living in Illinois, USA. The higher the acculturation level, the higher the sleep quality and sleep efficiency. Additionally, the indirect effects of acculturation on the association between the length of stay in the USA with both sleep quality and sleep efficiency were identified. Although acculturation did not moderate the effects of women's demographic characteristics, health-related factors, and sleep (i.e. sleep quality, sleep efficiency, and risk of OSA), it was negatively related to sleep quality scores (higher sleep quality) and positively related to sleep efficiency.

This study found the associations of acculturation and sleep. Higher acculturation is associated with higher sleep quality and sleep efficiency. After adjusting for demographic and health-related factors (age, length of stay in the USA, education, household income, marital status, numbers of children, employment status, BMI, anxiety, menopausal symptoms, exercise time, and chronic disease diagnosis), the associations of acculturation with both sleep quality and

sleep efficiency remained significant. The result was partially consistent with previous studies on the Latino populations in the US, which reported the association of high acculturation levels and better sleep-related outcomes (Martinez-Miller et al., 2019). This may be explained through several factors. First, individuals with low US acculturation may have high acculturative stress due to lack of social support, perceived discrimination, and language barriers influencing psychological factors and poor sleep (Kim & Dimsdale, 2007; Park et al., 2020). A score of 50 with SD of 10 is the average anxiety score for general population in the USA (Rothrock et al., 2020). In this study, the participants experienced lower anxiety scores compared to average and a higher anxiety t-score was associated with lower sleep quality; therefore, this could explain why Thai women with high acculturation had less sleep problems.

A previous study found a higher prevalence of sleep disturbance to be associated with a greater acculturative stress (Lee et al., 2022). The majority of Thai women in this study were recruited from Thai temples, churches, and community centers, which offer a strong supporting system in their community. This may facilitate Thai women to be able to adjust to the US culture and better their coping skills, possibly leading to lower acculturative stress and higher strategies in managing sleep problems. This idea was supported by a previous study on immigrants showing greater social support from family and community members to be associated with greater life satisfaction (Hombrados-Mendieta et al., 2019). On the other hand, perceived discrimination, limited English language proficiency, and low levels of family cohesion were strong predictors of acculturative stress (Lueck & Wilson, 2010) leading to higher sleep disturbances.

Place of birth might also be associated with sleep-related problems. Most of the Thai women recruited in this study (n=116 from 120 participants) were born outside the US. It was

previously reported that immigrants born outside the US (first generation immigrants) had a lower prevalence of sleep problems compared to the US-born immigrants (Grandner et al., 2013; Hale et al., 2014; Im et al., 2020; Seicean et al., 2011). This finding was corroborated by another study that participants being born outside of the US were more likely to report healthier sleep than the US-born population (Newsome et al., 2017). The potential explanation for the associations found in this study is that native-born US populations were reported to be more likely to engage in unhealthy behaviors, while those immigrants born outside the US may engage in healthier lifestyles leading to less sleep-related problems (Hale & Rivero-Fuentes, 2011). This study revealed that the US-born Mexican Americans had higher stress levels and smoking rates compared to their non-US-born counterparts, which may be associated with shorter sleep durations.

The findings in this study also revealed that higher acculturation is associated with higher sleep efficiency. This is similar to the previous finding from Ghani et al. (2020) that Anglo orientation was positively associated with sleep efficiency during the weekdays, and it was negatively associated with sleep efficiency during the weekends. This may be related to different social behavior patterns among American acculturations. Since sleep efficiency was calculated as sleep time divided by time in bed, these people may have short sleep duration and busy daily schedules; thus, they may go to bed only when they need to sleep in the weekdays and tend to stay in bed longer during the weekend. However, this study did not identify the associations between potential behavior patterns and sleep or compare sleep duration and sleep efficiency between weekdays and weekends. Therefore, future studies should consider exploring different social behaviors leading to these associations.

The mediating effects of acculturation on the relationships between the length of stay in the USA and sleep (i.e. sleep quality and sleep efficiency) were presented in this study. A longer stay in the US was related to a higher level of acculturation resulting in higher sleep quality (lower sleep quality score) and efficiency. Although length of stay in the USA had no direct effect on sleep outcomes, it had an indirect effect through acculturation. This finding was similar to the study of sleep-related symptoms experienced by the immigrants (Im et al., 2020).

According to researchers the length of stay in the USA along with acculturation accounted for the numbers and severity of sleep-related symptoms 1.01% and 1.41%, respectively; however, the length of stay in the USA, by itself did not predict sleep-related symptoms. While the concept of acculturation as a mediator on the relationship between health-related factors and sleep cannot be identified in this study, acculturation may be a significant factor affecting health-related behaviors which may be associated with sleep outcomes.

The role of acculturation in these relationships has never been identified in previous literature. This finding may be attributable to the fact that most of the Thai women in this study were foreign-born and have been living in the US for a long time; thus, they were more likely to have successfully adjusted to the US culture and experienced less acculturative stress, which led to better sleep. However, this finding contradicts the previous study among Asian Americans and Pacific Islanders (Ryu et al., 2021). The researchers in previous studies stated that foreign-born Asians living in the US for a longer time had more sleep difficulties and shorter sleep time compared to those living in the US for a shorter period.

In this study, menopausal symptoms were associated with all sleep outcomes. Higher menopausal symptoms led to lower sleep quality, lower sleep efficiency, and an increased risk of OSA. Similarly, sleep disturbances were found to be associated with menopausal transition

stages and symptoms (Woods & Mitchell, 2016). Another study from Mirer et al., (2017) also reported a higher prevalence of sleep disorders and risk of OSA in relation with menopausal symptoms in middle-aged women. Menopausal symptoms could be signs or symptoms of OSA as there is an overlap of physical and psychological symptoms such as: fatigue, excessive day time sleepiness, difficulty concentrating during the day, morning headaches, and mood changes or irritability (Odai et al., 2022). The prevalence of middle-aged women with OSA significantly increased after menopause (Barot, 2021). Therefore, it may be difficult to distinguish if women experience sleep disturbance from an underlying sleep disorder or menopausal symptoms. In addition to menopausal symptoms, this study also found the associations among demographics and health-related factors with sleep (e.g. age, BMI, smoking status, and drinking behavior). These results were similar to the previous finding of the sociodemographic and socioeconomic factors and sleep studies. Social and environmental factors such as marital status, education, income, and immigration status were found to be associated with short sleep duration (Grandner et al., 2013, 2016; Whinnery et al., 2014).

To be able to improve sleep health, the associations among sociodemographic, acculturation, and health-related factors with sleep need further investigation. This study revealed the significant effects of acculturation on sleep quality and sleep efficiency. It also expands the literature by confirming the indirect effects of acculturation on the relationship of length of stay in the USA and sleep quality, as well as the relationship of length of stay in the USA and sleep efficiency. However, the results did not support the hypothesis of the moderating role of acculturation in sleep.

Limitations and Strengths

The current study has many strengths and limitations. Using the nonprobability sampling strategies may limit the generalizability of the study results and impose selection bias. The cross-sectional designs do not allow us to capture the full dynamic of sleep changes which may vary by several factors. Another limitation of this study was the fact that we collected data using only subjective sleep measures. Moreover, only four US-born Thai women were included; thus, the effects of acculturation on sleep outcomes among foreign-born and US-born Thai cannot be compared. While the researchers have tried to advertise the study online and at other locations (e.g. Asian restaurants, groceries, and salon), most of the participants were recruited onsite, mainly at Thai temples, churches, and community centers around Chicago areas, in which most of the women were members. Therefore, participants in this study might not represent all Thai women in Illinois. If more participants had been recruited from a wider community, the relationships of acculturation and demographic factors may have been identified.

This study had several strengths. The association of acculturation and sleep has never been explored in the Thai population living in the US. To date, this is the first study to comprehensively examine the relationship among demographic characteristics, health-related factors, acculturation, and sleep among this population. In addition, this study employed a validated acculturation scale which makes it more accurate to evaluate acculturation compared to previous studies using language or English proficiency as a proxy measure for acculturation. The analysis employed various factors and different approaches which allowed to expand the literature on acculturation and sleep.

Implications for Practice and Future Research

Given the insufficient and contradictory findings from the current literature, additional research is needed to investigate the role of acculturation and sleep-related outcomes, using both objective and subjective sleep measures. In addition to the US-born population, future studies among other racial and ethnic groups and foreign-born individuals should be considered. Understanding how acculturation affects sleep may help the identification of interventions to improve sleep health. Longitudinal studies investigating the associations and underlying mechanisms of acculturation, acculturative stress, and sleep may increase the understanding of additional factors related to sleep-related outcomes.

Conclusion

The results support the idea that sleep may depend on acculturation. This study concluded that acculturation has significant effects on sleep among Thai women in Illinois, USA. Also, we should consider the relationships between demographic characteristics and sleep through acculturation. Given the significant associations observed between acculturation and both sleep quality and sleep efficiency, sleep doctors and nurses should consider investigating the acculturation level and acculturative stress when evaluating sleep-related symptoms. Future research on acculturation and sleep among participants with sleep disturbances should be investigated to identify the actual role of acculturation in this relationship.

References

- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173–1182. <https://doi.org/10.1037/0022-3514.51.6.1173>
- Barot, N. (2021). Optimal sleep habits in middle-aged adults. In *Reference Module in Neuroscience and Biobehavioral Psychology*. Elsevier. <https://doi.org/10.1016/B978-0-12-822963-7.00003-7>
- Buyse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- Cappuccio, F. P., & Miller, M. A. (2017). Sleep and Cardio-Metabolic Disease. *Current Cardiology Reports*, 19(11), 110. <https://doi.org/10.1007/s11886-017-0916-0>
- Carnethon, M. R., De Chavez, P. J., Zee, P. C., Kim, K.-Y. A., Liu, K., Goldberger, J. J., Ng, J., & Knutson, K. L. (2016). Disparities in sleep characteristics by race/ethnicity in a population-based sample: Chicago Area Sleep Study. *NHLBI Workshop on Reducing Health Disparities: The Role of Sleep Deficiency and Sleep Disorders*, 18, 50–55. <https://doi.org/10.1016/j.sleep.2015.07.005>
- Chapagai, S., & Martyn-Nemeth, P. (2022). Sleep Health, Acculturation, and Acculturative Stress in Immigrants in the United States: A Scoping Review. *Journal of Transcultural Nursing*, 10436596211072884. <https://doi.org/10.1177/10436596211072884>
- Cook, W. K., Li, L., Tam, C. C., Mulia, N., & Kerr, W. C. (2022). Associations of clustered health risk behaviors with diabetes and hypertension in White, Black, Hispanic, and

Asian American adults. *BMC Public Health*, 22(1), 773.

<https://doi.org/10.1186/s12889-022-12938-y>

Cutler, I. (2006). *Chicago: Metropolis of the mid-continent*. Carbondale. Southern Illinois Univ. Press.

Fetveit, A., Straand, J., Bjorvatn, B., & Kristoffersen, E. S. (2019). Self-reported sleeplessness in 12,655 persons living in the north of Norway: The Tromsø Study. *Sleep Science (Sao Paulo, Brazil)*, 12(3), 147–155. PubMed. <https://doi.org/10.5935/1984-0063.20190070>

Freedman, D. A. (2006). On The So-Called “Huber Sandwich Estimator” and “Robust Standard Errors.” *The American Statistician*, 60(4), 299–302.
<https://doi.org/10.1198/000313006X152207>

Galvan, T., Camuso, J., Sullivan, K., Kim, S., White, D., Redline, S., & Joffe, H. (2017). Association of estradiol with sleep apnea in depressed perimenopausal and postmenopausal women: A preliminary study. *Menopause (New York, N.Y.)*, 24(1), 112–117. PubMed. <https://doi.org/10.1097/GME.0000000000000737>

Ghani, S. B., Delgadillo, M. E., Granados, K., Okuagu, A. C., Alfonso-Miller, P., Buxton, O. M., Patel, S. R., Ruiz, J., Parthasarathy, S., Haynes, P. L., Molina, P., Seixas, A., Williams, N., Jean-Louis, G., & Grandner, M. A. (2020). Acculturation Associated with Sleep Duration, Sleep Quality, and Sleep Disorders at the US-Mexico Border. *International Journal of Environmental Research and Public Health*, 17(19), 1.
<https://doi.org/10.3390/ijerph17197138>

Grandner, M. A., Petrov, M. E. R., Rattanaumpawan, P., Jackson, N., Platt, A., & Patel, N. P. (2013). Sleep Symptoms, Race/Ethnicity, and Socioeconomic Position. *Journal of Clinical Sleep Medicine*, 09(09), 897–905. <https://doi.org/10.5664/jcsm.2990>

- Grandner, M. A., Williams, N. J., Knutson, K. L., Roberts, D., & Jean-Louis, G. (2016). Sleep disparity, race/ethnicity, and socioeconomic position. *NHLBI Workshop on Reducing Health Disparities: The Role of Sleep Deficiency and Sleep Disorders*, 18, 7–18. <https://doi.org/10.1016/j.sleep.2015.01.020>
- Hale, L., & Rivero-Fuentes, E. (2011). Negative Acculturation in Sleep Duration Among Mexican Immigrants and Mexican Americans. *Journal of Immigrant and Minority Health*, 13(2), 402–407. <https://doi.org/10.1007/s10903-009-9284-1>
- Hale, L., & Rivero-Fuentes, E. (2011). Negative Acculturation in Sleep Duration Among Mexican Immigrants and Mexican Americans. *Journal of Immigrant and Minority Health*, 13(2), 402–407. <https://doi.org/10.1007/s10903-009-9284-1>
- Hale, L., Troxel, W. M., Kravitz, H. M., Hall, M. H., & Matthews, K. A. (2014). Acculturation and sleep among a multiethnic sample of women: The Study of Women’s Health Across the Nation (SWAN). *Sleep*, 37(2), 309–317. PubMed. <https://doi.org/10.5665/sleep.3404>
- Hayes, A. F. (2022). *Introduction to Mediation, Moderation, and Conditional Process Analysis, Third Edition: A Regression-Based Approach*. Guilford Publications.
- Heilemann, M. V., Choudhury, S. M., Kury, F. S., & Lee, K. A. (2012). Factors associated with sleep disturbance in women of Mexican descent. *Journal of Advanced Nursing*, 68(10), 2256–2266. <https://doi.org/10.1111/j.1365-2648.2011.05918.x>
- Hombrados-Mendieta, I., Millán-Franco, M., Gómez-Jacinto, L., Gonzalez-Castro, F., Martos-Méndez, M. J., & García-Cid, A. (2019). Positive Influences of Social Support on Sense of Community, Life Satisfaction and the Health of Immigrants in Spain. *Frontiers in Psychology*, 10, 2555. <https://doi.org/10.3389/fpsyg.2019.02555>

- Im, E.-O., Ko, Y., Lee, Y., Chee, E., & Chee, W. (2020). Immigration Transition and Cognitive Symptoms During Menopausal Transition. *Western Journal of Nursing Research*, 42(4), 269–277. PubMed. <https://doi.org/10.1177/0193945919858366>
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning* (Vol. 103). Springer. <https://doi.org/10.1007/978-1-4614-7138-7>
- Jenatabadi, H. S. (2015). *An Overview of Path Analysis: Mediation Analysis Concept in Structural Equation Modeling*.
- Jones, H. J., Zak, R., & Lee, K. A. (2018). Sleep Disturbances in Midlife Women at the Cusp of the Menopausal Transition. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, 14(7), 1127–1133. PubMed. <https://doi.org/10.5664/jcsm.7208>
- Kalleinen, N., Aittokallio, J., Lampio, L., Kaisti, M., Polo-Kantola, P., Polo, O., Heinonen, O. J., & Saaresranta, T. (2021). Sleep during menopausal transition: A 10-year follow-up. *Sleep*, 44(6), zsaa283. PubMed. <https://doi.org/10.1093/sleep/zsaa283>
- Kandula, N. R., & Lauderdale, D. S. (2005). Leisure Time, Non-leisure Time, and Occupational Physical Activity in Asian Americans. *Annals of Epidemiology*, 15(4), 257–265. <https://doi.org/10.1016/j.annepidem.2004.06.006>
- Keith, T. Z. (2014). *Multiple Regression and Beyond: An Introduction to Multiple Regression and Structural Equation Modeling* (2nd ed.). Routledge. <https://doi.org/10.4324/9781315749099>
- Kim, E.-J., & Dimsdale, J. E. (2007). The Effect of Psychosocial Stress on Sleep: A Review of Polysomnographic Evidence. *Behavioral Sleep Medicine*, 5(4), 256–278. <https://doi.org/10.1080/15402000701557383>

- Lao, X. Q., Liu, X., Deng, H.-B., Chan, T.-C., Ho, K. F., Wang, F., Vermeulen, R., Tam, T., Wong, M. C. S., Tse, L. A., Chang, L., & Yeoh, E.-K. (2018). Sleep Quality, Sleep Duration, and the Risk of Coronary Heart Disease: A Prospective Cohort Study With 60,586 Adults. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, 14(1), 109–117. <https://doi.org/10.5664/jcsm.6894>
- Lee, S., Ryu, S., Lee, G. E., Kawachi, I., Morey, B. N., & Slopen, N. (2022). The association of acculturative stress with self-reported sleep disturbance and sleep duration among Asian Americans. *Sleep*, 45(4), zsab298. <https://doi.org/10.1093/sleep/zsab298>
- Leong, F., & Chou, E. L. (1998). Developing Brief Versions of the SuinnLew Asian SelfIdentity Acculturation (SLASIA) Scale for Counseling Research. *Asian American and Pacific Islander Journal of Health*, 6(1), 13–24.
- Long, J. S., & Long, J. S. (1997). *Regression Models for Categorical and Limited Dependent Variables*. SAGE.
- Lueck, K., & Wilson, M. (2010). Acculturative stress in Asian immigrants: The impact of social and linguistic factors. *International Journal of Intercultural Relations*, 34(1), 47–57. <https://doi.org/10.1016/j.ijintrel.2009.10.004>
- Martinez-Miller, E. E., Prather, A. A., Robinson, W. R., Avery, C. L., Yang, Y. C., Haan, M. N., & Aiello, A. E. (2019). US acculturation and poor sleep among an intergenerational cohort of adult Latinos in Sacramento, California. *Sleep*, 42(3), zsy246. <https://doi.org/10.1093/sleep/zsy246>
- Mirer, A. G., Young, T., Palta, M., Benca, R. M., Rasmuson, A., & Peppard, P. E. (2017). Sleep-disordered breathing and the menopausal transition among participants in the Sleep in

- Midlife Women Study. *Menopause (New York, N.Y.)*, 24(2), 157–162. PubMed.
<https://doi.org/10.1097/GME.0000000000000744>
- Neruntarat, C., & Chantapant, S. (2011). Prevalence of sleep apnea in HRH Princess Maha Chakri Srinthorn Medical Center, Thailand. *Sleep & Breathing = Schlaf & Atmung*, 15(4), 641–648. <https://doi.org/10.1007/s11325-010-0412-x>
- Netzer, N. C., Stoohs, R. A., Netzer, C. M., Clark, K., & Strohl, K. P. (1999). Using the Berlin Questionnaire To Identify Patients at Risk for the Sleep Apnea Syndrome. *Annals of Internal Medicine*, 131(7), 485–491. <https://doi.org/10.7326/0003-4819-131-7-199910050-00002>
- Newsome, V., Seixas, A., Iwelunmor, J., Zizi, F., Kothare, S., & Jean-Louis, G. (2017). Place of Birth and Sleep Duration: Analysis of the National Health Interview Survey (NHIS). *International Journal of Environmental Research and Public Health*, 14(7), 738. <https://doi.org/10.3390/ijerph14070738>
- Nowakowski, S., Meers, J., & Heimbach, E. (2013). Sleep and Women's Health. *Sleep Medicine Research*, 4(1), 1–22. PubMed. <https://doi.org/10.17241/smr.2013.4.1.1>
- Odai, T., Terauchi, M., Umeki, H., Miyasaka, N., & Somekawa, Y. (2022). Sleep apnea in postmenopausal women is associated with joint pain severity and fatigability: A cross-sectional study. *Menopause*, 29(6), 680–686. <https://doi.org/10.1097/GME.0000000000001974>
- Ohayon, M. M. (2006). Severe Hot Flashes Are Associated With Chronic Insomnia. *Archives of Internal Medicine (1960)*, 166(12), 1262–1268. <https://doi.org/10.1001/archinte.166.12.1262>

- Park, C., Spruill, T. M., Butler, M. J., Kwon, S. C., Redeker, N. S., Gharzeddine, R., & Whittemore, R. (2020). Gender Differences in Acculturative Stress and Habitual Sleep Duration in Korean American Immigrants. *Journal of Immigrant and Minority Health*, 22(4), 736–745. <https://doi.org/10.1007/s10903-019-00926-1>
- Ryu, S., Slopen, N., Ogbenna, B. T., & Lee, S. (2021). Acculturation and sleep outcomes in Asian Americans and Pacific Islanders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions-III. *Sleep Health*, 7(6), 683–690. <https://doi.org/10.1016/j.sleh.2021.09.004>
- Salabarria-Pena, Y., Trout, P., Gill, J., Morisky, D., Muralles, A., & Ebin, V. (2001). Effects of acculturation and psychosocial factors in Latino adolescents' TB-related behaviors. *Ethnicity & Disease*, 11(4), 661–675.
- Schneeberger, A. R., Seixas, A., Schweinfurth, N., Lang, U. E., Cajochen, C., Bux, D. A., Richards, S., Jean-Louis, G., & Huber, C. G. (2019). Differences in Insomnia Symptoms between Immigrants and Non-Immigrants in Switzerland attributed to Emotional Distress: Analysis of the Swiss Health Survey. *International Journal of Environmental Research and Public Health*, 16(2), E289. <https://doi.org/10.3390/ijerph16020289>
- Seicean, S., Neuhauser, D., Strohl, K., & Redline, S. (2011). An Exploration of Differences in Sleep Characteristics between Mexico-born US Immigrants and Other Americans to Address the Hispanic Paradox. *Sleep*, 34(8), 1021–1031. <https://doi.org/10.5665/SLEEP.1154>

- Suinn, R. M., Ahuna, C., & Khoo, G. (1992). The Suinn-Lew Asian Self-Identity Acculturation Scale: Concurrent and Factorial Validation. *Educational and Psychological Measurement*, 52(4), 1041–1046. <https://doi.org/10.1177/0013164492052004028>
- Thurtell, M. J., Bruce, B. B., Rye, D. B., Newman, N. J., & Biousse, V. (2011). The Berlin Questionnaire Screens for Obstructive Sleep Apnea in Idiopathic Intracranial Hypertension. *Journal of Neuro-Ophthalmology*, 31(4), 316–319. <https://doi.org/10.1097/WNO.0b013e31821a4d54>
- Tobin, J. (1958). Estimation of Relationships for Limited Dependent Variables. *Econometrica*, 26(1), 24–36. <https://doi.org/10.2307/1907382>
- Whinnery, J., Jackson, N., Rattanaumpawan, P., & Grandner, M. A. (2014). Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep*, 37(3), 601–611.
- Woods, N. F., & Mitchell, E. S. (2016). The Seattle Midlife Women’s Health Study: A longitudinal prospective study of women during the menopausal transition and early postmenopause. *Women’s Midlife Health*, 2(1), 6. <https://doi.org/10.1186/s40695-016-0019-x>
- Xu, Q., & Lang, C. P. (2014). Examining the relationship between subjective sleep disturbance and menopause: A systematic review and meta-analysis. *Menopause*, 21(12). https://journals.lww.com/menopausejournal/Fulltext/2014/12000/Examining_the_relationship_between_subjective.10.aspx
- Yazdi, Z., Sadeghniaat-Haghighi, K., Ziaee, A., Elmizadeh, K., & Ziaeeha, M. (2013). Influence of Sleep Disturbances on Quality of Life of Iranian Menopausal Women. *Psychiatry Journal*, 2013, 1–5. <https://doi.org/10.1155/2013/907068>

- Yin, J., Jin, X., Shan, Z., Li, S., Huang, H., Li, P., Peng, X., Peng, Z., Yu, K., Bao, W., Yang, W., Chen, X., & Liu, L. (2017). Relationship of Sleep Duration With All-Cause Mortality and Cardiovascular Events: A Systematic Review and Dose-Response Meta-Analysis of Prospective Cohort Studies. *Journal of the American Heart Association*, 6(9), e005947. <https://doi.org/10.1161/JAHA.117.005947>
- Young, E., Xiong, S., Finn, L., & Young, T. (2013). Unique sleep disorders profile of a population-based sample of 747 Hmong immigrants in Wisconsin. *Social Science & Medicine*, 79, 57–65.

TABLE I**DEMOGRAPHIC AND ACCULTURATION CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Age, years	51.53 \pm 7.73		40.00 - 65.00
Length of stay in the USA, years	21.77 \pm 12.96		1.00 - 52.00
Birthplace, n (%)			
Outside US		116 (96.67%)	
US		4 (3.33%)	
Education, n (%)			
High school equivalent or less		12 (10.00%)	
Some college or associate degree		15 (12.50%)	
College degree or higher		93 (77.50%)	
Household income per year, USD, n (%)			
< \$0 - \$30,000		12 (10.00%)	
\$30,001 - 70,000		41 (34.17%)	
> \$70,000		67 (55.83%)	
Marital status, n (%)			
Single		19 (15.83%)	
Married/partnered		90 (75.00%)	
Separated / Widowed		11 (9.17%)	
Numbers of children, n (%)			
None		106 (88.33%)	
1-2 children		14 (11.67%)	
Employment status, n (%)			
Unemployed		35 (29.17%)	

TABLE I (continued)**DEMOGRAPHIC AND ACCULTURATION CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Night shift work, n (%)		15 (12.50%)	
Acculturation: SL-ASIA	1.90 \pm 0.58		1.00 - 4.00

Notes. Results are shown in mean \pm standard deviation; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation

TABLE II**HEALTH- AND SLEEP-RELATED RELATED CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Anxiety: PROMIS SF v1.0	44.60 \pm 7.31		40.30 - 69.50
Menopause symptoms: MRS	3.63 \pm 4.71		0.00 - 23.00
Severity of menopausal symptoms, n (%)			
None		87 (72.50%)	
Mild		18 (15.00%)	
Moderate		10 (8.33%)	
Severe		5 (4.17%)	
Menopausal status, n (%)			
Premenopause		38 (31.67%)	
Perimenopause		14 (11.67%)	
Postmenopause		68 (56.67%)	
Smoking status, n (%)			
Never		117 (97.50%)	
Former		1 (0.83%)	
Current		2 (1.67%)	
Alcohol consumption, n (%)			
Never / monthly or less		112 (93.33%)	
Occasionally (2-4 times/month)		4 (3.33%)	
Sometimes 2-3 times/wk		3 (2.50%)	
Often (≥ 4 /wk)		1 (0.83%)	
Exercise time, n (%)			
<30 min per day		37 (30.83%)	
30 – 60 min per day		71 (59.17%)	

TABLE II (continued)**HEALTH- AND SLEEP-RELATED RELATED CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Chronic disease diagnosis, n (%)			
No		92 (76.67%)	
Yes		28 (23.33%)	
BMI, kg/m ²	24.17 \pm 4.01		16.56 - 39.63
Weight, kg	59.30 \pm 11.66		37.27 - 98.93
Height, cm	156.51 \pm 5.86		141.00 - 168.00
Systolic BP, mmHg	125.35 \pm 20.72		90.00 – 193.00
Diastolic BP, mmHg	79.09 \pm 12.72		52.00 – 122.00
Sleep quality, PSQI	4.18 \pm 3.03		0.00 - 17.00
Sleep quality status, n (%)			
Good		97 (80.83%)	
Poor		23 (19.17%)	
Sleep efficiency, PSQI (%)	95.36 \pm 5.96		63.64 - 100.00
Risk of OSA, Berlin questionnaire, n (%)			
Low		103 (85.83%)	
High		17 (14.17%)	

Notes. Results are shown in mean \pm standard deviation; MRS, Menopausal Rating Scale; BMI, Body Mass Index; BP, Blood Pressure; PSQI, Pittsburgh Sleep Quality Index; OSA, Obstructive Sleep Apnea

TABLE III**BIVARIATE ASSOCIATIONS AMONG SLEEP CHARACTERISTICS, ACCULTURATION, AND PARTICIPANTS CHARACTERISTICS**

Variables	Sleep quality ^a	Sleep efficiency ^a	Risk of OSA ^a	Acculturation ^a
<u>Demographic</u>				
Age, years	0.065	-0.013	0.084	-0.059
<i>p</i>	0.479	0.892	0.362	0.522
Length of stay in the USA, years	-0.129 [†]	0.057	0.054	0.250**
<i>p</i>	0.160	0.538	0.559	0.006
Education, n (%)	-0.026	0.132 [†]	0.051	0.095
<i>p</i>	0.775	0.149	0.579	0.301
Household income per year, USD, n (%)	-0.179 [†]	0.128 [†]	0.099 [†]	0.259**
<i>p</i>	0.051	0.165	0.285	0.004
Marital status, n (%)	0.142 [†]	-0.163 [†]	0.108	0.118 [†]
<i>p</i>	0.122	0.076	0.241	0.199
Numbers of children, n (%)	-0.020	-0.087	-0.148 [†]	-0.023
<i>p</i>	0.831	0.343	0.108	0.806
Employment status, n (%)	-0.031	0.144 [†]	0.103	0.036
<i>p</i>	0.734	0.117	0.263	0.694
Night shift work, n (%)	0.081	-0.079	-0.081	-0.065
<i>p</i>	0.381	0.393	0.377	0.479
<u>Health-related factors</u>				
BMI, kg/m ²	-0.011	0.048	0.226*	0.061
<i>p</i>	0.908	0.601	0.013	0.509
Anxiety, PROMIS SF v1.0	0.281**	-0.152 [†]	0.112 [†]	0.006
<i>p</i>	0.002	0.097	0.224	0.952
Menopausal symptoms, MRS, n (%)	0.454***	-0.318***	0.303***	-0.018
<i>p</i>	0.000	0.000	0.001	0.842
Menopausal status, n (%)	0.130 [†]	-0.128 [†]	0.072	-0.010
<i>p</i>	0.158	0.165	0.437	0.914

TABLE III (continued)**BIVARIATE ASSOCIATIONS AMONG SLEEP CHARACTERISTICS, ACCULTURATION, AND PARTICIPANTS CHARACTERISTICS**

Variables	Sleep quality ^a	Sleep efficiency ^a	Risk of OSA ^a	Acculturation ^a
Smoking status, n (%)	-0.050	-0.004	-0.065	0.069
<i>p</i>	0.588	0.967	0.480	0.457
Alcohol consumption, n (%)	-0.150 [†]	0.079	-0.109	0.170 [†]
<i>p</i>	0.103	0.390	0.238	0.063
Exercise time, n (%)	-0.059	-0.057	-0.226*	0.332***
<i>p</i>	0.525	0.537	0.013	0.000
Chronic disease diagnosis, n (%)	0.233*	-0.224*	0.454***	-0.013
<i>p</i>	0.011	0.014	0.000	0.889

Notes. *p*, *p* value; [†] *p*< 0.20, **p*<0.05, ***p*<0.01, ****p*<0.001; OSA, Obstructive Sleep Apnea; BMI, Body Mass Index; MRS, Menopausal Rating Scale;

^a Non-parametric correlation: Spearman's rho

TABLE IV**SUMMARY OF UNADJUSTED AND ADJUSTED REGRESSION OF ACCULTURATION WITH SLEEP CHARACTERISTICS AMONG THAI WOMEN**

Dependent Variables	Acculturation					
	Unadjusted			Adjusted		
	B	95% CI	<i>p</i>	B	95% CI	<i>p</i>
Sleep quality ^{a, c}	-1.105	-2.027, -0.184	0.019	-1.086	-2.042, -0.129	0.027
Sleep efficiency ^{a, c}	1.962	0.142, 3.782	0.035	2.425	0.370, 4.480	0.021
Risk of OSA ^{b, d}	-0.400	-1.346, 0.546	0.407	-0.579	-2.555, 1.340	0.566
Risk of OSA ^{b, e}	-0.400	-1.346, 0.546	0.407	-0.292	-1.681, 1.096	0.680

Notes. *B*, Beta; *95% CI*, 95% Confident Interval; *p*, *p* value; OSA, Obstructive Sleep Apnea; BMI, Body Mass Index

^a Multivariate linear regression

^b Logistic regression

^c Adjusted for age, length of stay in the USA, education, household income, marital status, numbers of children, employment status, BMI, anxiety, menopausal symptoms, exercise time, and chronic disease diagnosis

^d Adjusted for age, length of stay in the USA, education, household income, marital status, numbers of children, employment status, anxiety, menopausal symptoms, and exercise time

^e Adjusted for age, length of stay in the USA, education, employment status, anxiety, menopausal symptoms, and exercise time

TABLE V

SUMMARY OF STRUCTURAL EQUATION MODEL OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, AND HEALTH-RELATED FACTORS ON SLEEP QUALITY, SLEEP EFFICIENCY, AND RISK OF OBSTRUCTIVE SLEEP APNEA

Total effects	Dependent variables											
	Sleep quality				Sleep efficiency				Risk of OSA			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Age, years	-0.041	0.271	-0.114	0.032	-0.012	0.879	-0.169	0.145	0.002	0.686	-0.008	0.012
Length of stay in the USA, years	-0.012	0.547	-0.053	0.028	0.017	0.707	-0.071	0.104	0.002	0.460	-0.003	0.007
Education, n (%)												
High school equivalent or less												
Some college or associate degree	-0.539	0.566	-2.380	1.301	4.054	0.045	0.098	8.009	0.044	0.725	-0.203	0.292
College degree or higher	0.144	0.853	-1.376	1.664	2.549	0.126	-0.717	5.815	0.078	0.455	-0.127	0.282
Household income per year, USD n (%)												
< \$0 - \$30,000												
\$30,001 – 70,000	0.276	0.731	-1.296	1.848	0.032	0.985	-3.345	3.409	0.184	0.089	-0.028	0.397
> \$70,000	0.587	0.478	-1.034	2.207	-0.837	0.638	-4.320	2.645	0.194	0.080	-0.023	0.411
Marital status, n (%)												
Single												
Married/partnered	-0.882	0.188	-2.195	0.431	1.999	0.165	-0.823	4.821	0.203	0.024	0.027	0.379
Separated / Widowed	0.128	0.898	-1.826	2.083	-1.076	0.615	-5.277	3.124	0.125	0.349	-0.137	0.388
Numbers of children, n (%)												
None												
1-2 children	-0.874	0.255	-2.379	0.632	-1.293	0.433	-4.528	1.941	-0.133	0.195	-0.335	0.068
Employment status, n (%)												
Unemployed												
Employed	-0.429	0.428	-1.490	0.633	1.122	0.335	-1.159	3.403	0.050	0.493	-0.093	0.193
BMI, kg/m ²	0.027	0.651	-0.091	0.145	-0.135	0.297	-0.388	0.119	NA			
Anxiety, PROMIS SF v1.0	0.035	0.294	-0.030	0.100	0.087	0.226	-0.054	0.227	-0.002	0.627	-0.011	0.007
Menopause symptoms, MRS	0.351	0.000	0.246	0.456	-0.541	0.000	-0.766	-0.315	0.025	0.000	0.012	0.039
Alcohol consumption, n (%)												
Never / monthly or less												
Occasionally (2-4 times/month)	-1.753	0.155	-4.172	0.665	1.555	0.558	-3.642	6.752	-0.013	0.936	-0.337	0.311
Sometimes 2-3 times/wk	1.305	0.375	-1.576	4.187	-0.990	0.754	-7.182	5.202	0.045	0.823	-0.345	0.434
Often (≥4 /wk)	-6.117	0.014	-11.018	-1.215	6.712	0.212	-3.821	17.244	-0.314	0.341	-0.959	0.332

TABLE V (continued)

SUMMARY OF STRUCTURAL EQUATION MODEL OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, AND HEALTH-RELATED FACTORS ON SLEEP QUALITY, SLEEP EFFICIENCY, AND RISK OF OBSTRUCTIVE SLEEP APNEA

Total effects	Dependent variables											
	Sleep quality				Sleep efficiency				Risk of OSA			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Exercise time, n (%)												
<30 min												
30 – 60 min	0.048	0.923	-0.940	1.037	-1.871	0.084	-3.996	0.253	-0.149	0.028	-0.283	-0.016
>60 min	1.334	0.124	-0.365	3.034	-3.793	0.042	-7.444	-0.141	-0.143	0.222	-0.371	0.086
Diagnosed chronic diseases, n (%)												
No												
Yes	0.347	0.538	-0.759	1.454	-1.299	0.284	-3.677	1.079	NA			
Acculturation, SL-ASIA	-1.086	0.013	-1.944	-0.227	2.425	0.010	0.581	4.269	-0.035	0.556	-0.151	0.081
Direct effects	Sleep quality				Sleep efficiency				Risk of OSA			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Age, years	-0.016	0.022	-0.030	-0.002	-0.016	0.022	-0.030	-0.002	-0.016	0.022	-0.030	-0.002
Length of stay in the USA, years	0.021	0.000	0.013	0.029	0.021	0.000	0.013	0.029	0.021	0.000	0.013	0.029
Education, n (%)												
High school equivalent or less												
Some college or associate degree	-0.186	0.355	-0.581	0.208	-0.186	0.355	-0.581	0.208	-0.186	0.355	-0.581	0.208
College degree or higher	0.000	1.000	-0.327	0.327	0.000	1.000	-0.327	0.327	0.000	1.000	-0.327	0.327
Household income per year, USD, n (%)												
< \$0 - \$30,000												
\$30,001 - 70,000	-0.011	0.951	-0.355	0.333	-0.011	0.951	-0.355	0.333	-0.011	0.951	-0.355	0.333
> \$70,000	0.215	0.230	-0.136	0.566	0.215	0.230	-0.136	0.566	0.215	0.230	-0.136	0.566
Marital status, n (%)												
Single												
Married/partnered	0.036	0.789	-0.226	0.298	0.036	0.789	-0.226	0.298	0.036	0.789	-0.226	0.298
Separated / Widowed	0.297	0.129	-0.086	0.681	0.297	0.129	-0.086	0.681	0.297	0.129	-0.086	0.681

Notes. *Coef.*, Coefficient; *p*, *p* value; *95% CI*, 95% Confident Interval; OSA, Obstructive Sleep Apnea; BMI, Body Mass Index; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation

TABLE VI

SUMMARY OF MULTIPLICATIVE APPROACH ESTIMATION OF STRUCTURAL EQUATION MODEL OF PARTICIPANTS CHARACTERISTICS AND SLEEP OUTCOMES

Equations	Coefficients	SE	z	p	95% CI	
<u>Sleep quality</u>						
Age	0.018	0.011	1.680	0.093	-0.003	0.039
Length of stay in the USA	-0.022*	0.010	-2.230	0.026	-0.043	-0.003
<u>Sleep efficiency</u>						
Age	-0.040	0.023	-1.740	0.083	-0.086	0.005
Length of stay in the USA	0.051*	0.022	2.360	0.018	0.009	0.093
<u>Risk of OSA</u>						
Age	0.001	0.001	0.310	0.754	-0.001	0.002
Length of stay in the USA	-0.001	0.001	-0.320	0.752	-0.002	0.002

Notes. SE, Standard Error; z, z- score; p, p value; 95% CI, 95% Confident Interval; OSA, Obstructive Sleep Apnea

TABLE VII

SUMMARY OF THE EFFECTS OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, AND ACCULTURATION ON SLEEP OUTCOMES FROM STRUCTURAL EQUATION MODEL

Independent variables	Dependent variables								
	Sleep quality			Sleep efficiency			Risk of OSA		
	Direct effect	Indirect effect	Mediator	Direct effect	Indirect effect	Mediator	Direct effect	Indirect effect	Mediator
Age, years	No	No	No	No	No	No	No	No	No
Length of stay in the USA, years	No	Yes	Acculturation	No	Yes	Acculturation	No	No	No
Education, n (%)	No	No	No	Yes ^b	No	No	No	No	No
Household income per year, USD, n (%)	No	No	No	No	No	No	No	No	No
Marital status, n (%)	No	No	No	No	No	No	Yes ^d	No	No
Numbers of children, n (%)	No	-	-	No	-	-	No	-	-
Employment status, n (%)	No	-	-	No	-	-	No	-	-
BMI, kg/m ²	No	-	-	No	-	-	NA	-	-
Anxiety, PROMIS SF v1.0	No	-	-	No	-	-	No	-	-
Menopause symptoms: MRS	Yes	-	-	Yes	-	-	Yes	-	-
Alcohol consumption, n (%)	Yes ^a	-	-	No	-	-	No	-	-
Exercise time, n (%)	No	-	-	Yes ^c	-	-	Yes ^e	-	-
Diagnosed chronic diseases, n (%)	No	-	-	No	-	-	NA	-	-
Acculturation, SL-ASIA	Yes	-	-	Yes	-	-	No	-	-

Notes. SEM, Structural Equation Models; OSA, Obstructive Sleep Apnea; BMI, Body Mass Index; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation

^a Only one category (Alcohol consumption: Often (≥ 4 times/wk)) showed direct effect compared to the reference

^b Only one category (Education: some college or associate degree) showed direct effect compared to the reference

^c Only one category (Exercise time: > 60 min / day) showed direct effect compared to the reference

^d Only one category Marital status: Married/ partnered) showed direct effect compared to the reference

^e Only one category (Exercise time: 30-60 min / day) showed direct effect compared to the reference

TABLE VIII

MODERATING EFFECTS OF ACCULTURATION ON THE RELATIONSHIP BETWEEN PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS WITH SLEEP QUALITY, SLEEP EFFICIENCY, AND RISK OF OBSTRUCTIVE SLEEP APNEA

Independent variables	Dependent variables											
	Sleep quality				Sleep efficiency				Risk of OSA ^a			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Age, years	-0.041	0.286	-0.117	0.035	-0.012	0.869	-0.158	0.134	0.077	0.099	-0.015	0.169
Length of stay in the USA, years	-0.012	0.547	-0.054	0.029	0.017	0.686	-0.065	0.099	-0.021	0.460	-0.078	0.035
Education, n (%)												
High school equivalent or less												
Some college or associate degree	-0.539	0.603	-2.592	1.513	4.054	0.016	0.757	7.350	1.035	0.733	-4.906	6.975
College degree or higher	0.144	0.860	-1.463	1.751	2.549	0.102	-0.517	5.615	2.779	0.373	-3.338	8.897
Household income per year, USD, n (%)									NA			
< \$0 - \$30,000												
\$30,001 - 70,000	0.276	0.756	-1.480	2.032	0.032	0.980	-2.527	2.591				
> \$70,000	0.587	0.553	-1.366	2.540	-0.837	0.569	-3.745	2.071				
Marital status, n (%)									NA			
Single												
Married/partnered	-0.882	0.386	-2.894	1.130	1.999	0.146	-0.710	4.708				
Separated / Widowed	0.128	0.935	-2.970	3.227	-1.076	0.608	-5.222	3.070				
Numbers of children, n (%)									NA			
None												
1-2 children	-0.874	0.254	-2.386	0.639	-1.293	0.441	-4.612	2.025				
Employment status, n (%)												
Unemployed												
Employed	-0.429	0.402	-1.441	0.583	1.122	0.364	-1.318	3.562	1.134	0.164	-0.464	2.732
BMI, kg/m ²	0.027	0.725	-0.126	0.181	-0.135	0.394	-0.447	0.177				
Anxiety, PROMIS SF v1.0	0.035	0.313	-0.033	0.103	0.087	0.265	-0.067	0.240	-0.045	0.333	-0.136	0.046
Menopause symptoms: MRS	0.351	0.000	0.217	0.484	-0.541	0.000	-0.827	-0.254	0.196	0.048	0.002	0.390
Alcohol consumption, n (%)									NA			
Never / monthly or less												
Occasionally (2-4 times/month)	-1.753	0.037	-3.402	-0.105	1.555	0.335	-1.629	4.739				
Sometimes 2-3 times/wk	1.305	0.373	-1.587	4.197	-0.990	0.678	-5.707	3.727				
Often (≥4 /wk)	-6.117	0.000	-8.531	-3.702	6.712	0.003	2.293	11.130				

TABLE VIII (continued)

MODERATING EFFECTS OF ACCULTURATION ON THE RELATIONSHIP BETWEEN PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS WITH SLEEP QUALITY, SLEEP EFFICIENCY, AND RISK OF OBSTRUCTIVE SLEEP APNEA

Independent variables	Dependent variables											
	Sleep quality				Sleep efficiency				Risk of OSA ^a			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Exercise time, n (%)												
<30 min												
30 – 60 min	0.048	0.939	-1.198	1.295	-1.871	0.065	-3.863	0.120	-1.601	0.021	-2.956	-0.246
>60 min	1.334	0.208	-0.754	3.423	-3.793	0.086	-8.132	0.547	-1.207	0.408	-4.064	1.650
Diagnosed chronic diseases, n (%)									NA			
No												
Yes	0.347	0.607	-0.988	1.683	-1.299	0.255	-3.549	0.952				
Acculturation, SL-ASIA	-1.086	0.066	-2.246	0.075	2.425	0.029	0.259	4.592	0.011	0.988	-1.406	1.429
Interaction	Sleep quality				Sleep efficiency				Risk of OSA ^a			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Acculturation x Education												
Some college or associate degree	NA				-6.285	0.083	-	0.828	NA			
Acculturation x Menopausal symptoms	-0.132	0.385	-0.432	0.168	0.362	0.170	13.398	0.883	0.168	0.266	-0.128	0.464
Acculturation x Alcohol consumption									NA			
Never/ monthly or less	-0.310	0.762	-2.337	1.717	0							
Often (≥4 /wk)	0											
Acculturation x Exercise time	NA											
30 – 60 min						NA			0.518	0.665	-1.829	2.865

Notes. Coef., Coefficient; *p*, *p* value; 95% CI, 95% Confident Interval; OSA, Obstructive Sleep Apnea; BMI, Body Mass Index; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation

^a Multiple linear regression with Robust Standard Errors estimation

TABLE IX

SUMMARY OF THE MODERATION EFFECTS OF ACCULTURATION ON PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS ON SLEEP OUTCOMES FROM STRUCTURAL EQUATION MODEL

Independent variables	Dependent variables		
	Sleep quality	Sleep efficiency	Risk of OSA
Age, years	No	No	No
Length of stay in the USA, years	No	No	No
Education, n (%)	No	No	No
Household income per year, USD, n (%)	No	No	No
Marital status, n (%)	No	No	No
Numbers of children, n (%)	No	No	No
Employment status, n (%)	No	No	No
BMI, kg/m ²	No	No	NA
Anxiety, PROMIS SF v1.0	No	No	No
Menopause symptoms, MRS	No	No	No
Alcohol consumption, n (%)	No	No	No
Exercise time, n (%)	No	No	-
Diagnosed chronic diseases, n (%)	No	No	NA
Acculturation, SL-ASIA	-	-	-

Notes. SEM, Structural Equation Models; OSA, Obstructive Sleep Apnea; BMI, Body Mass Index; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation

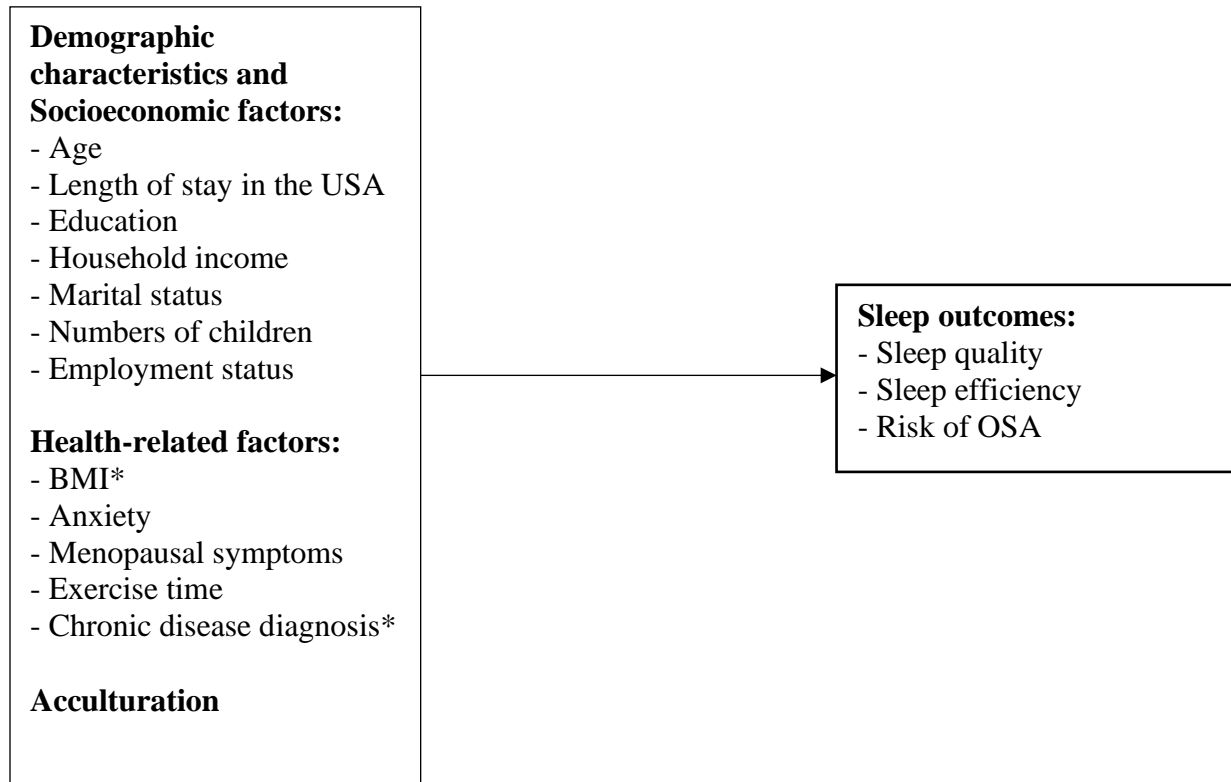


Figure 1. Proposed model to estimate paths toward sleep outcomes.

* Excluded for analysis of the risk of OSA model

Notes. BMI, Body Mass Index; OSA, Obstructive Sleep Apnea

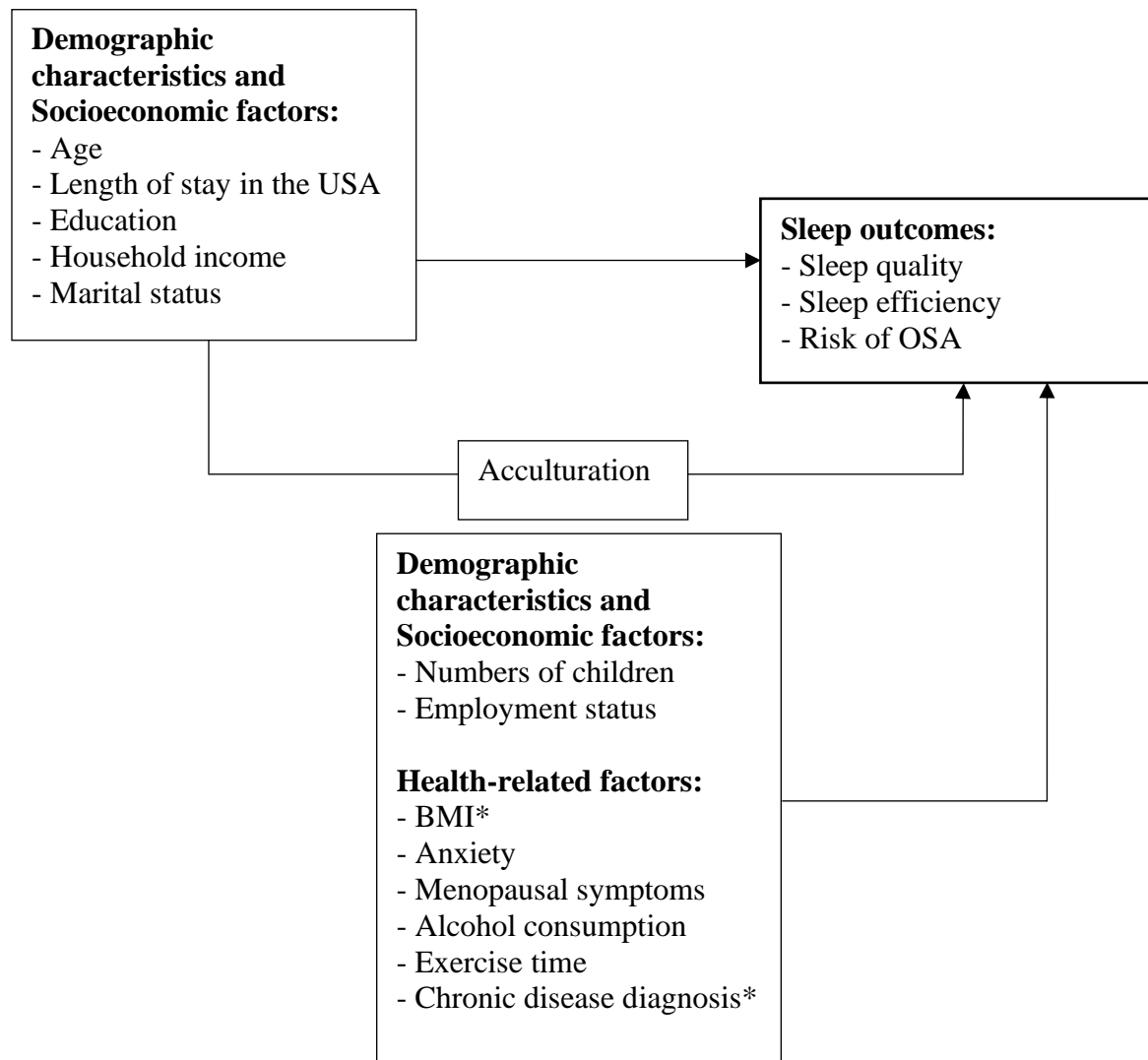


Figure 2. Proposed mediation model to estimate paths toward sleep outcomes through acculturation.

* Excluded for analysis of the risk of OSA model

Notes. BMI, Body Mass Index; OSA, Obstructive Sleep Apnea

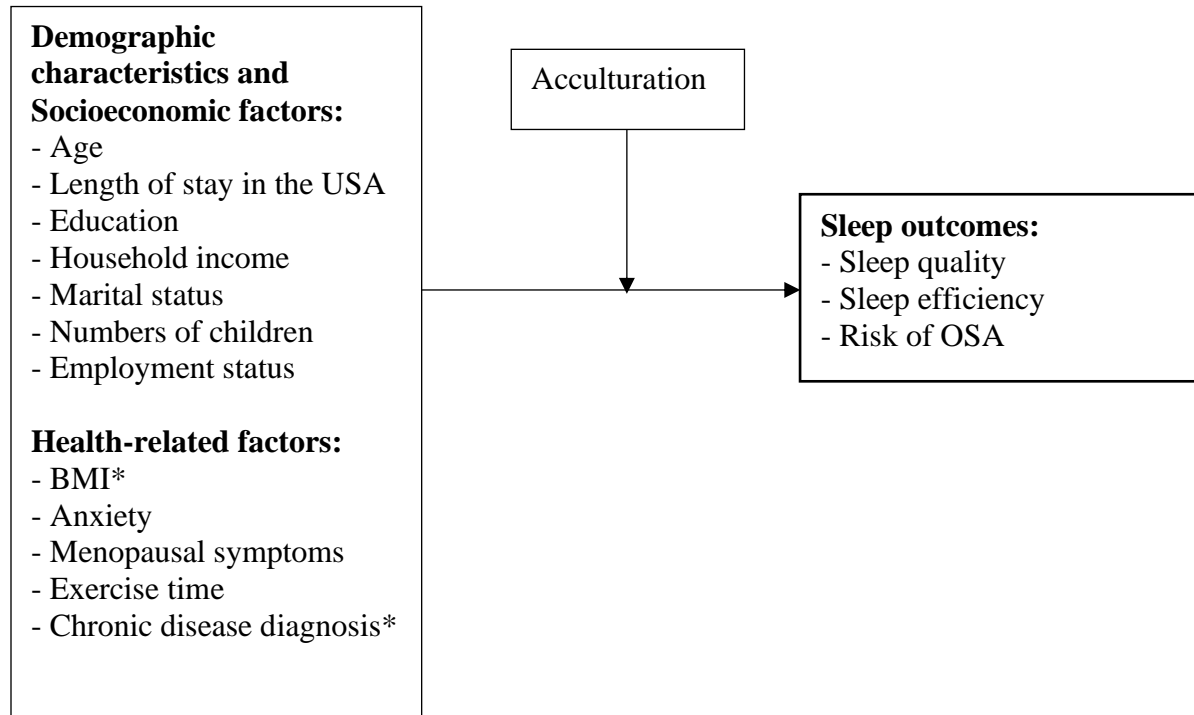


Figure 3. Proposed moderation model to estimate paths toward sleep outcomes.

* Excluded for the analysis of the risk of OSA model

Notes. BMI, Body Mass Index; OSA, Obstructive Sleep Apnea

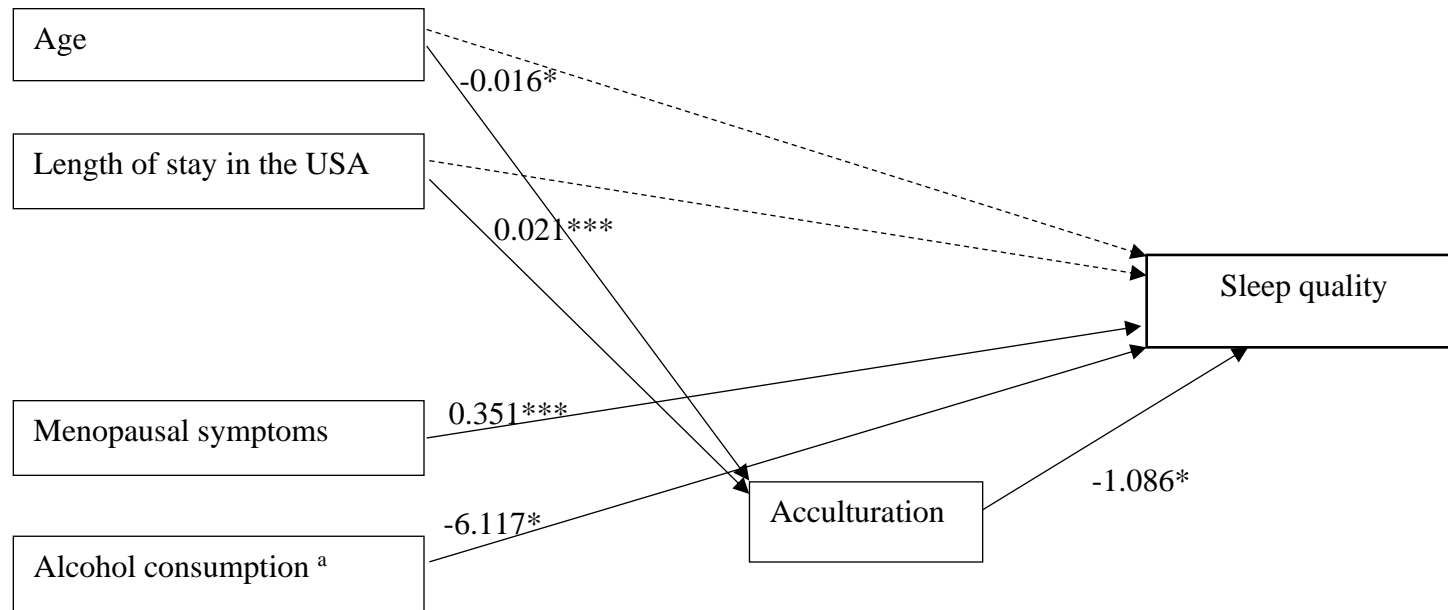


Figure 4. Path diagram for the final model of sleep quality.

Non-standardized estimates are reported for statistically significant effects shown as solid lines. Dash line represent paths that were estimated but not statistically significant. Covariates (education, household income, marital status, numbers of children, employment status, BMI, anxiety, exercise time, and chronic disease diagnosis) were controlled for the model, but did not show significant association, are not included in this figure for clarity. The indirect effect of length of stay in the USA was significant (coefficient=-0.022, $p=0.026$) but indirect effect of age was not significant (coefficient=0.018, $p=0.093$)

Notes. BMI, Body Mass Index; * $p<0.05$, ** $p<0.01$, *** $p<0.001$; ^a only if alcohol consumption ≥ 4 times/week

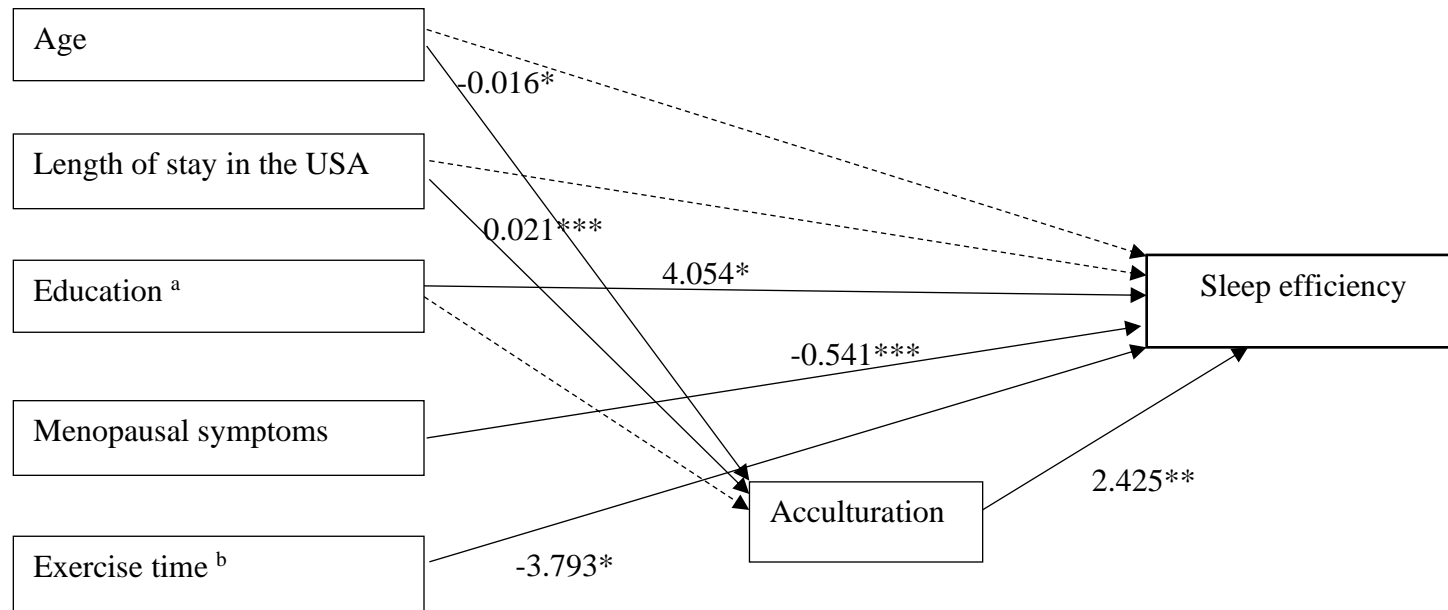


Figure 5. Path diagram for the final model of sleep efficiency.

Non-standardized estimates are reported for statistically significant effects shown as solid lines. Dash line represent paths that were estimated but not statistically significant. Covariates (household income, marital status, numbers of children, employment status, BMI, anxiety, alcohol consumption, and chronic disease diagnosis) were controlled for the model, but did not show significant association, are not included in this figure for clarity. The indirect effect of length of stay in US was significant (coefficient=0.051, $p=0.018$), but indirect effect of age was not significant (coefficient=-0.040, $p=0.083$).

Notes. BMI, Body Mass Index; * $p<0.05$, ** $p<0.01$, *** $p<0.001$; ^a, only in some college and associate degree group; ^b, only if exercise time > 60 min per day

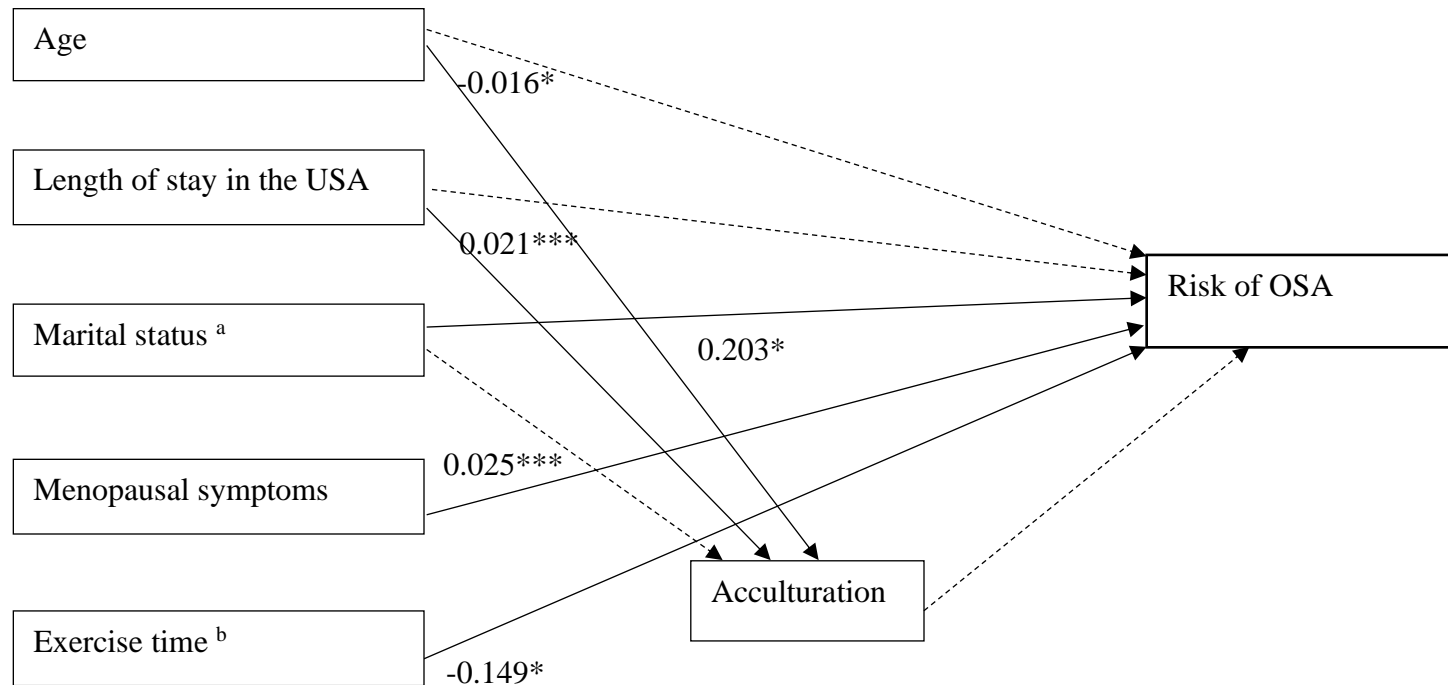


Figure 6. Path diagram for the final model of risk of obstructive sleep apnea.

Non-standardized estimates are reported for statistically significant effects shown as solid lines. Dash line represent paths that were estimated but not statistically significant. Covariates (education, household income, numbers of children, employment status, anxiety, and alcohol consumption) were controlled for the model, but did not show significant association, are not included in this figure for clarity. The indirect effect of age and length of stay in the USA was not significant (coefficient=0.001, $p=0.754$ and coefficient=-0.001, $p=0.752$, respectively).

Notes. OSA, Obstructive Sleep Apnea; * $p<0.05$, ** $p<0.01$, *** $p<0.001$; ^a only in married/ partnered group; ^b only if exercise time was 30-60 min per day

II. FACTORS RELATED TO CARDIOVASCULAR DISEASE RISK AMONG THAI WOMEN IN ILLINOIS: THE ROLES OF SLEEP QUALITY, SLEEP EFFICIENCY, AND RISK OF OBSTRUCTIVE SLEEP APNEA

Introduction

Cardiovascular Disease (CVD) is a leading cause of death among women in the United States, as well as worldwide (Mozaffarian et al., 2016). Poor sleep increases the risk of hypertension and may produce cardiovascular effects among women (Stranges et al., 2010). The risk of hypertension was found to be significantly higher among poor sleepers with insomnia and a short sleep duration (< 5 hours) (Vgontzas et al., 2009). Among poor sleepers who reported having bad dreams and difficulty falling asleep, the association of having an increased risk of coronary heart disease was also reported (Lao et al., 2018; Strand et al., 2016). Women with poor sleep quality were more likely to be at a high risk for CVD (Chair et al., 2017). CVD mortality, Congestive Heart Failure (CHF), Myocardial Infarction (MI), and stroke were found to be associated with individuals with low sleep efficiency (Yan et al., 2021). Additionally, the risk of having CVD increased in people with Obstructive Sleep Apnea (OSA) (Archontogeorgis et al., 2018; Gopalakrishnan & Tak, 2011; Medeiros et al., 2017).

There have been growing numbers of studies investigating the relationships between sleep and CVD among women in the pre-menopause (Makarem et al., 2019), perimenopause (Pedrosa et al., 2014) and post-menopause periods (Huang et al., 2019; Rissling et al., 2016; Sands et al., 2013; Sands-Lincoln et al., 2013). As previously reported, sleep-related symptoms (e.g. short sleep duration, low sleep quality, and OSA) in perimenopausal and postmenopausal women were associated with CVD (Chair et al., 2017; W.-Y. Huang et al., 2017; L. J. Yan & Xie, 2022). Most of the women experienced sleep-related symptoms during the menopausal

transition (Ciano et al., 2017; Galvan et al., 2017; Kalleinen et al., 2021; Kravitz & Joffe, 2011; Lampio et al., 2017; Mirer et al., 2017).

During the menopausal transition, changes in the production of female sex hormones including estrogen and progesterone lead to menopausal symptoms (Woods & Mitchell, 2016). Hot flashes, night sweats, tiredness, and self-reported pain were found to be significant predictors of poor sleep quality among women in this period (Freeman et al., 2015; Jones et al., 2018; Pien et al., 2008). These symptoms and hormonal changes may contribute to suboptimal sleep efficiency, sleep quantity, and sleep quality (Lampio et al., 2016; Lord et al., 2014), as well as an increase in the OSA symptoms with numerous downstream consequences to health and functioning, including CVD (Galvan et al., 2017).

Despite numerous studies in the US, the majority of them were conducted among White women and only 2-3% of Asian women were included (Chen et al., 2008; Sands et al., 2013). The risk of CVD and sleep disparities among immigrant women and women from diverse backgrounds have been found to vary based on the level of acculturation, acculturative stress, and duration of residency in the US (Daviglius et al., 2012; Kingsbury et al., 2013). Extreme sleep durations were reported disproportionately common in low-income and minority groups. Asian populations had two to three-fold higher odds of very short sleep (<5 hours) as compared to the White population (Whinnery et al., 2014). Moreover, the Asian population demonstrated a higher risk of mortality from MI at 1.6 times, angina at 1.2 times, CHF at 1.3 times, and stroke at 1.3 times compared to the White population (Johns & Sattar, 2017). There are a limited number of studies exploring the relationships among socio-cultural influences, sleep characteristics, and CVD risk among Asians, particularly in Thai women.

The prevalence of Thai menopausal women with the risk of CVD was 73.8% if they were in Thailand (Techatraisak & Wisarnsirak, 2019). Nevertheless, the risk of CVD and its association with acculturation and sleep characteristics among Thai women (during their transition to menopause) living in the US has never been explored. These women may experience difficulties related to acculturation to the US culture which may contribute to sleep-related symptoms, and these factors may be associated with the increased risk of CVD. Therefore, this study aimed to identify the relationships among sleep characteristics (i.e. sleep quality, sleep efficiency, and risk of OSA), factors influencing sleep, and CVD risk in Thai menopausal (pre-, peri-, and post-menopause) women.

The aim of this study was to examine whether the sleep quality, sleep efficiency, and risk of OSA could mediate or moderate the relationships between: 1) demographic factors and CVD risk, 2) socio-cultural factors and CVD risk, and 3) health-related factors and CVD risk. We hypothesized that 1) women with poorer sleep quality, lower sleep efficiency, and higher risk of OSA have higher risk of CVD; and 2) sleep quality, sleep efficiency, and risk of OSA mediate and/or moderate the association of CVD risk with demographics, socio-cultural factors, and health-related factors.

Methods

Study Design and Sample

This study was a cross-sectional descriptive design. The sample was recruited using convenient sampling methods. Data collection was conducted in Illinois, USA during May to November 2021.

The total numbers of the participants in this study were 120 Thai women. The recruiting sites included Thai churches, temples, community centers around the Chicago area, and social

media. Flyers were posted both online and at those recruiting sites. The inclusion criteria were: 1) self-identifying as a Thai woman, 2) aged between 40 to 65, and 3) good command of English. The participants were excluded if they were: 1) having serious mental conditions (e.g. severe major depression) or serious health problems (e.g. cancer); 2) having a history of cardiovascular disease (e.g. stroke or transient ischemic attack, heart failure, myocardial infarction, angina, intermittent claudication, significant limb ischemia, aortic atherosclerosis, thoracic aortic aneurysm, or abdominal aortic aneurysm); 3) taking sleeping pills/ sleep aids (e.g. melatonin); 4) involved in excessive alcohol intake (greater than 3 glasses per day) or drug abuse; and 4) pregnant or breastfeeding.

Procedures

This study obtained the Institutional Review Board of the University of Illinois Chicago approval prior to data collection (protocol #2020-0738). The participants were informed about the study's procedures and consent was obtained before recruitment. They were asked to respond to questionnaires regarding their demographics and socio-cultural factors, health-related factors, sleep characteristics, and CVD risks. Demographics and socio-cultural factors included age, length of stay in the US, place of birth, education, household income, marital status, numbers of children, employment status, night shift work, and acculturation. Health-related factors included anxiety, menopausal symptoms, menopausal status, smoking status, alcohol consumption, exercise time, and chronic disease diagnosis. Sleep characteristics including sleep quality, sleep efficiency, and risk of OSA were measured via Pittsburgh Sleep Quality Index (PSQI) and Berlin questionnaire. After completing the questionnaires, the participants' weight, height, and Blood Pressure (BP) were measured in order to calculate the risk of CVD. After completing all procedures, the participants were compensated with a \$10 gift card.

Measurements

Anthropometric measures. Height was measured using a portable stadiometer (Seca model 217: Seca, Chino, CA) and weight was measured with a portable digital scale (CAS model PB: CAS - USA Corp, East Rutherford, NJ) (Sarkkola et al., 2016). During the procedures, the participants were requested to remove their jacket and only wear light clothing, thin socks, stockings, or go bare feet. The PI measured the participants' weight and height twice to the nearest 0.01 kg and 0.1 cm, respectively. A third measurement was performed if the first two measurements differed by more than 0.5 kg and 0.5 cm. The average of the 2 closest values were used for the analysis. BMI was calculated using the formula of weight (kg) divided by height squared (m^2) (Turkbey et al. 2010).

Blood pressure was measured using a calibrated sphygmomanometer (BP7250: 2021 Omron Healthcare, Inc) (Takahashi et al., 2015), to the nearest 2 mmHg in sitting position at 5 minutes apart on three separate occasions. The participants were asked to be seated, legs uncrossed, feet flat on the floor for a period of 5 minutes, and refrain from talking while the BP was measured. The average of three readings were used for the analysis.

Framingham Risk Score (FRS)-BMI based was used to assess the CVD risk (D'Agostino et al., 2008). The algorithm used for calculating the 10-year risk of CVD incorporates the following seven factors: age, gender, systolic blood pressure, antihypertensive use, history of diabetes, smoking status, and BMI. The measurement was validated in a worldwide culturally diverse population, as well as in the Asians (Borhanuddin et al., 2018). It demonstrated good discriminant validity with c statistics at 0.79 in women (D'Agostino et al., 2008). The FRS-BMI based was tested for agreement across categories with the lipid profiles-based (original version) and reported to have moderate agreement with kappa values at 0.51 and

0.50 in women aged < 60 years and 60-74 years, respectively (Jones et al., 2015). The composite scores were calculated with the auto calculator prepared by D'Agostino et al. (2008) to identify CVD risks at a different level and presented in percentage. Risk categories were classified into 1) low (<10%), 2) moderate (10 – 20%), and 3) high ($\geq 20\%$) (Jones et al., 2015). The 10-year CVD risk for women can also be calculated as $1 - 0.948^{\exp(\sum \beta X - 26.0145)}$ where β is the regression coefficient and X is the level for each risk factor (Appendix A 1, based on D'Agostino et al., 2008). The test-retest reliability for Thai women in this study was 0.95, indicating good reliability.

Acculturation was assessed with the Suinn-Lew Asian Self-Identity Acculturation (SL-ASIA: Leong & Chou, 1998; Suinn et al., 1992)). The SLASIA is a well-validated instrument and has been used among the Asian population. The score ranges from 1 to 5 with a higher score indicating a high level of acculturation or being more Americanized (Leong & Chou, 1998).

Pittsburgh Sleep Quality Index (PSQI) consists of 19 self-rated questions (Buysse et al., 1989). It was used to measure habitual sleep quality and quantity over the previous month. The PSQI is composed of 7 subscales assessing subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each subscale has a possible score between 0 and 3, with an overall global score of 0–21 with higher scores indicating poor sleep quality. Participants with a score of ≥ 5 were considered as poor sleepers. Sleep efficiency was calculated from the habitual sleep efficiency subscale with a formula of (hours of sleep/ hours in bed)*100. It was reported in percentage with higher scores indicating higher sleep efficiency (Buysse et al., 1989).

Berlin questionnaire is a screening tool to identify patients at high risk of having OSA (Netzer et al., 1999). It consists of 10 questions on the following components: snoring, tiredness,

observed apnea, and high blood pressure classified into three categories: 1) the presence and severity of snoring, 2) frequency of daytime sleepiness, and 3) the presence of obesity or hypertension. The questionnaire has been used and confirmed to be valid among premenopausal and menopausal women (Yazdi et al., 2013). The sensitivity and specificity range from 57 – 71 % and 86 – 96 %, respectively. A positive score for two or more categories indicates a high likelihood of high OSA risk (Senaratna et al., 2017).

Menopausal status is classified following the stage of Reproductive Aging Workshop (STRAW) criteria (Harlow et al., 2012). The criteria define reproductive stages or menstrual period in the past 12 months and reason for irregular/ no periods into 3 stages: 1) Premenopause (regular period), 2) Perimenopause (irregular period or changes in menstrual cycles), and 3) Post menopause (no period in the past 12 months).

Menopausal symptoms were measured using the Menopause Rating Scale (MRS) (Heinemann et al., 2004). The MRS consisted of 11 questions with 3 dimensions (psychological, somato-vegetative, and urogenital symptoms) and 5 rating scales (0-4). The total MRS ranges from 0 to 44 which correspond with the symptoms from asymptomatic to the highest degree of complaints. The severity of menopausal symptoms can be divided into 3 categories: 1) 5 - 8 = mild; 2) 9 - 15 = moderate; and 3) > 15 = severe.

Anxiety was evaluated using the PROMIS SF v1.0 – Anxiety 4a (Teresi et al., 2016). It measured anxiety scores based on 4 questions regarding fearfulness, difficulty focusing, feeling overwhelmed, and uneasiness. Each item has 5 scales (never, rarely, sometimes, often, and very often). The score was auto-calculated into t-score, with higher t-scores indicating a higher level of anxiety.

The determinant variables included length of stay in the USA, education, household income, marital status, numbers of children, employment status, acculturation, anxiety score, menopausal symptoms, alcohol consumption, exercise time, sleep quality, sleep efficiency, and risk of OSA.

Statistical Analyses

The analysis was performed using STATA 15.1 (StataCorp, 2017). Frequency, mean, percentage, and Standard Deviation (SD) were used to examine the subjects' demographic, socio-cultural factors, sleep-related variables, and risk of CVD. Swilk test, Skewness, and Kurtosis normality tests were performed to identify data normality. None of the continuous data in this study were normally distributed; thus, bivariate analyses were performed with the Spearman's Rho correlation analysis. Additionally, CVD risk showed long tail data which may cause bias. The analysis for the CVD risk was performed using the Robust Regression to make the analysis more reliable when it presents with possible outliers and influential observations (Verardi & Croux, 2009).

Bivariate associations among CVD risk, sleep quality, sleep efficiency, and risk of OSA with demographic data, socio-cultural factors, and health-related factors were analyzed. Variables showed the $p\text{-value} < 0.20$ were selected to be included in the regression analysis. Demographics and socio-cultural factors included length of stay in the USA, education, household income, numbers of children, and employment status. Health-related factors included anxiety and menopausal symptoms. Other variables: marital status, acculturation, alcohol consumption, and exercise time were found to not correlate with CVD risk but correlate with sleep variables. Therefore, they were controlled in the sleep regressions but not included in the mediation analysis model. Sleep quality, sleep efficiency, and risk of OSA were considered as

mediators and moderators in the model on the relationships among demographics, socio-cultural factors, and CVD risk.

Structural Equation Models (SEM) (Jenatabadi, 2015; Keith, 2014) followed by multiplicative methods were employed to identify the indirect effect of demographic and socio-cultural factors (independent variable) on CVD risk (outcome) through a sleep variable (mediator). A path model for the mediation analysis was created based on the correlation coefficient and the SEM was performed following the path. The indirect effect was calculated and considered present if the multiplicative equation between independent variable, mediator, and outcome showed significant p-value.

A moderation analysis was also performed to analyze whether the effect of demographics and socio-cultural factors (independent variable) was based on the magnitude of the sleep variables (moderators). Sleep quality, sleep efficiency, and risk of OSA were set as moderators of the length of stay in the US, education, household income, numbers of children, employment status, anxiety, menopausal symptoms, and acculturation on FRS.

Results

Characteristics of the Participants

Table X represented the participants' characteristics. The mean age was 51.53 years (SD=7.73) with 21.77 years being the average length of stay in the USA (SD=12.96). Most of the women were not born in the USA (96.67%). The majority of them had a college degree (77.50%), household income over \$70,000 per year (55.83%), married (75.00%), and 1-2 children (88.33%). Among these women, 70.83% were employed and 12.50% were working night shifts. The mean acculturation score was 1.90 points (SD=0.58).

The percentage of CVD risk among Thai women in this study ranged from 1 to 30 percent with the average score of 6.56 (SD=5.74). One hundred participants (83.33%) were classified as having low risk of CVD. The mean subjective sleep quality measured by PSQI was 4.18 (SD=3.03). The majority of the participants were good sleepers (n=97, 80.83%). The mean sleep efficiency was 95.36 percent (SD=5.96). A small portion of them had a high risk of OSA (n=17, 14.17%) (Table X).

The anxiety t-score was 44.60 (SD=7.31, Table X). The average menopausal symptoms score was 3.63 (SD=4.71) with eighteen participants (15.00%) being classified with mild symptoms. Of these, 72.50% of the women did not experience menopausal symptoms (n=87). Thai women were classified in the pre-menopausal (31.67%), perimenopausal (11.67%), and post-menopausal (56.67%) group. The majority of the participants were non-smokers (97.50%), and never drank/drank monthly or less (93.33%). More than half of the participants exercised between 30-60 minutes per day (59.17%). Twenty-eight of the participants were diagnosed with a chronic disease. Their average BMI was 24.17 (SD=4.01), systolic BP was 125.35 (SD=20.72) and diastolic BP was 79.09 (SD=12.72) mmHg.

Relationships between Participants' Characteristics, Sleep Parameters, and Cardiovascular Disease Risk

The participants' characteristics (except for birthplace and smoking) with sleep-related characteristics were significantly associated with CVD risk. Birthplace and smoking status were not included in bivariate correlation due to high variability.

The correlation coefficients were presented in Table XI. Length of stay in the USA significantly correlated with CVD risk ($r=0.404$, $p<0.001$) while education and the number of children negatively associated with CVD risk ($r=-0.220$, $p=0.016$ and $r=-0.322$, $p<0.001$,

respectively). Household income ($r=-0.138$), employment status ($r=-0.146$), anxiety ($r=0.174$), and menopausal symptoms ($r=0.120$) were associated with CVD risk at $p<0.20$; thus, they were included in further analysis. Other variables including marital status, night shift work, acculturation, smoking status, alcohol consumption, and exercise time (Table XI) were not significantly associated with CVD risk or included in the regression (Figure 7).

Anxiety, menopausal symptoms, and chronic disease diagnosis were significantly associated with sleep quality ($r=0.281$, $p=0.002$; $r=0.454$, $p<0.001$; $r=0.233$, $p=0.011$, respectively). Other variables associated with sleep quality at $p<0.20$ in bivariate analyses included length of stay in USA ($r=-0.129$), household income ($r=-0.179$), acculturation ($r=-0.157$), alcohol consumption ($r=-0.159$), and diastolic BP ($r=-0.139$) (Table XI).

Menopausal symptoms, chronic disease diagnosis, and diastolic BP showed significant correlations with sleep efficiency ($r=-0.318$, $p<0.001$; $r=-0.224$, $p=0.014$; $r=0.231$, $p=0.011$, respectively). Other variables which associated with sleep efficiency at $p < 0.20$ were education ($r=0.132$), household income ($r=0.128$), marital status ($r=-0.163$), employment status ($r=0.144$), acculturation ($r=0.171$), anxiety ($r=-0.152$), and systolic BP ($r=0.162$).

Variables presenting a significant relationship with the risk of OSA were BMI ($r=0.226$, $p=0.013$), menopausal symptoms ($r=0.303$, $p=0.001$), exercise time ($r=-0.226$, $p=0.013$), chronic disease diagnosis ($r=0.454$, $p<0.001$), systolic BP ($r=0.368$, $p<0.001$), and diastolic BP ($r=0.233$, $p=0.011$). One variable associated with the risk of OSA at $p < 0.20$ was the number of children ($r=-0.148$).

BMI, chronic disease diagnosis, systolic BP, and diastolic BP were not included in the analyses due to the score of FRS-BMI based which was obtained via the same or similar components. Thus, the proposed CVD risk models were controlled for the length of stay in the

USA, education, household income, number of children, employment status, anxiety, and menopausal symptoms as predictors with direct effects on the CVD risk; on the other hand, marital status, acculturation, alcohol consumption, and exercise time were used as the predictors of CVD risk through sleep variables only (Figure 8 and Figure 9).

Sleep-related Characteristics as Predictors of the Risk of Cardiovascular Disease Risk

Sleep quality and sleep efficiency were not associated with increased CVD risk in unadjusted Robust regression analyses. In an unadjusted analysis, only the increased risk of OSA was significantly associated with higher CVD risk ($B=4.601$, $p<0.001$). This remained to be significant in the multivariate model after adjusting for the length of stay in the USA, education, household income, number of children, employment status, anxiety, menopausal symptoms, marital status, acculturation, alcohol consumption, and exercise time ($B=5.514$, $p<0.001$) (Table XII).

Mediation Analysis

The result from the Robust regression analysis of the participants characteristics, socioeconomic factors, health-related factors, and CVD risk were presented in Table XIII. The length of stay in the USA had a significant association with CVD risk (coefficient= 0.112 , $p<0.001$). Only one category from education and the number of children presented significant associations with CVD risk (college degree or higher, coefficient= -3.191 , $p=0.007$; and 1-2 children, coefficient= -2.963 , $p=0.006$, respectively). Lastly, menopausal symptoms significantly correlated with CVD risk (coefficient= -0.152 , $p=0.050$).

Table XIV showed the summary results of SEM on CVD risk with sleep-related characteristics as mediators. It presented the total effect of sleep quality along with the length of stay in the USA (coefficient= 0.114 , $p=0.001$), number of children (coefficient= -3.175 , $p=0.025$),

employment status (coefficient=-2.893, $p=0.004$), and anxiety (coefficient=0.240, $p<0.001$) on CVD risk. The total effect of sleep efficiency with the length of stay in the USA (coefficient=0.117, $p=0.001$), number of children (coefficient=-3.102, $p=0.029$), employment status (coefficient=-2.899, $p=0.004$), and anxiety (coefficient=0.234, $p<0.001$), also significantly associated with CVD risk. Similarly, the total effect of OSA risk with the length of stay in the USA (coefficient=0.115, $p<0.001$), employment status (coefficient=-3.098, $p=0.001$), and anxiety (coefficient=0.238, $p<0.001$) has significant effects on CVD risk. These variables were included in the multiplicative approach.

A subgroup analysis of CVD risk among women with children showed that having 1-2 children was found to have direct effect on CVD risk without presenting the indirect effects through sleep (Table XIIV). Based on the multiplicative approach estimation after performing the SEM on CVD risk (Table XV), menopausal symptoms have indirect effects on CVD risk through the risk of OSA (coefficient=0.149, $p=0.004$) (Figure 10). The direct and indirect effects of all the participants' characteristics on CVD risk were summarized in Table XVI. While the length of stay in the US, number of children, employment status, and anxiety had a direct effect on CVD risk, they did not have an indirect effect through sleep-related characteristics (neither sleep quality nor sleep efficiency) (Table XVI).

Moderation Analysis

Interaction terms were performed among demographic characteristics, health-related factors, sleep-related characteristics, and CVD risk (Table XVII). Sleep quality was found to be a moderator between education (some college or associate degree, and college degree or higher) (coefficient=0.888, $p=0.032$ and coefficient=1.069, $p=0.001$, respectively) and employment status (coefficient=0.648, $p=0.005$) with CVD risk (Figure 11). However, no moderating effects

were detected for sleep efficiency. Risk of OSA was a significant moderator for education (college degree or higher, coefficient=8.493, $p<0.001$), anxiety (coefficient=0.878, $p<0.001$) and menopausal symptoms (coefficient=0.772, $p<0.001$) with CVD risk (Figure 12). Other covariates: the length of stay in the USA, household income, number of children, employment status, and acculturation were controlled in the model, but did not show the statistically significant effects (Table XVII).

Table XVIII summarized the moderating effect of sleep-related characteristics (sleep quality, sleep efficiency, and risk of OSA) on CVD risk. Sleep quality was a moderator on the relationships of education and employment status with CVD risk. Additionally, risk of OSA was a moderator in the relationship between anxiety and menopausal symptoms with CVD risk.

Discussion

In this study, we explored the role of sleep (i.e. sleep quality, sleep efficiency, and risk of OSA) and the association between the participants' characteristics, socio-cultural factors, health-related factors, and CVD risk. The majority of Thai women had a low risk of CVD and good sleep quality (low PSQI score). They were also classified as good sleepers with high sleep efficiency and a low risk of OSA. The risk of OSA had a positive effect on CVD risk among Thai women in this study. It was found to be a mediator between menopausal symptoms and CVD risk and a moderator between anxiety score, menopausal symptoms, and CVD risk. Sleep quality was also a moderator on the relationships between education and employment status with CVD risk. This study confirms previous relationships between factors predicting CVD risk and extends the knowledge that sleep is a mediator and moderator among these relationships.

The Thai women in this study were found to enjoy good cardiovascular health and sleep (high sleep quality and sleep efficiency). The potential explanation for these findings is that the

majority of these participants: 1) had a college degree or higher; 2) had an income > \$70,000 per year; 3) had no children 4) were employed with no night shift work; 5) drank alcohol monthly, less, or never; 6) engaged in exercise 30 – 60 minutes per day; and 7) had no chronic disease with an average BMI of 24 kg/m². These factors may contribute to having a healthy lifestyle and more available time, knowing and using sleep hygiene strategies appropriately, and accessing healthcare services properly; thus, leading to low CVD risk. This finding contradicted a study among Thai women living in Thailand (Techatraisak & Wisarnsirak, 2019). The previous study among Thai women in Thailand reported women aged 45 to 60 had prevalence of CVD risk at 73.8%. However, this study did not explore the association between sleep-related characteristics and CVD risk among those Thai women.

The results from this study were consistent with those of a previous meta-analysis that concluded the independent association between moderate OSA and CVD (Wang et al., 2013). The CVD risk was 17% greater when the apnea–hypopnea index increased 10 units among the general population. However, the association was not significant in a sub-group analysis among women alone and only the studies with objective measurements were included in the meta-analysis. In middle-aged women aged 45 – 65 years, moderate to severe OSA was associated with coronary artery calcium or subclinical coronary atherosclerosis (Medeiros et al., 2017). Another study on women’s sleep characteristics and CVD risk reported that higher risk for OSA was associated with higher CVD (Makarem et al., 2019), especially among minority post-menopausal women. Having higher risk of OSA may also be a factor contributing to the higher risk of CVD.

The findings of the association between OSA and CVD risk might be explained by well-known risk factors for CVD, including obesity and hypertension. Obesity was previously

reported to have a significant association with CVD risk, in which obesity increased CVD in women by 64% (Manrique-Acevedo et al., 2020). It was suggested that Asian populations should use different overweight and obesity cut-off points due to the differences in their body composition and the association between BMI and the percentage of body fat. Asian people were reported to have a higher percentage of body fat at a lower BMI when compared to White and European populations. While BMI ≥ 25 kg/m² was used as a cut-point for being overweight among general populations, the BMI cut-off point at ≥ 23 kg/m² was suggested to determine public health action and to represent moderate to high health risk among Asians (WHO Expert Consultation, 2004). In the current study, the average BMI of Thai women was at 24.17 kg/m² (SD=4.01), which is classified as a possible increased health risk and may be associated with the increased risk of CVD.

Sleep quality did not have a significant relationship with 10-year CVD risk, but it was reported to have an indirect effect on CVD risk among Thai women. The direct effect could not be determined, possibly due to the Thai women, in this study, being mostly classified as good sleepers. The finding that poor sleep quality was associated with increased CVD risk can be supported by previous studies, in which Chinese women with good sleep quality were found to have less CVD risk compared to those with poor sleep quality (Chair et al., 2017). Another study on menopause revealed that the risk of arterial stiffness increased 3-fold in poor sleepers compared to good sleepers (Zhou et al., 2017). The association with CVD risk may be detected if the majority of Thai women in this study experienced poor sleep quality.

Unemployed participants tended to have a higher CVD risk. A study among Hong Kong nurses also reported that a higher CVD risk was associated with lower sleep quality, especially among the unemployed participants (Yan & Xie, 2022). Some possible explanations for the

higher CVD risk among unemployed participants with poor sleep quality was that most of the unemployed participants were at older ages, with less access to medical healthcare and possible chronic illnesses while their employed counterparts may be relatively younger and healthier. Therefore, a chance of having sleep problems and CVD risks were lower among employed participants.

Among Thai women, sleep efficiency was not significantly associated with CVD risk. This might be due to the fact that most Thai women reported high sleep efficiency. The result was similar to the previous study that sleep efficiency had negative correlation with the risk of CVD, but the association was not statistically significant (Yan & Xie, 2022). However, this finding was inconsistent with other studies which utilized objective measures on sleep efficiency and CVD risk. Using polysomnography and an 11-year follow up period was able to capture the incident of CVD and identify the significant association of low sleep efficiency and CVD. A previous study found that participants with poor sleep efficiency had a higher incidence of CVD mortality (Yan et al., 2021).

This study identified the possible effects of sleep quality and the effect of OSA risk on CVD risk. Sleep characteristics may be a modifiable risk factor to prevent CVD. Future studies may consider using sleep interventions to improve sleep and treat sleep disorders to prevent CVD. Additionally future studies may investigate the role of other sleep-related factors which may correlate with CVD risk in different populations.

Limitations and Strengths

This study has both strengths and limitations. Enrolling Thai premenopausal, perimenopausal, and postmenopausal women from the community settings, which were ordinary women from the non-sleep clinic population, may reduce biases towards the numbers of

participants with sleep problems. Moreover, CVD risk among Thai middle-aged women in their menopausal transition, especially in the different socio-cultural setting has never been studied. This was the first study to identify the associations of demographic characteristics, socio-cultural factors, health-related factors, sleep-related characteristics, and CVD risk among Thai women living in the USA.

There were some limitations in this study. Recruiting participants mainly from Thai temples, church, and community centers may pose selection bias on the relatively socio-cultural influences since these women were community members and may have similar supporting systems. The small sample size might be the potential reason for not being able to deem the conclusion on the relationships between sleep characteristics and CVD risk. Additionally, some measures for dependent variables and outcomes utilized the same component which may contribute to the analysis being inconclusive.

Implications for Practice and Future Research

Additional research on the role of sleep characteristics in relation with FRS or CVD risk need to be further explored. CVD risk factors and the prevalence of the risk also need to be identified. Longitudinal research and research implementing objective measures may help identify clearer associations or mechanisms between CVD risk and sleep-related factors. As OSA positively correlated with CVD risk, future research may explore the potential intervention on OSA to help decrease CVD risk.

Conclusion

The risk of OSA predicts the CVD risk among Thai women in Illinois, USA. Although the direct effects of sleep efficiency and sleep quality on CVD risk were not detected, sleep quality and OSA risk were identified to have indirect effects on increased CVD risk. To prevent

CVD and improve the cardiovascular health of women during their menopausal transition, there is a need for future studies and interventions targeting strategies that improve sleep and treat OSA.

References

- Archontogeorgis, K., Voulgaris, A., Nena, E., Strempele, M., Karailidou, P., Tzouvelekis, A., Mouemin, T., Xanthoudaki, M., Steiropoulos, S., Froudarakis, M. E., & Steiropoulos, P. (2018). Cardiovascular Risk Assessment in a Cohort of Newly Diagnosed Patients with Obstructive Sleep Apnea Syndrome. *Cardiology Research and Practice*, 2018, e6572785. <https://doi.org/10.1155/2018/6572785>
- Borhanuddin, B., Mohd Naw, A., Shah, S. A., Abdullah, N., Syed Zakaria, S. Z., Kamaruddin, M. A., Velu, C. S., Ismail, N., Abdullah, M. S., Ahmad Kamat, S., Awang, A., Hamid, M. A., & Jamal, R. (2018). 10-Year Cardiovascular Disease Risk Estimation Based on Lipid Profile-Based and BMI-Based Framingham Risk Scores across Multiple Sociodemographic Characteristics: The Malaysian Cohort Project. *The Scientific World Journal*, 2018, 2979206. <https://doi.org/10.1155/2018/2979206>
- Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- Chair, S. Y., Wang, Q., Cheng, H. Y., Lo, S. W.-S., Li, X. M., Wong, E. M.-L., & Sit, J. W.-H. (2017). Relationship between sleep quality and cardiovascular disease risk in Chinese post-menopausal women. *BMC Women's Health*, 17(1), 79. <https://doi.org/10.1186/s12905-017-0436-5>
- Chen, J.-C., Brunner, R. L., Ren, H., Wassertheil-Smoller, S., Larson, J. C., Levine, D. W., Allison, M., Naughton, M. J., & Stefanick, M. L. (2008). Sleep duration and risk of ischemic stroke in postmenopausal women. *Stroke*, 39(12), 3185–3192. <https://doi.org/10.1161/STROKEAHA.108.521773>

- Ciano, C., King, T. S., Wright, R. R., Perlis, M., & Sawyer, A. M. (2017). Longitudinal Study of Insomnia Symptoms Among Women During Perimenopause. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 46(6), 804–813.
<https://doi.org/10.1016/j.jogn.2017.07.011>
- D'Agostino, R. B., Vasan, R. S., Pencina, M. J., Wolf, P. A., Cobain, M., Massaro, J. M., & Kannel, W. B. (2008). General Cardiovascular Risk Profile for Use in Primary Care. *Circulation*, 117(6), 743–753.
<https://doi.org/10.1161/CIRCULATIONAHA.107.699579>
- Daviglus, M. L., Talavera, G. A., Avilés-Santa, M. L., Allison, M., Cai, J., Criqui, M. H., Gellman, M., Giachello, A. L., Gouskova, N., & Kaplan, R. C. (2012). Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. *Jama*, 308(17), 1775–1784.
- Freeman, E. W., Sammel, M. D., Gross, S. A., & Pien, G. W. (2015). Poor sleep in relation to natural menopause: A population-based 14-year follow-up of midlife women. *Menopause (New York, N.Y.)*, 22(7), 719–726.
<https://doi.org/10.1097/GME.0000000000000392>
- Galvan, T., Camuso, J., Sullivan, K., Kim, S., White, D., Redline, S., & Joffe, H. (2017). Association of estradiol with sleep apnea in depressed perimenopausal and postmenopausal women: A preliminary study. *Menopause (New York, N.Y.)*, 24(1), 112–117. PubMed. <https://doi.org/10.1097/GME.0000000000000737>

- Ghani, S. B., Delgadillo, M. E., Granados, K., Okuagu, A. C., Alfonso-Miller, P., Buxton, O. M., Patel, S. R., Ruiz, J., Parthasarathy, S., Haynes, P. L., Molina, P., Seixas, A., Williams, N., Jean-Louis, G., & Grandner, M. A. (2020). Acculturation Associated with Sleep Duration, Sleep Quality, and Sleep Disorders at the US-Mexico Border. *International Journal of Environmental Research and Public Health*, 17(19), 1. <https://doi.org/10.3390/ijerph17197138>
- Gopalakrishnan, P., & Tak, T. (2011). Obstructive Sleep Apnea and Cardiovascular Disease. *Cardiology in Review*, 19(6), 279–290. <https://doi.org/10.1097/CRD.0b013e318223bd08>
- Harlow, S. D., Gass, M., Hall, J. E., Lobo, R., Maki, P., Rebar, R. W., Sherman, S., Sluss, P. M., & de Villiers, T. J. (2012). Executive summary of the Stages of Reproductive Aging Workshop + 10: Addressing the unfinished agenda of staging reproductive aging. *Menopause (New York, N.y.)*, 19(4), 387–395. <https://doi.org/10.1097/gme.0b013e31824d8f40>
- Heinemann, K., Ruebig, A., Potthoff, P., Schneider, H. P., Strelow, F., Heinemann, L. A., & Thai, D. M. (2004). The Menopause Rating Scale (MRS) scale: A methodological review. *Health and Quality of Life Outcomes*, 2, 45. <https://doi.org/10.1186/1477-7525-2-45>
- Heit, J. A., Spencer, F. A., & White, R. H. (2016). The epidemiology of venous thromboembolism. *Journal of Thrombosis and Thrombolysis*, 41(1), 3–14. <https://doi.org/10.1007/s11239-015-1311-6>

- Huang, T., Zeleznik, O. A., Poole, E. M., Clish, C. B., Deik, A. A., Scott, J. M., Vetter, C., Schernhammer, E. S., Brunner, R., Hale, L., Manson, J. E., Hu, F. B., Redline, S., Tworoger, S. S., & Rexrode, K. M. (2019). Habitual sleep quality, plasma metabolites and risk of coronary heart disease in post-menopausal women. *International Journal of Epidemiology*, 48(4), 1262–1274. <https://doi.org/10.1093/ije/dyy234>
- Huang, W.-Y., Huang, C.-C., Chang, C.-C., Kor, C.-T., Chen, T.-Y., & Wu, H.-M. (2017). Associations of Self-Reported Sleep Quality with Circulating Interferon Gamma-Inducible Protein 10, Interleukin 6, and High-Sensitivity C-Reactive Protein in Healthy Menopausal Women. *PLOS ONE*, 12(1), e0169216. <https://doi.org/10.1371/journal.pone.0169216>
- Jenatabadi, H. S. (2015). *An Overview of Path Analysis: Mediation Analysis Concept in Structural Equation Modeling*. <https://www.researchgate.net/publication/275037561>
- Johns, E., & Sattar, N. (2017). Cardiovascular and Mortality Risks in Migrant South Asians with Type 2 Diabetes: Are We Winning the Battle? *Current Diabetes Reports*, 17(10), 100. <https://doi.org/10.1007/s11892-017-0929-5>
- Jones, C. A., Ross, L., Surani, N., Dharamshi, N., & Karmali, K. (2015). Framingham Ten-Year General Cardiovascular Disease Risk: Agreement between BMI-Based and Cholesterol-Based Estimates in a South Asian Convenience Sample. *PLoS ONE*, 10(3), e0119183. <https://doi.org/10.1371/journal.pone.0119183>
- Jones, H. J., Zak, R., & Lee, K. A. (2018). Sleep Disturbances in Midlife Women at the Cusp of the Menopausal Transition. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, 14(7), 1127–1133. PubMed. <https://doi.org/10.5664/jcsm.7208>

- Kalleinen, N., Aittokallio, J., Lampio, L., Kaisti, M., Polo-Kantola, P., Polo, O., Heinonen, O. J., & Saaresranta, T. (2021). Sleep during menopausal transition: A 10-year follow-up. *Sleep*, 44(6), zsaa283. PubMed. <https://doi.org/10.1093/sleep/zsaa283>
- Keith, T. Z. (2014). *Multiple Regression and Beyond: An Introduction to Multiple Regression and Structural Equation Modeling* (2nd ed.). Routledge.
<https://doi.org/10.4324/9781315749099>
- Kingsbury, J. H., Buxton, O. M., & Emmons, K. M. (2013). Sleep and its Relationship to Racial and Ethnic Disparities in Cardiovascular Disease. *Current Cardiovascular Risk Reports*, 7(5). <https://doi.org/10.1007/s12170-013-0330-0>
- Kravitz, H. M., & Joffe, H. (2011). Sleep during the perimenopause: A SWAN story. *Obstetrics and Gynecology Clinics of North America*, 38(3), 567–586.
<https://doi.org/10.1016/j.ogc.2011.06.002>
- Lampio, L., Polo-Kantola, P., Himanen, S.-L., Kurki, S., Huupponen, E., Engblom, J., Heinonen, O. J., Polo, O., & Saaresranta, T. (2017). Sleep During Menopausal Transition: A 6-Year Follow-Up. *Sleep*, 40(7). <https://doi.org/10.1093/sleep/zsx090>
- Lampio, L., Saaresranta, T., Engblom, J., Polo, O., & Polo-Kantola, P. (2016). Predictors of sleep disturbance in menopausal transition. *Maturitas*, 94, 137–142.
<https://doi.org/10.1016/j.maturitas.2016.10.004>
- Lao, X. Q., Liu, X., Deng, H.-B., Chan, T.-C., Ho, K. F., Wang, F., Vermeulen, R., Tam, T., Wong, M. C. S., Tse, L. A., Chang, L., & Yeoh, E.-K. (2018). Sleep Quality, Sleep Duration, and the Risk of Coronary Heart Disease: A Prospective Cohort Study With 60,586 Adults. *Journal of Clinical Sleep Medicine: JCSM: Official Publication of the American Academy of Sleep Medicine*, 14(1), 109–117. doi.org/10.5664/jcsm.6894

- Leong, F., & Chou, E. L. (1998). Developing Brief Versions of the SuinnLew Asian SelfIdentity Acculturation (SLASIA) Scale for Counseling Research. *Asian American and Pacific Islander Journal of Health*, 6(1), 13–24.
- Lord, C., Sekerovic, Z., & Carrier, J. (2014). Sleep regulation and sex hormones exposure in men and women across adulthood. *Pathologie-Biologie*, 62(5), 302–310.
<https://doi.org/10.1016/j.patbio.2014.07.005>
- Makarem, N., St-Onge, M.-P., Liao, M., Lloyd-Jones, D. M., & Aggarwal, B. (2019). Association of sleep characteristics with cardiovascular health among women and differences by race/ethnicity and menopausal status: Findings from the American Heart Association Go Red for Women Strategically Focused Research Network. *Sleep Health*, 5(5), 501–508. <https://doi.org/10.1016/j.sleh.2019.05.005>
- Manrique-Acevedo, C., Chinnakotla, B., Padilla, J., Martinez-Lemus, L. A., & Gozal, D. (2020). Obesity and cardiovascular disease in women. *International Journal of Obesity*, 44(6), 1210–1226. <https://doi.org/10.1038/s41366-020-0548-0>
- Medeiros, A. K. L., Coutinho, R. Q., Barros, I. M. L., Costa, L. O. B. F., Leite, A. P. D. L., Bittencourt, M. S., Lustosa, T. C., Carvalho, M. M. B., Lira, M. P. F., Ferreira, M. N. L., Lorenzi-Filho, G., Drager, L. F., & Pedrosa, R. P. (2017). Obstructive sleep apnea is independently associated with subclinical coronary atherosclerosis among middle-aged women. *Sleep and Breathing*, 21(1), 77–83. <https://doi.org/10.1007/s11325-016-1374-4>
- Mirer, A. G., Young, T., Palta, M., Benca, R. M., Rasmuson, A., & Peppard, P. E. (2017). Sleep-disordered breathing and the menopausal transition among participants in the Sleep in Midlife Women Study. *Menopause (New York, N.Y.)*, sleep dis(2), 157–162. PubMed.
<https://doi.org/10.1097/GME.0000000000000744>

- Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., Das, S. R., de Ferranti, S., Després, J.-P., Fullerton, H. J., Howard, V. J., Huffman, M. D., Isasi, C. R., Jiménez, M. C., Judd, S. E., Kissela, B. M., Lichtman, J. H., Lisabeth, L. D., Liu, S., ... Turner, M. B. (2016). Heart Disease and Stroke Statistics—2016 Update. *Circulation*, *133*(4), e38–e360. <https://doi.org/10.1161/CIR.0000000000000350>
- Netzer, N. C., Stoohs, R. A., Netzer, C. M., Clark, K., & Strohl, K. P. (1999). Using the Berlin Questionnaire To Identify Patients at Risk for the Sleep Apnea Syndrome. *Annals of Internal Medicine*, *131*(7), 485–491. <https://doi.org/10.7326/0003-4819-131-7-199910050-00002>
- Pedrosa, R. P., Barros, I. M. L., Drager, L. F., Bittencourt, M. S., Medeiros, A. K. L., Carvalho, L. L., Lustosa, T. C., Carvalho, M. M. B., Ferreira, M. N. L., Lorenzi-Filho, G., & Costa, L. O. B. F. (2014). OSA is common and independently associated with hypertension and increased arterial stiffness in consecutive perimenopausal women. *Chest*, *146*(1), 66–72. <https://doi.org/10.1378/chest.14-0097>
- Pien, G. W., Sammel, M. D., Freeman, E. W., Lin, H., & DeBlasis, T. L. (2008). Predictors of sleep quality in women in the menopausal transition. *Sleep*, *31*(7), 991–999.
- Risling, M. B., Gray, K. E., Ulmer, C. S., Martin, J. L., Zaslavsky, O., Gray, S. L., Hale, L., Zeitzer, J. M., Naughton, M., Woods, N. F., LaCroix, A., Calhoun, P. S., Stefanick, M., & Weitlauf, J. C. (2016). Sleep Disturbance, Diabetes, and Cardiovascular Disease in Postmenopausal Veteran Women. *The Gerontologist*, *56 Suppl 1*, S54–66. <https://doi.org/10.1093/geront/gnv668>

- Sands-Lincoln, M., Loucks, E. B., Lu, B., Carskadon, M. A., Sharkey, K., Stefanick, M. L., Ockene, J., Shah, N., Hairston, K. G., Robinson, J. G., Limacher, M., Hale, L., & Eaton, C. B. (2013). Sleep duration, insomnia, and coronary heart disease among postmenopausal women in the Women's Health Initiative. *Journal of Women's Health* (2002), 22(6), 477–486. <https://doi.org/10.1089/jwh.2012.3918>
- Sands, M., Loucks, E. B., Lu, B., Carskadon, M. A., Sharkey, K., Stefanick, M., Ockene, J., Shah, N., Hairston, K. G., Robinson, J., Limacher, M., Hale, L., & Eaton, C. B. (2013). Self-reported Snoring and Risk of Cardiovascular Disease among Postmenopausal Women (From the Women's Health Initiative). *The American Journal of Cardiology*, 111(4), 540–546. <https://doi.org/10.1016/j.amjcard.2012.10.039>
- Sarkkola, C., Rounge, T. B., Simola-Ström, S., von Kraemer, S., Roos, E., & Weiderpass, E. (2016). Validity of home-measured height, weight and waist circumference among adolescents. *European Journal of Public Health*, 26(6), 975–977. <https://doi.org/10.1093/eurpub/ckw133>
- Senaratna, C. V., Perret, J. L., Matheson, M. C., Lodge, C. J., Lowe, A. J., Cassim, R., Russell, M. A., Burgess, J. A., Hamilton, G. S., & Dharmage, S. C. (2017). Validity of the Berlin questionnaire in detecting obstructive sleep apnea: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 36, 116–124. <https://doi.org/10.1016/j.smr.2017.04.001>
- StataCorp. (2017). *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC. <https://www.stata.com/support/faqs/resources/citing-software-documentation-faqs/>

- Strand, L. B., Tsai, M. K., Gunnell, D., Janszky, I., Wen, C. P., & Chang, S.-S. (2016). Self-reported sleep duration and coronary heart disease mortality: A large cohort study of 400,000 Taiwanese adults. *International Journal of Cardiology*, 207, 246–251.
<https://doi.org/10.1016/j.ijcard.2016.01.044>
- Stranges, S., Dorn, J. M., Cappuccio, F. P., Donahue, R. P., Rafalson, L. B., Hovey, K. M., Freudenheim, J. L., Kandala, N.-B., Miller, M. A., & Trevisan, M. (2010). A population- based study of reduced sleep duration and hypertension: The strongest association may be in premenopausal women. *Journal of Hypertension*, 28(5), 896–902.
<https://doi.org/10.1097/HJH.0b013e328335d076>
- Suinn, R. M., Ahuna, C., & Khoo, G. (1992). The Suinn-Lew Asian Self-Identity Acculturation Scale: Concurrent and Factorial Validation. *Educational and Psychological Measurement*, 52(4), 1041–1046. <https://doi.org/10.1177/0013164492052004028>
- Takahashi, H., Yoshika, M., & Yokoi, T. (2015). Validation of two automatic devices for the self-measurement of blood pressure according to the ANSI/AAMI/ISO81060-2:2009 guidelines: The Omron BP765 (HEM-7311-ZSA) and the Omron BP760N (HEM-7320-Z). *Vascular Health and Risk Management*, 11, 49–53.
<https://doi.org/10.2147/VHRM.S72438>
- Techatraisak, K., & Wisarnsirirak, P. (2019). *Cardiovascular Disease Risk Factors in Thai Natural Menopause with First-Time Diagnosis of Low Bone Mass Density / Siriraj Medical Journal*. <https://he02.tci-thaijo.org/index.php/sirirajmedj/article/view/190632>

- Teresi, J. A., Ocepek-Welikson, K., Kleinman, M., Ramirez, M., & Kim, G. (2016). Measurement Equivalence of the Patient Reported Outcomes Measurement Information System® (PROMIS®) Anxiety Short Forms in Ethnically Diverse Groups. *Psychological Test and Assessment Modeling*, 58(1), 183–219.
- Thurtell, M. J., Bruce, B. B., Rye, D. B., Newman, N. J., & Biousse, V. (2011). The Berlin Questionnaire Screens for Obstructive Sleep Apnea in Idiopathic Intracranial Hypertension. *Journal of Neuro-Ophthalmology*, 31(4), 316–319.
<https://doi.org/10.1097/WNO.0b013e31821a4d54>
- Verardi, V., & Croux, C. (2009). Robust regression in Stata. *Stata Journal*, 9(3), 439–453.
- Vgontzas, A. N., Liao, D., Bixler, E. O., Chrousos, G. P., & Vela-Bueno, A. (2009). Insomnia with objective short sleep duration is associated with a high risk for hypertension. *Sleep*, 32(4), 491–497. <https://doi.org/10.1093/sleep/32.4.491>
- Wang, X., Ouyang, Y., Wang, Z., Zhao, G., Liu, L., & Bi, Y. (2013). Obstructive sleep apnea and risk of cardiovascular disease and all-cause mortality: A meta-analysis of prospective cohort studies. *International Journal of Cardiology*, 169(3), 207–214.
<https://doi.org/10.1016/j.ijcard.2013.08.088>
- Wang, X., Ouyang, Y., Wang, Z., Zhao, G., Liu, L., & Bi, Y. (2013). Obstructive sleep apnea and risk of cardiovascular disease and all-cause mortality: A meta-analysis of prospective cohort studies. *International Journal of Cardiology*, 169(3), 207–214.
<https://doi.org/10.1016/j.ijcard.2013.08.088>
- Whinnery, J., Jackson, N., Rattanaumpawan, P., & Grandner, M. A. (2014). Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep*, 37(3), 601–611.

WHO Expert Consultation. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet (London, England)*, 363(9403), 157–163. [https://doi.org/10.1016/S0140-6736\(03\)15268-3](https://doi.org/10.1016/S0140-6736(03)15268-3)

Woods, N. F., & Mitchell, E. S. (2016). The Seattle Midlife Women's Health Study: A longitudinal prospective study of women during the menopausal transition and early postmenopause. *Women's Midlife Health*, 2(1), 6. <https://doi.org/10.1186/s40695-016-0019-x>

Yan, B., Yang, J., Zhao, B., Fan, Y., Wang, W., & Ma, X. (2021). Objective Sleep Efficiency Predicts Cardiovascular Disease in a Community Population: The Sleep Heart Health Study. *Journal of the American Heart Association*, 10(7), e016201. <https://doi.org/10.1161/JAHA.120.016201>

Yan, L. J., & Xie, Y. J. (2022). Associations Between Sleep Quality and 10-Year Cardiovascular Disease Risk Among Female Nurses in Hong Kong: A Cross-sectional Study. *Journal of Cardiovascular Nursing*, 37(3), E22. <https://doi.org/10.1097/JCN.0000000000000857>

Yazdi, Z., Sadeghniaat-Haghighi, K., Ziaee, A., Elmizadeh, K., & Ziaeeha, M. (2013). Influence of Sleep Disturbances on Quality of Life of Iranian Menopausal Women. *Psychiatry Journal*, 2013, 1–5. <https://doi.org/10.1155/2013/907068>

Zhou, Y., Yang, R., Li, C., & Tao, M. (2017). Sleep disorder, an independent risk associated with arterial stiffness in menopause. *Scientific Reports*, 7(1), 1904. <https://doi.org/10.1038/s41598-017-01489-7>

TABLE X**DEMOGRAPHIC, ACCULTURATION, SLEEP- AND HEALTH-RELATED CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Age, years	51.53 \pm 7.73		40.00 – 65.00
Length of stay in the USA, years	21.77 \pm 12.96		1.00 – 52.00
Birthplace, n (%)			
Outside US		116 (96.67%)	
US		4 (3.33%)	
Education, n (%)			
High school equivalent or less		12 (10.00%)	
Some college or associate degree		15 (12.50%)	
College degree or higher		93 (77.50%)	
Household income per year, USD, n (%)			
< \$0 - \$30,000		12 (10.00%)	
\$30,001 – 70,000		41 (34.17%)	
> \$70,000		67 (55.83%)	
Marital status, n (%)			
Single		19 (15.83%)	
Married/partnered		90 (75.00%)	
Separated / Widowed		11 (9.17%)	
Numbers of children, n (%)			
None		106 (88.33%)	
1-2 children		14 (11.67%)	

TABLE X (continued)**DEMOGRAPHIC, ACCULTURATION, SLEEP- AND HEALTH-RELATED CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Employment status, n (%)			
Unemployed		35 (29.17%)	
Employed		85 (70.83%)	
Night shift work, n (%)		15 (12.50%)	
Acculturation, SL-ASIA	1.90 \pm 0.58		0.59 1.00 - 4.00
CVD risk: FRS-BMI	6.56 \pm 5.74		1.00 - 30.00
CVD risk category, n (%)			
Low		100 (83.33%)	
Moderate		16 (13.33%)	
High		4 (3.33%)	
Sleep quality, PSQI	4.18 \pm 3.03		0.00 - 17.00
Sleep quality status, n (%)			
Good		97 (80.83%)	
Poor		23 (19.17%)	
Sleep efficiency, PSQI, (%)	95.36 \pm 5.96		63.64 - 100.00
Risk of OSA: Berlin questionnaire, n (%)			
Low		103 (85.83%)	
High		17 (14.17%)	
Anxiety, PROMIS SF v1.0	44.60 \pm 7.31		40.30 - 69.50
Menopause symptoms, MRS	3.63 \pm 4.71		0.00 - 23.00

TABLE X (continued)

DEMOGRAPHIC, ACCULTURATION, SLEEP- AND HEALTH-RELATED
CHARACTERISTICS OF PARTICIPANTS

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Severity of menopause symptoms, n (%)			
None		87 (72.50%)	
Mild		18 (15.00%)	
Moderate		10 (8.33%)	
Severe		5 (4.17%)	
Menopause status, n (%)			
Premenopause		38 (31.67%)	
Perimenopause		14 (11.67%)	
Postmenopause		68 (56.67%)	
Smoking status, n (%)			
Never		117 (97.50%)	
Former		1 (0.83%)	
Current		2 (1.67%)	
Alcohol consumption, n (%)			
Never / monthly or less		112 (93.33%)	
Occasionally (2-4 times/month)		4 (3.33%)	
Sometimes 2-3 times/wk		3 (2.50%)	
Often (≥ 4 /wk)		1 (0.83%)	
Exercise time, n (%)			
<30 min per day		37 (30.83%)	
30 – 60 min per day		71 (59.17%)	
>60 min per day		12 (10.00%)	

TABLE X (continued)**DEMOGRAPHIC, ACCULTURATION, SLEEP- AND HEALTH-RELATED CHARACTERISTICS OF PARTICIPANTS**

Variables	Results		
	Mean \pm SD	N (percent)	Range: min-max
Chronic disease diagnosis, n (%)			
No		92 (76.67%)	
Yes		28 (23.33%)	
BMI, kg/m ²	24.17 \pm 4.01		16.56 - 39.63
Weight, kg	59.30 \pm 11.66		37.27 - 98.93
Height, cm	156.51 \pm 5.86		141.00 - 168.00
Systolic BP, mmHg	125.35 \pm 20.72		90.00 – 193.00
Diastolic BP, mmHg	79.09 \pm 12.72		52.00 – 122.00

Notes. Results are shown in mean \pm standard deviation; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation; CVD, Cardiovascular Disease; FRS-BMI, Framingham risk score-BMI based; PSQI, Pittsburgh Sleep Quality Index; OSA, Obstructive Sleep Apnea; MRS, Menopausal Rating Scale; BMI, Body Mass Index; BP, Blood Pressure

TABLE XI

BIVARIATE ASSOCIATIONS AMONG CARDIOVASCULAR DISEASE RISK, SLEEP-RELATED CHARACTERISTICS, AND PARTICIPANTS CHARACTERISTICS

Variables	CVD risk ^a	Sleep quality ^a	Sleep efficiency ^a	Risk of OSA ^a
<u>Demographics</u>				
Age, years	0.782***	0.065	-0.013	0.084
<i>p</i>	0.000	0.479	0.891	0.362
Length of stay in the USA, years	0.404***	-0.129 [†]	0.057	0.054
<i>p</i>	0.000	0.160	0.538	0.559
Education, n (%)	-0.220*	-0.026	0.132 [†]	0.051
<i>p</i>	0.016	0.775	0.149	0.579
Household income per year, USD, n (%)	-0.138 [†]	-0.179 [†]	0.128 [†]	0.099
<i>p</i>	0.133	0.051	0.165	0.285
Marital status, n (%)	-0.018	0.142 [†]	-0.163 [†]	0.108
<i>p</i>	0.847	0.122	0.076	0.241
Numbers of children, n (%)	-0.322***	-0.020	-0.087	-0.148 [†]
<i>p</i>	0.000	0.831	0.343	0.108
Employment status, n (%)	-0.146 [†]	-0.031	0.144 [†]	-0.103
<i>p</i>	0.111	0.734	0.117	0.263
Night shift work, n (%)	0.015	0.081	-0.079	-0.081
<i>p</i>	0.875	0.381	0.393	0.377
Acculturation, SL-ASIA	0.036	-0.157 [†]	0.171 [†]	-0.073
<i>p</i>	0.699	0.086	0.062	0.432
<u>Health-related factors</u>				
BMI, kg/m ²	0.426***	-0.011	0.048	0.226*
<i>p</i>	0.000	0.908	0.601	0.013
Anxiety, PROMIS SF v1.0	0.174 [†]	0.281**	-0.152 [†]	0.112
<i>p</i>	0.057	0.002	0.097	0.224

TABLE XI (continued)

BIVARIATE ASSOCIATIONS AMONG CARDIOVASCULAR DISEASE RISK, SLEEP-RELATED CHARACTERISTICS, AND PARTICIPANTS CHARACTERISTICS

Variables	CVD risk ^a	Sleep quality ^a	Sleep efficiency ^a	Risk of OSA ^a
Menopause symptoms, MRS	0.120 [†]	0.454***	-0.318***	0.303***
<i>p</i>	0.190	0.000	0.000	0.001
Smoking status, n (%)	0.048	-0.050	-0.004	-0.065
<i>p</i>	0.602	0.588	0.967	0.480
Alcohol consumption, n (%)	-0.081	-0.150 [†]	0.079	-0.109
<i>p</i>	0.380	0.103	0.390	0.238
Exercise time, n (%)	-0.045	-0.059	-0.057	-0.226*
<i>p</i>	0.629	0.525	0.537	0.013
Chronic disease diagnosis, n (%)	0.440***	0.233*	-0.224*	0.454***
<i>p</i>	0.000	0.011	0.014	0.000
Average systolic BP	0.853***	-0.078	0.162 [†]	0.368***
<i>p</i>	0.000	0.397	0.076	0.000
Average diastolic BP	0.510***	-0.139 [†]	0.231*	0.233*
<i>p</i>	0.000	0.130	0.011	0.011

Notes. *p*, *p* value; [†] *p* < 0.20, **p* < 0.05, ***p* < 0.01, ****p* < 0.001; CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation; BMI, Body Mass Index; MRS, Menopausal Rating Scale; BP, Blood Pressure;

^a Non-parametric correlation: Spearman rho

TABLE XII

SUMMARY OF UNADJUSTED AND ADJUSTED RELATIONSHIPS OF SLEEP-RELATED CHARACTERISTICS AND CARDIOVASCULAR DISEASE RISK

Independent variables	Dependent variables: CVD risk ^a					
	Unadjusted			Adjusted		
	B	95% CI	<i>p</i>	B	95% CI	<i>p</i>
Sleep quality ^b	0.164	-0.181, 0.508	0.348	-0.171	-0.574, 0.233	0.233
Sleep efficiency ^b	-0.023	-0.142, 0.095	0.695	-0.024	-0.149, 0.101	0.704
Risk of OSA ^c	4.601	2.687, 6.514	0.000	5.514	3.444, 7.584	0.000

Notes. B, Beta; 95% CI, 95% Confidence Interval; *p*, *p* value; CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea

^a Robust regression

^b Adjusted for length of stay in the USA, education, household income, numbers of children, employment status, anxiety, menopause symptoms, marital status, acculturation, alcohol consumption, exercise time, and acculturation

^c Adjusted for length of stay in the USA, education, household income, numbers of children, employment status, anxiety, menopause symptoms, and acculturation

TABLE XIII

SUMMARY OF ROBUST REGRESSION OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, AND CARDIOVASCULAR DISEASE RISK

Independent variables		Dependent variables CVD risk ^a				
		Coefficient	SE	t	p	95% CI
Length of stay in the USA, years		0.112	0.028	4.050	0.000	0.057 0.167
Education, n (%)						
	High school equivalent or less					
	Some college or associate degree	-2.884	1.407	-2.050	0.043	-5.676 -0.093
	College degree or higher	-3.191	1.160	-2.750	0.007	-5.493 -0.890
Household income per year, USD, n (%)						
	< \$0 - \$30,000					
	\$30,001 - 70,000	-0.259	1.208	-0.210	0.830	-2.655 2.136
	> \$70,000	-1.566	1.215	-1.290	0.200	-3.975 0.843
Numbers of children, n (%)						
	None					
	1-2 children	-2.963	1.051	-2.820	0.006	-5.049 -0.878
Employment status, n (%)						
	Unemployed					
	Employed	-1.430	0.780	-1.830	0.070	-2.977 0.117
Anxiety, PROMIS SF v1.0		0.082	0.049	1.670	0.098	-0.016 0.180
Menopause symptoms, MRS		-0.152	0.077	-1.980	0.050	-0.304 0.000
Marital status, n (%)						
	Single					
	Married/partnered	0.534	0.998	0.540	0.593	-1.445 2.514
	Separated / Widowed	0.784	1.487	0.530	0.599	-2.167 3.734
Acculturation, SL-ASIA		-0.667	0.655	-1.020	0.310	-1.966 0.631
Alcohol consumption, n (%)						
	Never / monthly or less					
	Occasionally (2-4 times/month)	-0.107	1.835	-0.060	0.954	-3.746 3.532
	Sometimes 2-3 times/wk	-1.545	2.208	-0.700	0.486	-5.924 2.834
	Often (≥4 /wk)	2.971	3.666	0.810	0.420	-4.300 10.243
Exercise time, n (%)						
	<30 min					
	30 – 60 min	-0.092	0.754	-0.120	0.903	-1.587 1.403
	>60 min	0.835	1.304	0.640	0.523	-1.750 3.421
		F(17, 102) = 3.71, p = 0.000				

Notes. SE., Standard Error; t, t-test; p, p value; 95% CI, 95% Confidence Interval; CVD, Cardiovascular Disease; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation; ^aRobust regression

TABLE XIV

SUMMARY OF STRUCTURAL EQUATION MODEL OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, SLEEP-RELATED CHARACTERISTICS (MEDIATOR), AND CARDIOVASCULAR DISEASE RISK

Total effect on CVD risk (Independent variables)	Dependent variables: CVD risk											
	Mediator ^a											
	Sleep quality ^a				Sleep efficiency ^a				Risk of OSA ^a			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Length of stay in the USA, years	0.114	0.001	0.046	0.181	0.117	0.001	0.050	0.184	0.115	0.000	0.054	0.177
Education, n (%)												
High school equivalent or less												
Some college or associate degree	-0.829	0.664	-4.565	2.908	-0.867	0.653	-4.643	2.910	-0.848	0.628	-4.280	2.584
College degree or higher	-2.180	0.159	-5.211	0.851	-2.225	0.156	-5.299	0.849	-2.274	0.109	-5.058	0.510
Household income per year, USD, n (%)												
< \$0 - \$30,000												
\$30,001 - 70,000	2.109	0.205	-1.155	5.373	2.082	0.212	-1.190	5.354	0.923	0.551	-2.113	3.958
> \$70,000	-0.444	0.781	-3.578	2.689	-0.469	0.770	-3.609	2.671	-1.766	0.237	-4.693	1.161
Numbers of children, n (%)												
None												
1-2 children	-3.175	0.025	-5.954	-0.397	-3.102	0.029	-5.887	-0.316	-2.296	0.080	-4.867	0.275
Employment status, n (%)												
Unemployed												
Employed	-2.893	0.004	-4.862	-0.925	-2.899	0.004	-4.884	-0.914	-3.098	0.001	-4.908	-1.289
Anxiety, PROMIS SF v1.0	0.240	0.000	0.110	0.369	0.234	0.000	0.104	0.365	0.238	0.000	0.119	0.356
Menopause symptoms, MRS	0.167	0.166	-0.069	0.403	0.130	0.252	-0.092	0.352	-0.036	0.719	-0.231	0.159
Mediator ^a	-0.136	0.444	-0.484	0.212	0.020	0.813	-0.142	0.182	5.896	0.000	3.483	8.309
Direct effect with mediators (Independent variable)	Mediator ^a											
	Sleep quality ^a				Sleep efficiency ^a				Risk of OSA ^a			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Length of stay in the USA, years	-0.020	0.288	-0.056	0.017	0.001	0.981	-0.077	0.079	0.003	0.303	-0.002	0.007
Education, n (%)												
High school equivalent or less												
Some college or associate degree	-0.618	0.511	-2.459	1.224	4.334	0.033	0.355	8.312	0.045	0.724	-0.203	0.292
College degree or higher	0.140	0.857	-1.379	1.658	2.887	0.084	-0.393	6.168	0.074	0.475	-0.130	0.278

TABLE XIV (continued)

SUMMARY OF STRUCTURAL EQUATION MODEL OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, SLEEP-RELATED CHARACTERISTICS (MEDIATOR), AND CARDIOVASCULAR DISEASE RISK

Direct effect with mediators (Independent variables)	Mediators ^a											
	Sleep quality ^a				Sleep efficiency ^a				Risk of OSA ^a			
	Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Household income per year, USD, n (%)												
< \$0 - \$30,000												
\$30,001 – 70,000	0.349	0.665	-1.231	1.930	-0.057	0.974	-3.471	3.358	0.182	0.093	-0.030	0.394
> \$70,000	0.815	0.315	-0.775	2.404	-1.040	0.553	-4.474	2.394	0.185	0.089	-0.028	0.399
Numbers of children, n (%)												
None												
1-2 children	-0.632	0.368	-2.009	0.744	-0.775	0.609	-3.748	2.197	-0.150	0.112	-0.335	0.035
Employment status, n (%)												
Unemployed												
Employed	-0.266	0.609	-1.287	0.755	1.217	0.280	-0.988	3.422	0.042	0.552	-0.095	0.179
Anxiety, PROMIS SF v1.0	0.034	0.297	-0.030	0.099	0.073	0.306	-0.067	0.212	-0.002	0.652	-0.011	0.007
Menopause symptoms, MRS	0.364	0.000	0.264	0.464	-0.598	0.000	-0.814	-0.381	0.025	0.000	0.012	0.039
Marital status, n (%)												
Single												
Married/partnered	-0.745	0.264	-2.051	0.562	1.661	0.248	-1.160	4.482	0.200	0.025	0.025	0.376
Separated / Widowed	0.257	0.796	-1.690	2.203	-1.094	0.610	-5.299	3.111	0.120	0.368	-0.141	0.382
Acculturation, SL-ASIA	-1.043	0.017	-1.900	-0.187	2.526	0.007	0.676	4.377	-0.038	0.518	-0.153	0.077
Alcohol consumption, n (%)												
Never / monthly or less												
Occasionally (2-4 times/month)	-1.483	0.226	-3.884	0.918	0.996	0.707	-4.190	6.182	-0.020	0.903	-0.342	0.302
Sometimes 2-3 times/wk	1.424	0.334	-1.466	4.313	-0.765	0.810	-7.005	5.476	0.037	0.853	-0.351	0.425
Often (≥4 /wk)	-6.365	0.009	-11.163	-1.567	8.827	0.095	-1.537	19.191	-0.324	0.324	-0.969	0.320
Exercise time, n (%)												
<30 min												
30 – 60 min	0.137	0.785	-0.849	1.124	-1.922	0.077	-4.052	0.209	-0.153	0.024	-0.285	-0.021
>60 min	1.371	0.115	-0.335	3.077	-4.020	0.033	-7.705	-0.334	-0.142	0.226	-0.371	0.088

Notes. *Coef.*, Coefficient; *p*, *p* value; *95% CI*, 95% Confidence Interval; CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation

TABLE XV

SUMMARY OF MULTIPLICATIVE APPROACH ESTIMATION OF STRUCTURAL EQUATION MODEL OF PARTICIPANTS CHARACTERISTICS AND SLEEP-RELATED CHARACTERISTICS ON CARDIOVASCULAR DISEASE RISK

Equation (Dependent variables)	Coefficient	SE	z	p	95% CI	
<u>Sleep quality (n=120)</u>						
Length of stay in the USA	0.003	0.004	0.620	0.535	-0.006	0.011
Numbers of children	0.086	0.147	0.580	0.560	-0.203	0.374
Employment status	0.036	0.085	0.430	0.671	-0.131	0.203
Anxiety	-0.005	0.008	-0.620	0.537	-0.019	0.010
Menopause symptoms	-0.049	0.065	-0.760	0.447	-0.177	0.078
<u>Sleep efficiency (n=120)</u>						
Length of stay in the USA	0.000	0.001	0.020	0.981	-0.002	0.002
Education ^a	0.085	0.360	0.230	0.814	-0.622	0.791
Numbers of children	-0.015	0.071	-0.210	0.830	-0.153	0.123
Employment status	0.024	0.103	0.230	0.817	-0.178	0.226
Anxiety	0.001	0.006	0.230	0.818	-0.011	0.014
Menopause symptoms	-0.012	0.049	-0.240	0.813	-0.109	0.085
<u>Risk of OSA (n=120)</u>						
Length of stay in the USA	0.015	0.015	1.010	0.314	-0.014	0.044
Employment status	0.245	0.416	0.590	0.555	-0.569	1.060
Anxiety	-0.012	0.026	-0.450	0.653	-0.063	0.040
Menopause symptoms	0.149**	0.051	2.910	0.004	0.049	0.249

Notes. SE, Standard Error; z, z- score; p, p value; 95% CI, 95% Confidence Interval; *p<0.05, **p<0.01, ***p < 0.001; CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea; ^a Some college or association degree

TABLE XVI

SUMMARY OF THE DIRECT AND INDIRECT EFFECTS OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, AND SLEEP-RELATED CHARACTERISTICS ON CARDIOVASCULAR DISEASE RISK

Independent variables	Dependent variables		
	CVD risk (n=120)		
	Direct effect	Indirect effect	Mediator
Length of stay in the USA, years	Yes ^b	No	No
Education, n (%)	No	No	No
Household income per year, USD, n (%)	No	No	No
Numbers of children, n (%)	Yes ^a	No	No
Employment status, n (%)	Yes ^b	No	No
Anxiety, PROMIS SF v1.0	Yes ^b	No	No
Menopause symptoms, MRS	No	Yes	Risk of OSA
Acculturation, SL-ASIA	No	No	No
Marital status, n (%)	-	Yes ^d	-
Alcohol consumption	-	No	-
Exercise time, n (%)	-	Yes ^e	-
Sleep quality, PSQI	No	-	-
Sleep efficiency, PSQI, n (%)	No	-	-
Risk of OSA, Berlin questionnaire, n (%)	Yes ^c	-	-

Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation; PSQI, Pittsburgh Sleep Quality Index; OSA, Obstructive Sleep Apnea;

^a Only in Sleep quality and sleep efficiency model

^b All model: Sleep quality, sleep efficiency, risk of OSA, positive with OSA category 1, and subgroup analysis

^c Showed direct effect only after adjusted for length of stay in the USA, education, household income, numbers of children, employment status, anxiety, menopause symptoms, and acculturation

^d Only one category (Single) showed direct effect compared to the reference

^e Only one category (Exercise time: 30-60 min / day) showed direct effect compared to the reference

TABLE XVII

MODERATING EFFECTS OF SLEEP-RELATED CHARACTERISTICS ON THE RELATIONSHIP BETWEEN PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, AND CARDIOVASCULAR DISEASE RISK

Independent variables					Dependent variables: CVD risk											
					Moderators ^b											
					Sleep quality ^a				Sleep efficiency ^a				Risk of OSA ^a			
Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI						
Length of stay in the USA, years	0.108	0.000	0.056	0.160	0.112	0.000	0.059	0.165	0.102	0.000	0.048	0.155				
Education, n (%)																
High school equivalent or less																
Some college or associate degree	-2.740	0.046	-5.431	-0.048	-2.558	0.070	-5.331	0.215	-2.511	0.074	-5.275	0.253				
College degree or higher	-3.397	0.002	-5.571	-1.223	-3.281	0.005	-5.525	-1.036	-3.674	0.001	-5.907	-1.441				
Household income per year, n (%)																
< \$0 - \$30,000																
\$30,001 - 70,000	-0.122	0.918	-2.464	2.219	-0.315	0.794	-2.702	2.072	-0.891	0.470	-3.326	1.544				
> \$70,000	-1.133	0.325	-3.404	1.137	-1.271	0.278	-3.583	1.042	-1.542	0.201	-3.919	0.836				
Numbers of children, n (%)																
None																
1-2 children	-3.081	0.003	-5.076	-1.087	-3.116	0.003	-5.151	-1.081	-2.869	0.007	-4.932	-0.805				
Employment status, n (%)																
Unemployed																
Employed	-1.717	0.018	-3.136	-0.299	-1.787	0.016	-3.240	-0.335	-1.900	0.011	-3.360	-0.440				
Anxiety, PROMIS SF v1.0	0.108	0.023	0.016	0.201	0.117	0.017	0.022	0.212	0.171	0.001	0.076	0.266				
Menopause symptoms, MRS	-0.083	0.337	-0.253	0.087	-0.145	0.079	-0.308	0.017	-0.180	0.025	-0.337	-0.023				
Acculturation, SL-ASIA	-0.601	0.322	-1.798	0.596	-0.528	0.392	-1.747	0.690	-0.570	0.355	-1.787	0.646				
Moderator ^b	-0.148	0.250	-0.402	0.106	-0.018	0.767	-0.138	0.102	4.815	0.000	2.865	6.766				
	F(11, 108) = 5.67, p = 0.000				F(11, 108) = 5.57, p = 0.000				F(11, 108) = 8.25, p = 0.000							
Interaction with moderators					Moderators ^b											
					Sleep quality ^a				Sleep efficiency ^a				Risk of OSA ^a			
					Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI		Coef.	<i>p</i>	95% CI	
Length of stay in the USA	0.006	0.551	-0.014	0.027	-0.005	0.238	-0.014	0.004	-0.117	0.129	-0.269	0.035				
Education																
Some college or associate degree	0.888	0.032	0.077	1.699	NA											
College degree or higher	1.069	0.001	0.454	1.684	-0.210	0.124	-0.479	0.059	8.493	0.000	4.000	12.986				
Numbers of children	0.069	0.890	-0.918	1.056	0.026	0.896	-0.363	0.415	0							
Employment status	0.648	0.005	0.205	1.091	0.151	0.163	-0.062	0.364	1.114	0.646	-3.683	5.910				
Anxiety	-0.019	0.204	-0.048	0.010	0.011	0.212	-0.006	0.028	0.878	0.000	0.692	1.063				
Menopause symptoms, MRS	NA				NA				0.772	0.000	0.452	1.092				

Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation; ^a Robust regression; ^b Moderator

TABLE XVIII

SUMMARY OF THE MODERATING EFFECTS OF PARTICIPANTS CHARACTERISTICS, SOCIOECONOMIC FACTORS, HEALTH-RELATED FACTORS, AND SLEEP-RELATED CHARACTERISTICS ON CARDIOVASCULAR DISEASE RISK

Independent variables	Dependent variables
	CVD risk (n=120)
	Moderator
Length of stay in the USA, years	No
Education, n (%)	Sleep quality
Household income per year, USD, n (%)	No
Numbers of children, n (%)	No
Employment status, n (%)	Sleep quality
Anxiety, PROMIS SF v1.0	Risk of OSA
Menopause symptoms, MRS	Risk of OSA
Acculturation, SL-ASIA	No
Marital status, n (%)	-
Alcohol consumption, n (%)	-
Exercise time, n (%)	-
Sleep quality, PSQI	-
Sleep efficiency, PSQI, n (%)	-
Risk of OSA, Berlin questionnaire, n (%)	-

Notes. CVD, Cardiovascular Disease; MRS, Menopausal Rating Scale; SL-ASIA, Suinn-Lew Asian Self-Identity Acculturation; PSQI, Pittsburgh Sleep Quality Index; OSA, Obstructive Sleep Apnea



Figure 7. Proposed model to estimate paths toward cardiovascular disease risk.
Notes. CVD, Cardiovascular Disease

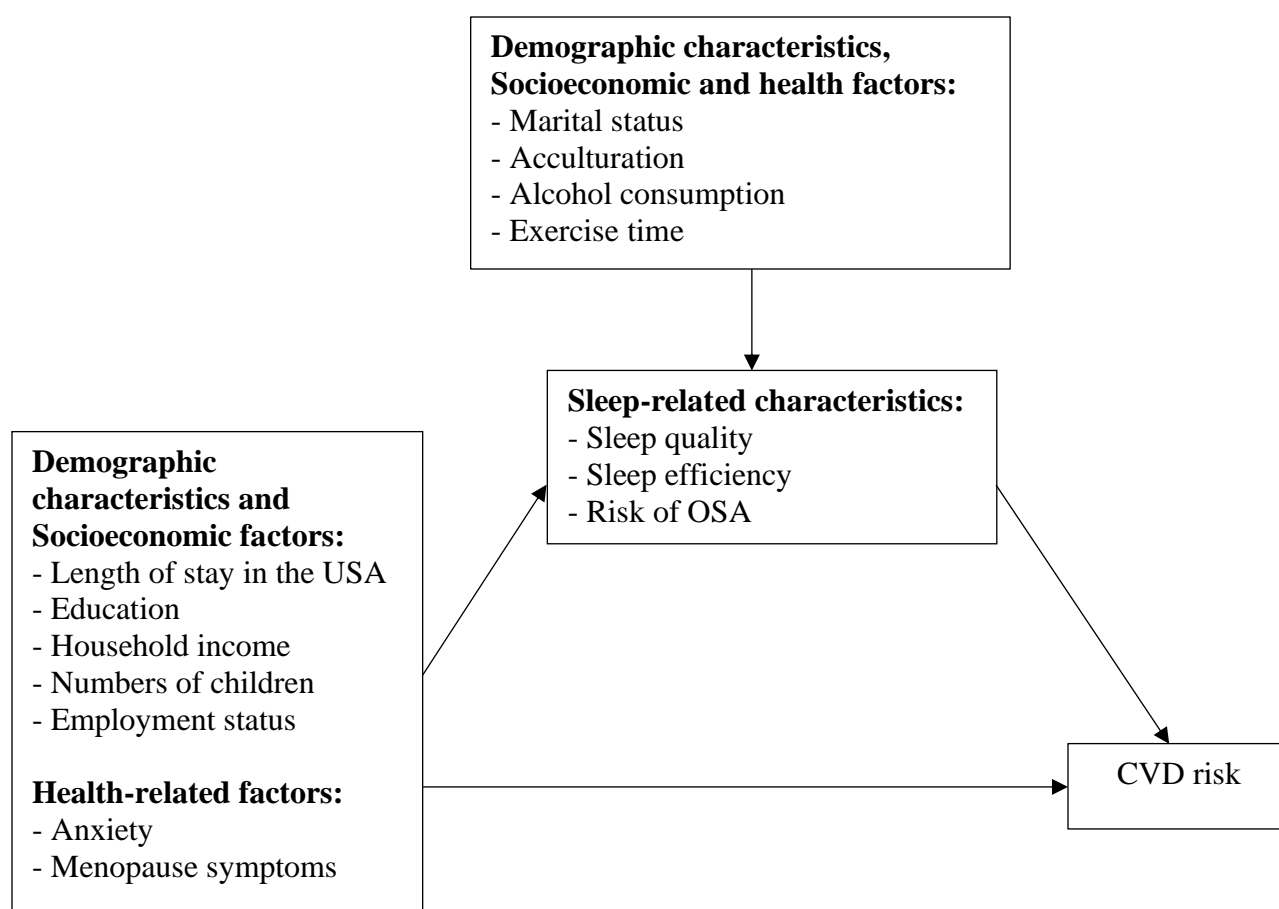


Figure 8. Proposed model to estimate paths toward cardiovascular disease risk (mediation).

Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea

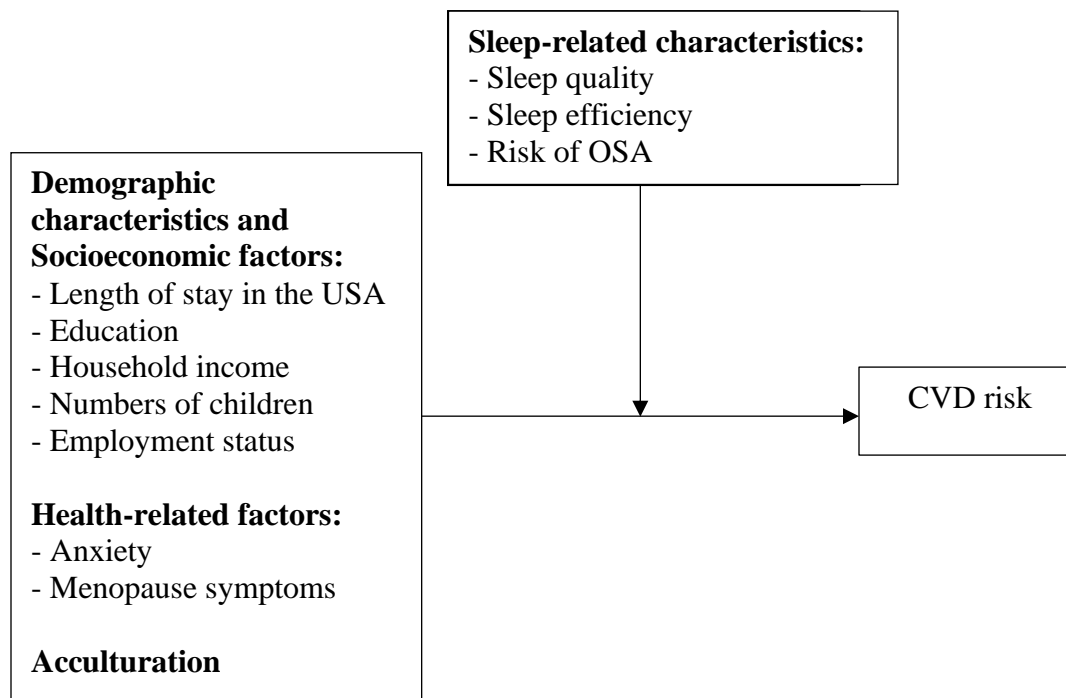


Figure 9. Proposed model to estimate paths toward cardiovascular disease risk (moderation).
Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea

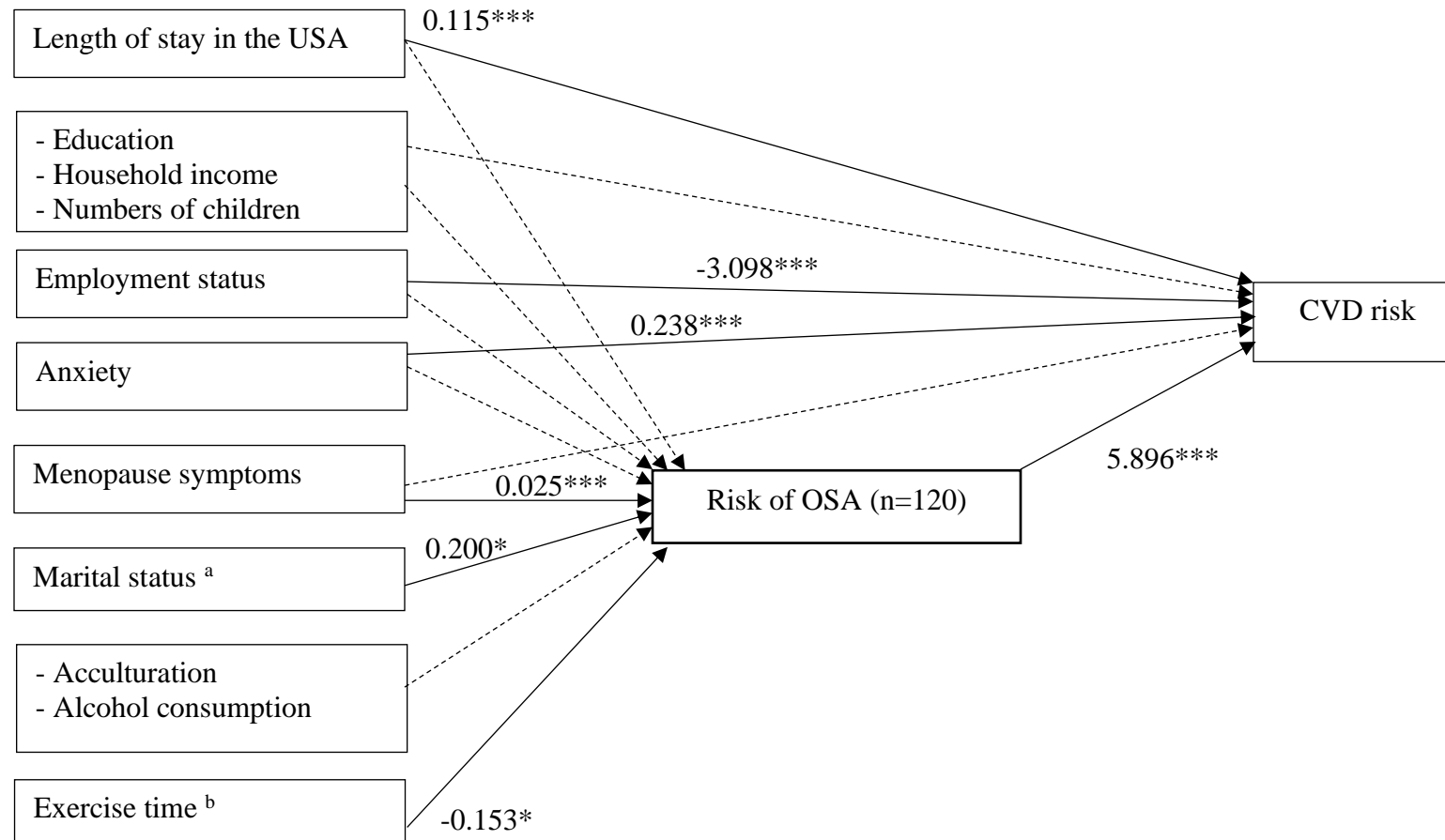


Figure 10. Path diagram for the final mediation model of risk of Obstructive Sleep Apnea.

Non-standardized estimates are reported for statistically significant effects shown as solid lines.

Dash line represent paths that were estimated but not statistically significant. The indirect effect of menopause symptoms was significant (coefficient=0.149, $p=0.004$). Other covariates: length of stay in the USA, marital status, and exercise time did not show indirect effect with CVD risk.

Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea; * $p<0.05$, ** $p<0.01$, *** $p<0.001$;

^a only in single group; ^b only if exercise time was 30-60 min per day

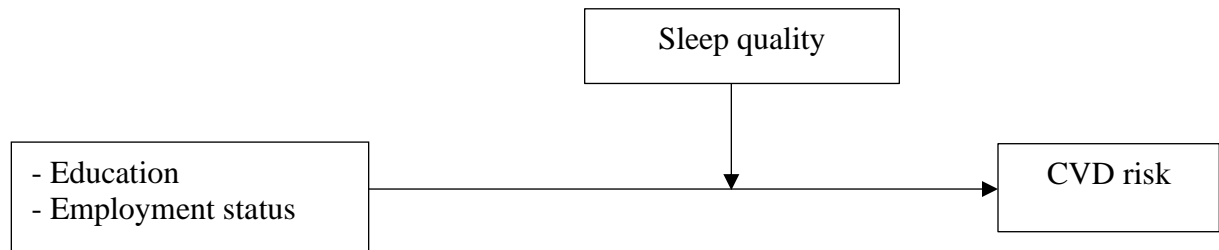


Figure 11. Path diagram for the moderating model of sleep quality.

Non-standardized estimates are reported for statistically significant effects shown as solid lines. The effect of sleep quality was significant for education (in both groups: some college or associate degree, and college degree or higher (coefficient=0.888, $p=0.032$ and coefficient=1.069, $p=0.001$, respectively) and employment status (employed: coefficient=0.648, $p=0.005$). Other covariates: length of stay in the USA, marital status, household income, numbers of children, employment status, anxiety, menopause symptoms, and acculturation were controlled in the model.

Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea

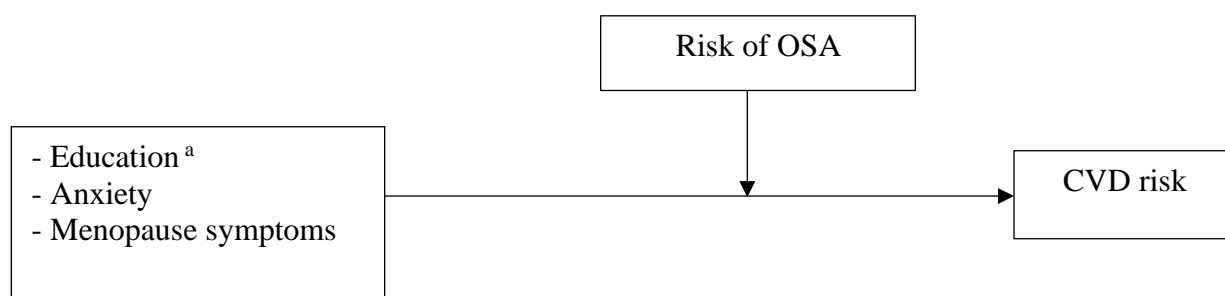


Figure 12. Path diagram for the moderating model of risk of Obstructive Sleep Apnea. Non-standardized estimates are reported for statistically significant effects shown as solid lines. The effect of risk of OSA was significant for anxiety (coefficient=0.878, $p<0.001$) and menopause symptoms (coefficient=0.772, $p<0.001$). Other covariates: length of stay in the USA, education, household income, numbers of children, employment status, and acculturation were controlled in the model.

Notes. CVD, Cardiovascular Disease; OSA, Obstructive Sleep Apnea;

^a only college degree

APPENDICES

APPENDIX A

Regression Coefficients and Hazard Ratios: the FRS-BMI based for women

Women (10-year Baseline Survival: $So(10) = 0.948$)				
Variables	Beta	<i>p</i>	Hazard Ratio	95% CI
Log of Age	2.721	=0.000	15.200	(8.590, 26.870)
Log of Body Mass Index	0.511	=0.061	1.670	(0.980, 2.850)
Log of SBP if not treated	2.813	=0.000	16.660	(8.270, 33.540)
Log of SBP if treated	2.883	=0.000	17.860	(8.970, 35.570)
Smoking	0.619	=0.000	1.860	(1.530, 2.250)
Diabetes	0.778	=0.000	2.180	(1.630, 2.910)

Formula: $1-0.948^{\exp(\sum \beta X - 26.0145)}$ where β is the regression coefficient and X is the level for each risk factor

Notes. *p*, p-value; 95% *CI*, 95% Confidence Interval; FRS-BMI, Framingham risk score-BMI based

APPENDIX B

Survey questionnaires

1. Demographic questions

Age:.....(in years)

Date of birth (mm/dd/yy) ____ / ____ / _____. (this data will be used to calculate participants' age only)

1a. What is the highest degree you earned?

- ☐ Less than 7th grade
- ☐ Junior high school (7th, 8th, or 9th grade)
- ☐ Partial high school (10th or 11th grade)
- ☐ Non-academic training requiring high school
- ☐ Completed high school, trade school, or other academic degree
- ☐ Attended college, but did not receive four years
- ☐ Vocational certificate/ GED
- ☐ Bachelor's degree
- ☐ Master's or Doctorate's degree

1b. Are you:

- ☐ Unable to work (please specify reason.....)
- ☐ Unemployed, looking for work / not looking for work
- ☐ Housewife
- ☐ Working part-time
- ☐ Retired
- ☐ Self-employed
- ☐ Working full-time

1b1. What is your occupation (Fill in the blank.....)

1c. Annual family income:

- ☐ < \$10,000
- ☐ \$10,001-30,000
- ☐ \$30,001-50,000
- ☐ \$50,001-70,000

- ☐ \$70,001-90,000
- ☐ \$90,001-\$100,000
- ☐ >\$100,000

1c1. If you don't, who/what is the major source of Income (please specify
.....)

1d. Numbers of family members (including yourself) People

1d1. Numbers of Children under 5 years old People

2. Do you work night shifts?

- ☐ Yes
- ☐ No

Work shift is: ☐ Fixed ☐ Rotating

Fixed Work Shift: ☐ 1st (9am-5pm) ☐ 2nd Shift (4pm-12am)

☐ 3rd Shift (overnight)

3. Marital Status:

- ☐ Single (not presently living conjugally with a partner)
- ☐ Legally Separated/ Legally Divorced
- ☐ Widowed
- ☐ Married

Health Status

4. Do you have any health problems or chronic illnesses?

- ☐ Yes, please specify
 - ☐ Diabetes
 - ☐ Hypertension
 - Do you receive treatment for hypertension?
.....YesNo
 - ☐ Asthma/ Pulmonary problems
 - ☐ Epilepsy
 - ☐ Renal disease
 - ☐ GI problem
 - ☐ Thyroid problems
 - ☐ Immune System problems

- ☐ Neurological condition
- ☐ Rheumatological problems
- ☐ Head Injury/ Accident
- ☐ Others

☐ No

5. Are there any other (acute) medical illnesses in the past 3 months?

☐ Yes, please specify

☐ No

Daily tobacco and Alcohol consumption

6. You are a (choose one):

☐ non-smoker

☐ current smoker

☐ ex-smoker

7. When was your last cigarette?" _____yrs/ mnths/ hrs/ min. ago

8. Do you NOW smoke cigarettes every day, some days, or not at all?

☐ Not at all

☐ Some days

☐ Every day

9. Estimate typical daily consumption of "tobacco" for the past month: (daily)

☐ Non-smoker

☐ Light (0-10)

☐ Moderate (11-20)

☐ Heavy (21-40+)

10. How often do you have a drink containing alcohol?

☐ Never

☐ Monthly or less

☐ 2-4 times a month

☐ 2-3 times a week

☐ 4 or more times a week

11. Estimate the typical daily consumption of "alcohol" for the past month: (daily)

- ☐ Non-alcoholic drinker
- ☐ Light (0-10)
- ☐ Moderate (11-20)
- ☐ Heavy (21-40+)

12. How many standard drinks containing alcohol do you have on a typical day when you are drinking?

- ☐ 1 or 2
- ☐ 3 or 4
- ☐ 5 or 6
- ☐ 7 to 9
- ☐ 10 or more

13. How often do you have 6 or more drinks on one occasion?

- ☐ Never
- ☐ Less than monthly
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or almost daily

Physical activity

14. On average, how many days per week do you engage in moderate to strenuous exercise (like walking fast, running, jogging, dancing, swimming, biking, or other activities that cause a light or heavy sweat)?

- ☐ 0 days
- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days
- ☐ 6 days
- ☐ 7 days

15. On average, how many minutes do you engage in exercise at this level? (per week)

- ☐ 0 minutes
- ☐ 10 minutes
- ☐ 20 minutes
- ☐ 30 minutes
- ☐ 40 minutes
- ☐ 50 minutes
- ☐ 60 minutes
- ☐ 70 minutes
- ☐ 80 minutes
- ☐ 90 minutes
- ☐ 120 minutes
- ☐ 150 minutes

2. Menopausal status: The stage of Reproductive Aging Workshop

1) During the past 12 months, how often did you have a menstrual period?

- ☐ I had a period every month
- ☐ I did not have a period every month, but I had at least 1 period in the last 3 to 12 months
- ☐ I have not had a period in the last 12 months

2) How is your menstrual cycle?

- ☐ Regular
- ☐ Variable
- ☐ Subtle changes in flow/ length

3) How variation?

- ☐ Length persistent ≥ 7 days difference in consecutive cycle
- ☐ Interval of amenorrhea of ≥ 60 days

4) How long since your last menstruation?

..... years.....months

3. Menopausal symptoms: Menopause Rating Scale

Which of the following symptoms apply to you at this time?

Please, mark the appropriate box for each symptom. For symptoms that do not apply, please mark 'none'.

- 1) Hot flushes, sweating (episode of sweating)
 - ☐ No
 - ☐ Mild
 - ☐ Moderate
 - ☐ Severe
 - ☐ Very severe
- 2) Heart discomfort (unusual awareness of heartbeat, heart skipping, heart racing, tightness)
 - ☐ No
 - ☐ Mild
 - ☐ Moderate
 - ☐ Severe
 - ☐ Very severe
- 3) Sleep problems (difficulty in falling asleep, difficulty in sleeping through, waking up early)
 - ☐ No
 - ☐ Mild
 - ☐ Moderate
 - ☐ Severe
 - ☐ Very severe
- 4) Depressive mood (feeling down, sad, on the verge of tears, lack of drive, mood swings)
 - ☐ No
 - ☐ Mild
 - ☐ Moderate
 - ☐ Severe
 - ☐ Very severe

5) Irritability (feeling nervous, inner tension, feeling aggressive)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

6) Anxiety (inner restlessness, feeling panicky)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

7) Physical and mental exhaustion (general decrease in performance, impaired memory, decrease in concentration, forgetfulness)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

8) Sexual problems (change in sexual desire, in sexual activity and satisfaction)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

9) Bladder problems (difficulty in urinating, increased need to urinate, bladder incontinence)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

10) Dryness of vagina (sensation of dryness or burning in the vagina, difficulty with sexual intercourse)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

11) Joint and muscular discomfort (pain in the joints, rheumatoid complaints)

- ☐ No
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Very severe

4. Risk of CVD: The Framingham risk score-BMI based**(Data will be collected via demographics and anthropometric measures)**

1) Ageyear

2) Gender

☐ Female

3) Systolic Blood Pressure mmHg

4) treatment for hypertension

☐ Yes☐ No

5) history of smoke

☐ Yes☐ No

6) history of diabetes

☐ Yes☐ No7) BMI kg/m²☐ Weight kg☐ Height cm

5. Sleep quality and quantity: the PSQI

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, when have you usually gone to bed at night?

USUAL BED TIME On the night before a work day, ____:____ am/pm

USUAL BED TIME On a night before a day off (e.g. a weekend), ____:____am/pm

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

NUMBER OF MINUTES.....

3) During the past month, when have you usually gotten up in the morning?

USUAL GETTING UP TIME Before a work day or school day, ____:____ am/pm

4) USUAL GETTING UP TIME Before a day off (e.g. a weekend), ____:____ am/pm.

During the past month, have you taken naps during the day?

- ☐ not during the past month
- ☐ less than once a week
- ☐ once or twice a week
- ☐ three or more times a week

b. 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 spend in bed.}

HOURS OF SLEEP PER NIGHT hours

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...

	Not during the past month	Less than once a month	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Had bad dreams				
i. Have pain				
j. Other reason (s), how often?				

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) Please rate the severity of your sleep problems in the last month:

	Very severe	Severe	Moderate	Mild	None
Difficulty falling asleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty staying asleep during night	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Problem waking up too early & being unable to get back to sleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How long have you suffered from these problems? ____ wks / ____ months / ____ yrs					

6. Obstructive sleep apnea: The Berlin Questionnaire

Part1

1) Do you snore?

- ☐ Yes (go to question 2)
- ☐ No (go to question 6)
- ☐ Don't know (go to question 6)

2) Your snoring is:

- ☐ Slightly louder than breathing
- ☐ As loud as talking
- ☐ Louder than talking

3) How often do you snore?

- ☐ Almost everyday
- ☐ 3-4 times per week
- ☐ 1-2 times per week
- ☐ 1-2 times per month
- ☐ Rarely or never

4) Have you snoring ever bothered other people?

- ☐ Yes
- ☐ No
- ☐ Don't know

5) Has anyone noticed that you stop breathing during your sleep?

- ☐ Almost everyday
- ☐ 3-4 times per week
- ☐ 1-2 times per week
- ☐ 1-2 times per month
- ☐ Rarely or never

Part2

6) How often do you feel tired or fatigued after your sleep?

- ☐ Almost everyday
- ☐ 3-4 times per week
- ☐ 1-2 times per week
- ☐ 1-2 times per m

7) During your waking time, do you feel tired, fatigued or not up to par?

- ☐ Almost everyday
- ☐ 3-4 times per week
- ☐ 1-2 times per week
- ☐ 1-2 times per month
- ☐ Rarely or never

8) Have you ever nodded off or fallen asleep while driving a vehicle?

- ☐ Yes
- ☐ No

9) How often does this occur?

- ☐ Almost everyday
- ☐ 3-4 times per week
- ☐ 1-2 times per week
- ☐ 1-2 times per month
- ☐ Rarely or never

Part3

10) Do you have high blood pressure?

- ☐ Yes
- ☐ No
- ☐ Don't know

7. Short Form of the Suinn-Lew Asian Self-identity Acculturation Scale

- 1) What language(s) do you prefer to use?
 - a. An Asian language only (e.g., Thai, Chinese, Filipino, Korean, etc.)
 - a. Mostly Asian, some English
 - b. Asian and English about equally well (bilingual)
 - c. Mostly English, some Asian
 - d. Only English
- 2) What identification does (did) your father use?
 - a. Oriental
 - e. Asian
 - f. Asian-American
 - g. Thai/ Thai-American
 - h. American
- 3) What was the ethnic: origin of the friends and peers you had as a child from age 6 - 18
 - i. Almost exclusively Asians, Asian Americans, Orientals
 - j. Mostly Asians, Asian-Americans, Orientals
 - k. About equally Asian groups and Angola groups
 - l. Mostly Anglos, Blacks, Hispanic, or other not-Asian ethnic groups
 - m. Almost exclusively Anglos, Backs, or other not-Asian ethnic groups
- 4) What is your food preference at home?
 - n. Exclusively Asian food
 - o. Mostly Asian food, some American
 - p. About equally Asian and American
 - q. Mostly American food
 - r. Exclusively American food
- 5) How would you rate yourself?
 - s. Very Asian
 - t. Mostly Asian
 - u. Bicultural
 - v. Mostly Anglicized
 - w. Very Anglicized

9. Anxiety: PROMIS SF v1.0 - Anxiety 4a

EDANX01: In the past 7 days, I felt fearful

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

EDANX40: In the past 7 days, I found it hard to focus on anything other than my anxiety

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

EDANX41: In the past 7 days, my worries overwhelmed me

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

EDANX53: In the past 7 days, I felt uneasy

- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

APPENDIX C

Approval Notice Initial Review – Expedited Review

July 31, 2020
Manassawee Srimoragot
Biobehavioral Health Science

RE: **Protocol # 2020-0738**
“Sleep and Factors Associated with Sleep Among Asian, African American, and White/Caucasian Women”

Dear Mx. Srimoragot:

Please note that for social/behavioral research the Initial Review Application has replaced the need for a separate protocol therefore, the Initial Review Application will be the protocol of record.

PIs who wish to begin or resume research involving activities that have been placed on temporary hold by the University due to the COVID-19 pandemic (i.e., non-therapeutic, in-person research) must complete a COVID-19 Human Subjects Research Restart Worksheet for an assessment of their studies prior to resuming or initiating the research.

Please refer to the Human Subjects Research Restart page on the OVCR website for additional information.

The research restart is being managed by the Office of the Vice Chancellor for Research (OVCR) and the UIC Center for Clinical and Translational Sciences (CCTS). Questions about the campus research restart may be directed to research@uic.edu.

Members of Institutional Review Board (IRB) #2 reviewed and approved your research protocol under expedited review procedures [45 CFR 46.110(b)(1)] on July 27, 2020. You may now begin your research.

Your research meets the criteria for approval under the following category(ies): Protocol reviewed under expedited review procedures [45 CFR 46.110] Category: 7

Please note the following information about your approved research protocol:

<u>Protocol Approval Date:</u>	July 27, 2020
<u>Approved Subject Enrollment #:</u>	2000
<u>Performance Sites:</u>	UIC
<u>Sponsor:</u>	None

Institutional Proposal (IP)#: Not applicable

Research Protocol(s):

- a) Sleep and Factors Associated with Sleep Among Asian, African American, and White/Caucasian Women, 07/28/2020

Documents that require an approval stamp or separate signature can be accessed via [OPRS Live](#). The documents will be located in the specific protocol workspace. You must access and use only the approved documents to recruit and enroll subjects into this research project.

Recruitment Material(s):

- a) Eligibility Screening Form, Version 3, 07/28/2020
- b) Recruitment Materials (compressed) 07/29/2020

Informed Consent(s):

- a) US Consent, Version 5, 07/30/2020
- b) EU Consent, Version 5, 07/30/2020
- c) Research involves activities related to screening, recruitment, or determining eligibility per 45 CFR 46.116(g).
- d) A waiver of documentation of consent has been granted under 45 CFR 46.117 for the online research activities; minimal risk; subjects will be provided with an information sheet and electronically agree to participate.

Additional Determinations for Research Involving Minors: This research is not approved for minors.

Please remember to:

à Use only the IRB-approved and stamped consent document(s) when enrolling new subjects.

→ Use your **research protocol number** (2020-0738) on any documents or correspondence with the IRB concerning your research protocol.

à Review and comply with the [policies](#) of the UIC Human Subjects Protection Program (HSPP) and the guidance [Investigator Responsibilities](#).

Please note that the UIC IRB has the right to ask further questions, seek additional information, or monitor the conduct of your research and the consent process.

Please be aware that if the [scope of work](#) in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact the OPRS office at (312) 996-1711 or me at (312) 355-0816. Please send any correspondence about this protocol to OPRS via [OPRS Live](#).

Sincerely,

Alison Santiago, MSW, MJ
Assistant Director, IRB # 2
Office for the Protection of Research
Subjects

cc: Bilgay Izci Balserak (Faculty Advisor), Biobehavioral Health Science, M/C 802
Lauretta Quinn, Biobehavioral Health Science, M/C 802

**Approval Notice
Amendment – Expedited Review
UIC Amendment # 1**

November 13, 2020

Manassawee Srimoragot
Biobehavioral Health Science

RE: **Protocol # 2020-0738**
“Sleep and Factors Associated with Sleep Among Asian, African American, and White/Caucasian Women”

Dear Ms. Srimoragot:

PIs who wish to begin or resume research involving activities that have been placed on temporary hold by the University due to the COVID-19 pandemic (i.e., non-therapeutic, in-person research) must complete a [COVID-19 Human Subjects Research Restart Worksheet](#) for an assessment of their studies prior to resuming or initiating the research.

Please refer to the [Human Subjects Research Restart page on the OVCR website](#) for additional information.

The research restart is being managed by the Office of the Vice Chancellor for Research (OVCR) and the UIC Center for Clinical and Translational Sciences (CCTS). Questions about the campus research restart may be directed to research@uic.edu.

Your application was reviewed and approved on November 12, 2020. The amendment to your research may now be implemented.

Please note the following information about your approved amendment:

Amendment Approval Date: November 12, 2020

Amendment:

Summary: Amendment Summary: UIC Amendment #1 (Response to Required Conditions to Secure Approval), dated; and accepted via OPRSLive 12 October 2020, is an investigator-initiated amendment to:

- (1) Revise protocol procedures to adopt two - steps verification to recruit subjects. The subjects were previously directed to the questionnaire after they complete the eligibility screening and consent form. This will change to: (1) subjects will complete the eligibility screening form and inform consent; (2) then the researchers will verify their information and send them the link to access the questionnaire to protect against cyber scams.
- (2) Revise compensation to offer participants to be entered into lottery after completing the survey. Thirty (30) Amazon gift cards in value of \$10 will be offered for every 100 subjects instead of giving each subject \$10 Starbucks/Target gift card compensation.

Thirty (30) out of every 100 participants will be offered the gift card and lottery drawing will happen each time 100 participants complete the survey. The odds of winning the lottery is in 1:3 ratio. The winners will be notified by text messages or emails depending on the contact information they provide. Compensation is only offered to participants in the United States.

- (3) Submit revised Initial Review Application (dated 7-28-20) and v6, 10-24-20 in the footer reflecting aforementioned changes to the protocol.
- (4) Submit following new and revised recruitment and consent documents reflecting aforementioned changes to the protocol: revised Eligibility Screening Form, v4, 10-24-20; Recruitment materials compressed (file name 10-24-20); (US Consent), v6, 10-24-20.

<u>Approved Subject Enrollment #:</u>	2000
<u>Performance Sites:</u>	UIC
<u>Sponsor:</u>	None
Institutional Proposal (IP) #:	None

Grant/Contract No:	None
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Grant/Contract Title:	None
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Research Protocol(s):

- a) Initial Review Application: Sleep and Factors Associated with Sleep Among Asian, African American, and White/Caucasian Women, 11/03/2020

Documents that require an approval stamp or separate signature can be accessed via [OPRS Live](#). The documents will be located in the specific protocol workspace. You must access and use only the approved documents to recruit and enroll subjects into this research project.

Recruiting Material(s):

- a) Eligibility Screening Form, Version 5, 11/03/2020
- b) Recruitment materials compressed (file name 11-3-20)

Informed Consent(s):

- a) (US Consent), Version 6, 10/24/2020

Please be sure to:

- Use **only the IRB-approved and stamped consent document(s) when enrolling subjects.**
- Use your research protocol number (2020-0738) on any documents or correspondence with the IRB concerning your research protocol.
- Review and comply with the [policies](#) of the UIC Human Subjects Protection Program (HSPP) and the guidance [Investigator Responsibilities](#).

Please note that the IRB has the right to ask further questions, seek additional information, or monitor the conduct of your research and the consent process.

Please be aware that if the [scope of work](#) in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact the OPRS at (312) 996-1711 or me at (312) 413-1518. Please send any correspondence about this protocol to OPRS via [OPRS Live](#).

Sincerely,

Alma Milat, BS
IRB Coordinator, IRB # 2
Office for the Protection of Research Subjects

cc: Bilgay Izci Balserak, Faculty Advisor, Biobehavioral Health Science, M/C 802

Susan Dunn, Biobehavioral Health Science, M/C 802

**Approval Notice
Amendment – Expedited Review
UIC Amendment # 3**

April 22, 2021

Manassawee Srimoragot
Biobehavioral Health Science

RE: **Protocol # 2020-0738**
“Sleep and Factors Associated with Sleep Among Asian, African American, and White/Caucasian Women”

Dear Mx. Srimoragot:

Your application was reviewed and approved on April 22, 2021. The amendment to your research may now be implemented.

Principal Investigators must complete a [COVID-19 Human Subjects Research Review Worksheet](#) for a protocol COVID safety assessment prior to initiating or re-starting any research activities that require in-person contact between research subjects and staff during the COVID-19 pandemic.

For additional information about this process, please refer to the [Human Subjects Research Review page on the OVCR website](#). If you need assistance, questions may be directed to research@uic.edu.

Please note the following information about your approved amendment:

Please note the administrative notice regarding the approved consent document below.

Amendment Approval Date: April 22, 2021

Amendment:

Summary: UIC Amendment #3 (response to conditions required), dated 19 April 2021, and submitted and accepted 20 April 2021, is an investigator-initiated amendment replacing terminated research procedures with a new study including:

(1) enrolling 120 Thai participants between the ages of 40-65 years old who identify as female to complete a 30-minute questionnaire regarding sleep and general health, and have their blood pressure, height, and weight measured and collected; participants will be recruited online via listservs, social media, ResearchMatch, and UIHRR, and by passively posting flyers on campus and at community sites such as temples, churches, businesses, and health fairs; potential participants will be directed to an online screener housed on UIC REDCap, either by linking to the online screener via online recruitment materials, after speaking with the investigator via telephone, or in person by the investigator if the investigator is present at a community recruitment site; eligible participants will be directed to contact the investigator

to schedule an in-person data collection session or may proceed directly from screening to data collection if the investigator is present; questionnaires may be completed on paper or via REDCap, and questionnaires completed on paper may be mailed or returned to the investigator at a later time; participant consent may be obtained online via REDCap or on paper; paper consent documents and/or questionnaires will be secured in a portable lock box by the investigator until the paper documents can be transferred to an appropriate locked, secure setting on campus; participants will be compensated via a \$10 gift card upon completion of data collection and participants who provide their contact information for additional compensation will have a 4 in 120 chance of winning a \$100, \$75, \$50, or \$25 gift card after all data collection has been completed (Initial Review application, 4/18/2021; Appendix K; Survey Questionnaire); and

(2) submitting recruitment and consent documents reflecting the above (Flyers, English + Thai, v2, 4/18/2021; Social Media Scripts (Email Scripts, Social Media Post Scripts, ResearchMatch Scripts, Craigslist Scripts, Reminder Scripts for Email or Text Messages, Script for Ineligible Participants, Script for Eligible Participants), v2, 4/18/2021; Eligibility Screening Questionnaire, v2, 4/18/2021; UIHRR IRB Submission Document, 4/19/2021; Sleep Women, v3, 4/22/2021).

<u>Approved Subject Enrollment #:</u>	120
<u>Performance Site:</u>	UIC
<u>Sponsor:</u>	None
Research Protocol:	

b) Sleep Characteristics and Cardiovascular Disease Risk among Thai Women;04/18/2021

Documents that require an approval stamp or separate signature can be accessed via [OPRS Live](#). The documents will be located in the specific protocol workspace. You must access and use only the approved documents to recruit and enroll subjects into this research project.

Please note that minor administrative edits have been made to the consent document and only the approved and stamped document may be used to consent and enroll subjects.

Recruiting Materials:

- c) Eligibility Screening; Version 2; 04/18/2021
- d) Flyers (English); Version 2; 04/18/2021
- e) Flyers (Thai); Version 2; 04/18/2021
- f) Email Scripts; Version 2; 04/18/2021
- g) Script for Eligible Participants; Version 2; 04/18/2021
- h) ResearchMatch Scripts; Version 2; 04/18/2021
- i) Craigslist Scripts; Version 2; 04/18/2021

- j) Reminder Scripts for Email or Text Messages; Version 2; 04/18/2021
- k) Script for Ineligible Participants; Version 2; 04/18/2021
- l) Social Media Post Scripts; Version 2; 04/18/2021

Informed Consents:

- b) Sleep Women; Version 3; 04/22/2021
- c) A waiver of documentation of written signature on a consent document has been granted for this minimal risk research under 45 CFR 46.117(c) (participants will be presented with an information sheet containing all of the elements of consent)
- d) Exceptions to informed consent for identifying, recruiting, and eligibility screening of potential participants has been acknowledged under 45 CFR 46.116(g)

Please be sure to:

- **Use only the IRB-approved and stamped consent documents when enrolling subjects.**
- Use your research protocol number (2020-0738) on any documents or correspondence with the IRB concerning your research protocol.
- Review and comply with the [policies](#) of the UIC Human Subjects Protection Program (HSPP) and the guidance [Investigator Responsibilities](#).

Please note that the IRB has the right to ask further questions, seek additional information, or monitor the conduct of your research and the consent process.

Please be aware that if the [scope of work](#) in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact the OPRS at (312) 996-1711 or me at (312) 996-2014. Please send any correspondence about this protocol to OPRS via [OPRS Live](#).

Sincerely,

Sandra Costello
Assistant Director, IRB # 2
Office for the Protection of Research Subjects

cc: Bilgay Izci Balserak (faculty advisor), Biobehavioral Health Science
Susan Dunn, Biobehavioral Health Science

VITA

NAME: Manassawee Srimoragot, MNS, RN

EDUCATION:

2018 – present Doctor of Philosophy in Nursing
PhD Candidate, anticipated graduation December 2022
College of Nursing, University of Illinois Chicago, Chicago, USA
Dissertation title: Sleep Characteristics and Cardiovascular Disease Risk
Among Thai Women

2015 - 2017 Master of Nursing Science, MNS (Midwifery)
Faculty of Nursing, Chiang Mai University, Chiang Mai, Thailand
Thesis title: Factors Related to Perceived Insufficient Milk Supply Among
First-time Mothers

2008 - 2012 Bachelor of Nursing Science, BNS
Faculty of Nursing, Mahidol University, Bangkok, Thailand

POSITIONS AND EMPLOYMENT:

2014 - 2018 Lecturer and Clinical Instructor
Obstetrics & Gynecological Nursing Department, Faculty of Nursing,
Mahidol University, Thailand

2012 - 2014 Registered Nurse (Operating room)
Department of Nursing Siriraj Hospital, Faculty of Medicine-Siriraj
Hospital, Mahidol University, Thailand

HONORS AND AWARDS:

2022 The Seth and Denise Rosen Memorial Research Award
College of Nursing, University of Illinois Chicago

2022 The Chancellor's Student Service Award (CSSA),
University of Illinois Chicago

2022 Travel Grant for Conference Presenters, The Health Professions Student
Council (HPSC), University of Illinois Chicago

2022	Conference Awards, University of Illinois Chicago
2021	The Tom and Sherri Mendelson Student Research Award College of Nursing, University of Illinois Chicago
2020	The Provost's Graduate Research Award (PGRA) Graduate College, University of Illinois Chicago
2020	Virginia Ohlson International Scholarship Nursing Dean's Scholarship Endowment Fund College of Nursing Scholarship, University of Illinois Chicago
2020	Travel Grant for Conference Presenters HPSC, University of Illinois Chicago
2020	Chicago Consular Corps (CCC) Scholarship Office of International Affairs (OIA), University of Illinois Chicago
2018	Scholarship to study Doctoral Program at University of Illinois Chicago, Faculty of Nursing, Mahidol University, Thailand
2017	Graduate Students Scholarship for Thesis Graduate School, Chiang Mai University, Thailand
2015	Scholarship to study Master of Nursing Science in Midwifery, Faculty of Nursing, Mahidol University, Thailand
2014	Scholarship to attend Tutorium in Intensive English at University of Illinois Chicago, USA, Faculty of Nursing, Mahidol University, Thailand

PUBLICATIONS:

Zhu, B., Wang, Y., Yuan, J., Mu, Y., Chen, P., **Srimoragot, M.**, . . . Reutrakul, S. (2022).

Associations between sleep variability and cardiometabolic health: A systematic review.
Sleep Medicine Reviews, 66, 101688.

doi: <https://doi.org/10.1016/j.smr.2022.101688>

Srimoragot, M., Hershberger, P. E., Park, C., Hernandez, T. L., & Izci Balserak, B. (2022).

Infant feeding type and maternal sleep during the postpartum period: a systematic review
and meta-analysis. *Journal of Sleep Research*, e13625. doi: 10.1111/jsr.13625

Fritschi, C., Kim, M.J., **Srimoragot, M.**, Jun, J., Sanchez, L., & Sharp, L.K. (2022). "Something
Tells Me I Can't Do That No More:" Experiences with Real-Time Glucose and Activity

- Monitoring among Underserved Black Women with Type 2 Diabetes. *The Science of Diabetes Self-Management and Care*, 48(2):78-86. doi: 10.1177/26350106221076042
- Srimoragot, M.**, Kuntaruksa, K., & Chaloumsuk, N. (2021). Factors Related to Perceived Insufficient Milk Supply Among First-time Mothers. *Nursing Journal*, 48(3), 354-365.
- Zhu, B., Grandner, M. A., Jackson, N. J., Pien, G. W., **Srimoragot, M.**, Knutson, K. L., & Izci-Balserak, B. (2021). Associations between Diet and Sleep Duration in Different Menopausal Stages. *Western Journal of Nursing Research*, 0193945920986788. doi: 10.1177/0193945920986788
- Imayama, I., Balserak, B. I., Gupta, A., Munoz, T., **Srimoragot, M.**, Keenan, B. T., . . . Prasad, B. (2021). Racial Differences in Functional and Sleep Outcomes with Positive Airway Pressure Treatment. *Diagnostics*, 11(12). doi: 10.3390/diagnostics11122176
- Presented and published in Conference Proceedings:
- Srimoragot, M.**, Hershberger, P.E., Park, C., Hernandez, T.L., & Balserak, B.I. (2022). Infant Feeding Type and Postpartum Maternal Total Sleep Time: A Systematic Review and Meta-Analysis. Together Again: Creating Unity, Growth & Diversity in Midwifery, Chicago, Illinois. May 22-26 2022. Virtual Poster Presentation.
- Srimoragot, M.**, Hershberger, P.E., Park, C., Hernandez, T.L., & Balserak, B.I. (2022). Infant Feeding Type and Postpartum Maternal Total Sleep Time: A Systematic Review and Meta-Analysis. *Innovative Solutions: Re-Imagining Nursing Research and Scholarship*, Schaumburg, Illinois. March 30-April 2 2022. Poster Presentation.
- Srimoragot M.** (2020). Associations between Sleep Deprivation during Pregnancy and Risk of Preterm Birth: An Integrative Review. N-nergizing Nursing Profession for NCD Challenges, Bangkok, Thailand. 8-10 January 2020. Poster Presentation.

LICENSURE:

2012 - Present	Nursing and Midwifery (First-Class License)
	Thailand Nursing and Midwifery Council, Bangkok, Thailand

CERTIFICATIONS:

2021	Sleep Health
2018 – 2020	Advanced Cardiac Life Support

2012 – present Basic Life Support

PROFESSIONAL MEMBERSHIPS:

2021 – present Midwest Nursing Research Society (MNRS), USA

2021 – present American College of Nurse Midwives (ACNM), USA

2020 – present American Academy of Sleep Medicine (AASM) and
the Sleep Research Society (SRS), USA

2020 - present American Association of University Women (AAUW), USA

2020 - present Graduate Women International (GWI), Switzerland

2019 - present Member of Sigma Theta Tau International Honor Society of Nursing,
Alpha Lambda Chapter, USA

2017 - present Member of Chiang Mai University Alumni Association

2016 - present Member of Sigma Theta Tau International Honor Society of Nursing,
Phi Omega at Large, Thailand

2012 - present Member of Thailand Nursing and Midwifery Council

2012 - present Member of the Nurses' Association of Thailand

2012 - present Member of Siriraj Nurses' Alumni under the Patronage of Princess
Mother

SERVICE TO PROFESSIONAL ORGANIZATIONS:

2021 - 2022 PhD representative, Graduate Student Nurses Organization (GSNO),
University of Illinois Chicago, USA

2021 – 2022 Head of Midwest region, The Association of Thai Students in the United
States of America (ATSA)

2020 – 2022 The President and Founder of the Thai Student Association
at University of Illinois Chicago

2016 - 2017 Board Committee of Graduate Student Council
Faculty of Nursing, Chiang Mai University, Thailand

2015 - 2017 Secretary of Graduate Student Association
Faculty of Nursing, Chiang Mai University, Thailand

2010 - 2011 Vice President of Nursing Student Association
Faculty of Nursing, Mahidol University, Thailand