The Relationship Between Sleep Hygiene Practices and Nocturnal Sleep for Midlife Women With and Without Insomnia

by

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Abstract

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In this study sleep hygiene practices and perceived and somnographic sleep indicators were analyzed for 92 women with insomnia and 29 women with no insomnia ages 40 to 55. Women recorded practices and perceptions in diaries during 6 days of polysomnographic sleep monitoring. Self-reported practices included smoking cigarettes, drinking alcohol, drinking caffeine, and exercising. Optimal sleep hygiene practices include abstaining from tobacco and alcohol or caffeine intake while getting regular exercise and maintaining a regular schedule for sleeping. Perceptions included sleep onset latency, awakenings, restfulness after sleeping, and sleep quality. Somnographic measures included bedtime, latency to Stages 1 and 2, Stage 0, and getting up time. Regular bedtimes and regular getting up times were defined as less than 30 minutes variation day to day. Women in both groups reported similar practices except for differences in alcohol and caffeine intake. More women with insomnia (52%) than without insomnia (31%) abstained from alcohol each day (95% CI = .01,.41). Less than 10% in both groups reported drinking alcohol everyday. More than 80% in both groups reported drinking one or more servings of caffeine per day, but women with insomnia averaged one less serving of caffeine per day than women without insomnia ($p < .05$). Few women in either group reported smoking (< 10%). Less than 25% reported 30 minutes of exercise each day, although about one-half of each group reported exercising an average of 30 minutes per day. Very few women had regular bedtimes (< 5%) or regular getting up times (<10%) for all five days assessed. Women with insomnia showed less variation in day to day sleep hygiene practices, but greater variation in sleep perceptions as measured by mean standard deviations. Women with insomnia showed significantly smaller variations in alcohol intake (p=.05) and bedtimes (p=.02) and greater variations in reported SOL (p=.005) and sleep quality (p=.002) than women without insomnia. Regression analyses showed that combinations of sleep hygiene practices explained small amounts of the variances in sleep indicators. In summary, sleep hygiene practices were similar between women with and without insomnia except for caffeine and alcohol. Women with insomnia showed less variation in sleep hygiene practices, but greater variation in sleep perceptions compared to women with quality sleep.

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DEDICATION

For all my sisters who do and don't sleep easily,

especially for Arlene, who sleeps beautifully!

Introduction

Insomnia, the most commonly reported sleep disorder, is experienced by 27% of adults "occasionally" and by an additional 9% "frequently" (Gallup Organization, 1991). More women (26% to 61%) than men (13% to 39%) report experiencing insomnia (Bixler, Kales, Soldatos, Kales, & Healey, 1979; Gallup Organization, 1991; Karacan, Thornby, Anch, Holzer, et al., 1976; Klink, Quan, Kaltenborn, & Lebowitz, 1992; Mellinger, Balter, & Uhlenhuth, 1985; Thornby, et al., 1977). Insomnia is the perception of an inability to get the quantity and/or quality of sleep needed to function satisfactorily the following day.

Chronic lack of sleep has a substantial economic cost and diminishes quality of life for millions of individuals. People with chronic insomnia have more memory problems, impaired interpersonal relationships, diminished coping ability, impaired daytime functioning, and feel less well physically (Gallup Organization, 1991). Five per cent of people with chronic insomnia have had auto accidents related to fatigue, compared to 2% for those without insomnia (Gallup Organization, 1991). Longitudinal studies indicate that habitual short sleepers have an increased risk for mortality (Berkman & Breslow, 1983; Kripke, Simons, Garfinkel, & Hammond, 1979). Although the precise function of sleep is uncertain, sleep is essential for life as well as for physical and mental restoration.

Conceptually, insomnia occurs when some combination of predisposing, precipitating, and perpetuating factors reaches a theoretical threshold for insomnia (Spielman, 1986; Spielman, Caruso, & Glovinsky, 1987; Spielman, Nunes, & Glovinsky, 1996). Any behavior which increases arousal, prevents sleep generation, or disrupts circadian rhythmicity brings a person closer to their insomnia threshold. Behaviors which influence sleep are particularly important for a person vulnerable to insomnia.

Optimal sleep hygiene practices are a person's usual activities which facilitate cyclical, restorative sleep. Currently recommended sleep hygiene practices include not smoking, not ingesting caffeine, not drinking alcohol, exercising regularly, maintaining a regular bedtime and getting up time; and having a relaxing bedtime routine (Hauri, 1991; Walsh, Hartman, & Kowall, 1994; Zarcone, 1994). These practices promote sleep by decreasing a person's arousal level prior to the hour of sleep, minimizing sympathetic stimulation during the sleep period, and/or strengthening the circadian rhythmicity of the sleep-wake cycle. Attention to sleep hygiene practices is a fundamental aspect of treatment for insomnia, yet little is known about sleep hygiene practices in the general population.

The actual sleep hygiene practices for adults with insomnia are unknown. The only two studies reporting about sleep hygiene practices were retrospective and had contradictory results. Nau and Walsh (1983) found that both controls and those with insomnia had poor sleep hygiene practices. Lacks and Rotert (1986) reported that (1) adults with insomnia knew more about sleep hygiene recommendations than good sleepers, but reported practicing the behaviors less often, and (2) practices differed between those with sleep onset insomnia and sleep maintenance insomnia. Sleep improved for adults with chronic insomnia who completed sleep hygiene programs, but which behaviors changed, if any, was not reported in these studies. Whether sleep hygiene practices change or remain the same from day to day is unknown as well.

The purpose of this research was to investigate the relationship between specific sleep hygiene practices and nocturnal sleep quality for middle aged women with insomnia. This descriptive study was a retrospective analysis of data from a study of insomnia in midlife women. The specific aims were to

(1) compare midlife women with and without insomnia on levels of sleep hygiene practices (i.e., smoking cigarettes, drinking alcohol, drinking caffeine, exercising, and maintaining regular bedtimes and getting up times) and frequencies of

following recommended practices (not smoking cigarettes, not drinking alcohol, not drinking caffeine, getting regular exercise, and maintaining regular bedtimes and getting up times) across five days;

(2) compare midlife women with and without insomnia on the stability of specific sleep hygiene practices across five days;

(3) compare midlife women with and without insomnia on the stability of perceived sleep (perceptions of sleep onset latency, number of awakenings, restfulness, and quality of sleep) across five nights;

(4) describe associations between sleep hygiene practices and perceived sleep over five days and nights for midlife women with and without insomnia; and

(5) describe associations between a day's sleep hygiene practices and somnographic sleep variables (sleep onset latency, wake time, and number of awakenings) the subsequent night for midlife women with and without insomnia.

Long term goals are to develop more efficient, effective strategies to improve sleep hygiene practices. Identifying the adequacy of current sleep hygiene practices of midlife women helps establish priorities for intervention programs. Knowing to what degree daily sleep hygiene practices fluctuate could improve assessment and evaluation strategies. Recognizing sleep hygiene practices associated with specific types of insomnia could help focus assessment and interventions. Assisting women to improve their sleep hygiene practices could prevent more women from reaching their threshold for insomnia each night.

Chapter I: Background and Significance

Sleep hygiene practices are one component of the broader concept of sleep hygiene. As defined by Chokroverty, sleep hygiene refers to "conditions and practices that promote continuous and effective sleep" (1994, p. 478). The following sleep hygiene practices are consistently recommended to promote nocturnal sleep:

(1) avoid caffeine consumption;

(2) abstain from drinking alcohol;

(3) refrain from smoking tobacco;

(4) get regular exercise;

(5) maintain a regular bedtime or getting up time; and

(6) maintain a relaxing bedtime routine.

These activities are self-management strategies expected to facilitate higher quality sleep.

Consuming Caffeine

Caffeine is considered the most commonly ingested psychoactive drug (Gilbert, 1984; Fredholm, 1995). Caffeine is consumed in cocoa, coffee, tea, soft drink beverages, and certain medications. Gilbert (1984) estimated the mean caffeine intake from all sources for adults in the United States was 211 mg/day. From a survey of 173 men and 228 women, Weidner and Istvan (1985) estimated that the mean caffeine intake from all sources for men was 381 mg/day and for women was 424 mg/day. When ingested, caffeine is rapidly absorbed from the gastrointestinal system, distributed throughout body water (including the brain), metabolized in the liver, and excreted via the kidneys (Yesair, Branfman, & Calahan, 1984). Caffeine is a central nervous system stimulant that prevents sleep.

Caffeine consistently prevents sleep by increasing alertness and vigilance. In the first study of caffeine, Hollingworth (1912) concluded that 65 mg. to 130 mg. of caffeine enhanced vigilance. Additional studies have confirmed that caffeine delays sleep onset, increases the number of nocturnal awakenings, increases time awake after sleep onset, and decreases total sleep time (Karacan, Thornby, Anch, Booth, et al., 1976; Stavric, 1992). The degree of sleep disruption is directly related to amount of caffeine consumed. Caffeine, also, lowered the threshold for arousal to auditory stimuli during sleep (Bonnet, Webb, & Barnard, 1979). Caffeine increased men's alertness during the day, (Zwyghuizen-Doorenbos, Roehrs, Lipschutz, Timms, & Roth, 1990) or night (Walsh et al., 1990). Even after a night of restricted sleep, 75 mg. of caffeine (an amount less than one cup of regular coffee) increased men's alertness (Rosenthal, Roehrs, Zwyghuizen-Doorenbos, Plath, & Roth, 1991). These studies did not include women, but clearly demonstrated that caffeine increases alertness and prevents sleep for men.

Physiologically, caffeine decreases cerebral blood flow and acts on neuronal synapses in the brain. After ingestion, caffeine diffuses through the entire body and quickly penetrates the brain. Cerebral blood flow decreased by 30% after 250 mg. of caffeine was given orally or intravenously (Cameron, Modell, & Hariharan, 1990). Caffeine may act on neurons by (1) blocking adenosine receptors, (2) mobilizing intracellular calcium, or (3) inhibiting phosphodiesterase. Although caffeine may have all three actions, only inhibition of adenosine receptors occurs with concentrations of caffeine normally consumed by humans (Fredholm, 1995; Nehlig, 1992). The physiological basis for sleep disturbances from caffeine may be through changes in either blood flow or neuronal functioning.

Individuals vary in their sensitivity to caffeine, but sensitivity can last 8 to 14 hours (Zarcone, 1994). Noncaffeine drinkers are more sensitive to the acute effects of caffeine on sleep than habitual caffeine drinkers (Goldstein, Warren, & Kaizer, 1965). People become more sensitive to caffeine as they get older (Nehlig, Daval, & Debry, 1992). Hauri (1991) noted that people with insomnia may be more sensitive to smaller amounts of caffeine than normal sleepers, but this has not been studied. Response to caffeine depends not only on a person's age, usual intake, and amount consumed, but, also, on excretion.

The rate of caffeine clearance from the body varies. The half-life of caffeine ranges from 2 to 7.5 hours in blood plasma for both men and women (Curatolo & Robertson, 1983; Stavric, 1988). Caffeine is primarily excreted in urine and saliva. Elimination of caffeine is prolonged with liver disorders and during pregnancy, but increased after smoking cigarettes. Oral contraceptive steroids extend the half-life for caffeine in young women (Patwardhan, Desmond, Johnson, & Schenker, 1980; Rietveld, Broekman, Houben, Eskes, & van Rossum, 1984). No data on the interaction of estrogen replacement therapy, common in midlife women, and caffeine clearance is available.

Although people recognize that ingesting caffeine disturbs their sleep, they continue to drink caffeinated beverages (Lacks & Rotert, 1986). A survey of the sleep hygiene practices of patients with insomnia revealed that 33% drank four or more servings of caffeine per day and 35% drank one or more drinks of caffeine near bedtime (Nau & Walsh, 1983). An unspecified number of people in the group with sleep onset insomnia continued to drink coffee in the evening even though they recognized that coffee prevented sleep (Lacks & Rotert, 1986). In the same survey, people with more severe insomnia did not ingest caffeine. The extent of caffeine consumption for adults with insomnia is unknown.

Refraining from ingesting caffeine eliminates a stimulating drug that interrupts sleep. Caffeine consistently enhances alertness and prevents or disturbs sleep. Recommendations vary about how many hours before sleeping to avoid caffeine, yet the time of caffeine ingestion may not be as important as the amount consumed and the rate of clearance.

Drinking Alcohol

People drink alcohol (ethanol) for its sedative effects, although

Western health care providers do not advocate alcohol for this purpose. A national survey in 1979 found that 6% of adults had used alcohol to help them sleep (Addison, Thorpy, Roehrs, & Roth, 1991). Compared to satisfied sleepers in this survey, twice as many dissatisfied sleepers used alcohol to help them sleep. A 1991 Gallup Organization survey found that 28% of those with insomnia had used alcohol to help them sleep better. Interviews of 175 women over the age of 85 living in the rural West revealed that 66% used alcoholic beverages to promote sleep (Johnson, 1994). Alcohol, a central nervous system depressant, expedites sleep onset, but is not recommended as a sedative because it, also, interferes with sleep.

Sleep onset latency decreases after drinking alcohol. The amount of alcohol consumed, time of day, and amount of prior sleep influence the length of the latency period. Higher doses of alcohol shorten sleep latency to a greater degree than smaller doses (MacLean & Cairns, 1982; Zwyghuizen-Doorenbos, Roehrs, Lamphere, Wittig, & Roth, 1987). After drinking three servings of alcohol or more, sleep came more quickly during the day (Zwyghuizen-Doorenbos, Roehrs, Lamphere, Wittig, & Roth, 1987), early afternoon (Horne & Gibbons, 1991), late evening (MacLean & Cairns, 1982; Rundell, Lester, Griffiths, & Williams, 1972), or night (Walsh, Humm, Muehlbach, Sugerman, & Schweitzer, 1991). The sedative effect of alcohol was less pronounced in the early evening when alertness was highest (Horne & Gibbons, 1991; Roehrs, Zwyghuizen-Doorenbos, Knox, Moskowitz, & Roth, 1992). The degree of sedation was greater when the amount of prior sleep was diminished than when the person was fully rested (Lumley, Roehrs, Asker, Zorick, & Roth, 1987).

Alcohol suppresses rapid eye movement sleep (REM) sleep and increases slow wave sleep (SWS) for nonalcoholic women as well as men (MacLean & Cairns, 1982; Williams, MacLean, & Cairns, 1983). The changes are greater with increasing doses of alcohol. If alcohol is fully metabolized during sleep, REM sleep increases thereafter

(Murphree, 1974). With large doses of alcohol, REM suppression lasts all night (Knowles, Laverty, & Kuechler, 1968). When alcohol is ingested every night, REM sleep and SWS return to baseline levels (MacLean & Cairns, 1982; Williams, MacLean, & Cairns, 1983; Rundell, Lester, Griffiths, & Williams, 1972; Yules, Lippman, & Freedman, 1967). These changes in sleep vary across the night and vary night to night according to the dose of alcohol in the blood. The significance of the changes in REM and SWS is unknown.

The duration of alcohol's action is related to amount consumed since metabolism and elimination are relatively constant in a given individual. Alcohol is efficiently absorbed from the gastrointestinal system and quickly penetrates the brain. Most alcohol is metabolized in the liver. In men, as much as 20% of ingested alcohol is deflected by the stomach lining and does not reach the circulation (Linder, 1991). This barrier is less active in women, making them more vulnerable to a specific amount of alcohol. Unmetabolized alcohol is excreted via ventilation or urine, but only 1 to 5% of the total is eliminated by either route (Batt, 1989; Linder, 1991). Because the liver metabolizes alcohol at a steady rate, additional alcohol intake remains in the blood until the alcohol can be metabolized. With normal liver function, alcohol metabolism continues until the alcohol is completely eliminated.

The consequences of alcohol on sleep last beyond its physical presence in the body. After alcohol concentration reaches zero, sleep onset latency continues to be reduced for a brief period of time and then increases slightly (Roehrs, Claiborue, Knox, & Roth, 1994; Roehrs, Zwyghuizen-Doorenbos, & Roth, 1993; Walsh, Humm, Muehlbach, Sugerman, & Schweitzer, 1991; Zwyghuizen-Doorenbos et al., 1989). After alcohol is metabolized, a person (waking or sleeping) experiences a relative sympathetic arousal, which can last for 2 to 3 hours (Walsh, Humm, Muehlback, Sugerman, & Schweitzer, 1991; Zarcone, 1994). This arousal is not well studied, but may cause fragmented sleep later in the night.

Abstaining from alcohol is recommended to obtain higher quality sleep. The minimal amount of alcohol that will disturb sleep is uncertain. Sleep is clearly disrupted after three servings of alcohol. Whether one serving of alcohol disrupts sleep is controversial as studies on smaller doses have shown differing results (MacLean & Cairns, 1982; Dijk, Brunner, Aeschbach, Tobler, & Borbély, 1992). The current recommendation is contrary to the popular belief that alcohol is a good sedative.

Smoking Cigarettes

Smoking tobacco cigarettes is associated with disturbed sleep, but a cause and effect relationship is not established. The only polysomnographic study comparing smokers and nonsmokers indicated that smokers (men and women) had longer sleep latencies and more awake time, but no differences in sleep stages (Soldatos, Kales, Scharf, Bixler, & Kales, 1980). Nicotine is the major psychoactive substance in tobacco, but other chemicals may contribute to changes due to smoking tobacco. The changes in sleep after smoking are not consistent.

Two studies tested the direct action of nicotine on sleep. After chewing nicotine gum, sleep stages for eight men with obstructive sleep apnea did not change, even though sleep apneas decreased in the first two hours of sleep (Gothe, Strohl, Levin, & Cherniack, 1985). Transdermal nicotine was associated with reduced total REM sleep time and early morning awakening, but not with prolonged sleep onset latency or other sleep stage changes for 12 nonsmoking men (Gillin, Lardon, Ruiz, Golshan, & Salin-Pascual, 1994).

Survey data supports that smokers have more disturbed sleep than nonsmokers, but the disturbances vary. Self-reports from 92 college women showed that smokers took longer to fall asleep, slept less total time, and had more dreams or nightmares than nonsmokers (Bale & White, 1982). In contrast, daily diaries from 58 college students who smoked did not show prolonged sleep onset (Lexcen & Hicks, 1993). These subjects reported poorer quality sleep: being restless during sleep, awakening early in the morning, waking up tired, and not being satisfied with their sleep. A recent epidemiological study of 3516 adults indicated that smoking cigarettes was associated with difficulty going to sleep, difficulty waking up, and nonrestorative sleep (Wetter & Young, 1994). In addition, for women, smoking was associated with excessive daytime sleepiness, but not with nightmares and disturbing dreams. Sleep disturbances of cigarette smokers are not the same in all populations.

Physiological changes associated with smoking are relevant to a person's sleep. Acetylcholine, dopamine, epinephrine, norepinephrine, and beta-endorphins increase after smoking one cigarette (Pomerleau, 1992). Norepinephrine levels increase quickly and decay quickly, but remain elevated for more than 45 minutes. Their increase is much greater than the increase in the other chemicals. These chemical messengers are all important for sleep generation or inhibition.

Women smoke for both stimulation and sedation (Russell, 1989). The per cent of women who smoke is decreasing, but almost 30% of women do smoke (Revicki, Sobal, & DeForge, 1991). The increased levels of catecholamines and beta-endorphins after smoking a cigarette explain why smoking tobacco is simultaneously stimulating and calming (Pomerleau, 1992). Catecholamines increase arousal. Beta-endorphins reduce anxiety and tension. Although people who smoke feel relaxed, their level of arousal is increased.

Smoking tobacco cigarettes is contraindicated for quality sleep, because of the sympathetic stimulation associated with smoking. Smokers regulate their smoking such that the level of plasma nicotine is relatively constant from day to day (Russell, 1989), but the level decreases at night when smoking is interrupted. The consequences of the decrease in nicotine during the sleep period has not been studied. Changes in sleep due to smoking are often confounded by simultaneous use of caffeine and alcohol.

Interaction of Caffeine, Alcohol, and Nicotine

The combination of alcohol with caffeine and/or nicotine in a person's body disturbs sleep more than any one substance individually. A person falls asleep more quickly while mildly sedated by alcohol. If nicotine and/or caffeine levels are still high after the alcohol is metabolized, arousal and fragmented sleep result. Caffeine does not reverse alcohol. The disruption of sleep is more profound for those over 45 years of age according to Zarcone (1994). The consequences from caffeine, alcohol, and nicotine are due to their differing actions and differing rates of metabolism.

Exercise

Regular exercise is recommended for higher quality sleep (Driver & Taylor, 1996; Hauri, 1991; Zarcone, 1994), but the rationale is uncertain (Taylor & Driver, 1995). The connection between exercise and sleep has been studied extensively in healthy subjects, but is not definite. Objective sleep measures do not show consistent changes attributable to exercise. Subjective sleep measures are rarely included in exercise studies. Nevertheless, the common belief is that regular exercise improves sleep.

European surveys reveal that people consider exercise to be very important for quality sleep. Finnish and Scottish men and women believed that exercise was the most important lifestyle habit for maintaining sleep quality (Shapiro & Bachmayer, 1988; Vuori, Urponen, Hasan, & Partinen, 1988). Middle-aged Finns believed that they went to sleep more easily, slept more deeply and soundly, and felt better and more alert in the morning after exercising (Hasan, Urponen, Vuori, & Partinen, 1988). Although similar surveys have not been done in the United States, perceptions of these Europeans provide support that exercise improves sleep.

The primary change in the sleep electroencephalogram (EEG) following exercise is an increase in SWS that occurs indirectly through heating of the body. Initial studies showed that SWS increased the night following exercise, but not consistently in all subjects (Horne, 1981). The increased SWS was related to exercise of high intensity, rather than of longer duration (Bunnell, Bevier, & Horvath, 1983; Horne & Staff, 1983). Nocturnal SWS increased after exercise if the core temperature increased during the exercise (Horne & Moore, 1985; Horne & Staff, 1983). Passive body heating produced similar increases in SWS confirming that heating was the cause (Horne & Reid, 1985). The meaning of increased SWS is uncertain, but athletes have higher baseline levels of SWS than nonathletes.

Physical fitness, not exercise per se, may be the reason a person who gets regular exercise sleeps better. Only one study evaluated sleep before and after an aerobic training program for untrained women (Driver, Meintjes, Rogers, & Shapiro, 1988). In this study, women reported higher quality sleep and increased morning vigilance after their fitness improved. Sleep EEG parameters did not change from baseline when comparing sleep following days of no exercise before and after the fitness program. Comparison of sleep following a day with exercise before and after the fitness program showed that SWS increased and sleep efficiency improved. None of these women had a sleep problem. The effect of a physical fitness program on individuals with poor sleep is unknown.

Regular exercise is associated with better sleep, but quantifying the changes due to exercise and establishing the mechanism is difficult. The EEG may not be the best indicator of improved sleep because the EEG measures brain activity rather than sleep quality directly (Horne, 1981). Since the link between exercise and sleep is not definite, recommendations about the type, length, and intensity of exercise to improve sleep are limited.

Sleep-Wake Schedule

Maintaining a regular schedule for sleeping and awakening strengthens sleep-wake cycling. The adult sleep wake cycle is longer than the 24 hour time clock. Living without time cues, young men's sleep-wake cycles are closer to 25 hours, while young women's are almost a half hour shorter (Wever, 1984). An older person's sleep wake cycle is closer to 24 hours (Monk, 1989; Weitzman, Moline, Czeisler, & Zimmerman, 1982). A regular schedule resets the "biological clock" each day to keep people in synchrony with their 24 hour physical and social environment.

A consistent bedtime is particularly important for adults with a phase advanced sleep-wake rhythm. Their endogenous pacemaker for sleep wake cycling is faster than 24 hours. They become sleepy early in the evening and awaken early in the morning. Staying awake until a predetermined bedtime delays the sleep cycle and keeps the cycle from advancing further.

In contrast, adults who have a phase delayed sleep-wake rhythm need a consistent getting up time. People who are not sleepy until very late in the evening and want to sleep late in the morning may be experiencing a phase delayed sleep-wake rhythm. Their endogenous pacemaker is slower than 24 hours. A regular getting up time will help mesh their sleep-wake cycle with the circadian, or 24 hour, environment. If they get up at a consistent time, sleep is more efficient and their bedtime will regulate itself. A portion of the adults with insomnia at sleep onset likely have a phase delayed sleep-wake rhythm.

Bedtime Routine

A relaxing bedtime routine assists people in making the transition from waking to sleeping by decreasing stimulation. Preparation for sleep requires decreased mental and physical activity. Taking time for a relaxing activity before sleeping helps people detach from their day's activities (Zarcone, 1994). Internal or external sensory stimulation of sufficient magnitude keeps people awake. Decreasing sensory input allows sleep generation to dominate.

The very few studies of bedtime routines indicate that adults believe bedtime routines improve sleep. Most elderly men and women in one non-urban community had a bedtime routine that was very important to them (Johnson, 1991). Bedtime routines were different for men and women. Both men and women watched TV, brushed their teeth, and bathed as part of their bedtime routine. Women, also, washed their faces, prayed, read, and listened to music. Men listed snacking, drinking, and walking the dog as essential to their routines. Elderly women with a bedtime routine viewed their sleep better than elderly women who did not have a routine (Johnson, 1986). Bedtime routines for other age groups are not reported.

Sleep Hygiene

Instruction in sleep hygiene is a primary intervention for insomnia (Erman, 1985; Gillin, 1992; Hauri, 1991; Kales & Kales, 1984; Nino-Murcia, 1992; Zarcone, 1994). Although Nathaniel Kleitman first wrote about sleep hygiene in 1939, the study of sleep hygiene is relatively recent. Not all recommendations have been evaluated to specify for whom or when they are appropriate. As a result, sleep hygiene programs vary, but basic recommendations are not disputed.

Programs of sleep hygiene are not standardized, but include varying information, recommendations, and degrees of personal support. A program may include general or detailed content about the function of sleep, developmental changes, individual sleep differences, or the effects of food, drugs, exercise, naps, and the environment on sleep. Recommendations, too, may be broad (e.g., avoid caffeine) or specific (e.g., do not drink any caffeine past noon). Therapists who assist subjects to integrate sleep hygiene information with their sleep problem provide differing amounts of individual attention. The variation in programs makes comparison of results difficult.

Sleep improved for people with sleep onset and/or sleep maintenance insomnia following a program of sleep hygiene in three separate studies (Chambers & Alexander, 1992; Engle-Friedman, Bootzin, Hazlewood, & Tsao, 1992; Schoicket, Bertelson, & Lacks, 1988). Outcome measures for improved sleep were self-reported and included a combination of sleep onset latency, number and duration of nocturnal awakenings, feeling refreshed upon awakening, and more restful sleep. Sleep improved within four weeks and lasted up to two years. None of these studies described which behaviors actually changed after the program.

Placing subjects with adequate sleep hygiene into intervention groups with subjects without adequate sleep hygiene obscures data about behavioral changes. Schoicket, Bertelson, & Lacks (1988) noted that most subjects complied with the sleep hygiene instructions after a sleep hygiene program, but some people adhered to sleep hygiene recommendations before entering the program. Sleep hygiene for the latter subjects could not improve. Since sleep improved for the group, either the change in behavior was very large for a portion of the subjects, or the improved sleep was due to attention or education rather than a change in behavior.

Data from the two studies that involved surveying people about specific sleep hygiene practices are conflicting. Comparisons between 27 adults with insomnia and 27 good sleepers from Missouri indicated that both groups had relatively poor self-reported sleep hygiene practices (Nau & Walsh, 1983). Sleep hygiene practices were not significantly different between the two groups. In contrast, another study of 143 adults, also from Missouri, showed that sleep hygiene practices were relatively good for those with any type of insomnia as well as for the good sleepers, but the practices of persons with specific types of insomnia differed significantly (Lacks & Rotert, 1986). Adults with sleep onset insomnia had significantly lower composite scores for sleep hygiene practices than either those with sleep maintenance insomnia or those without a sleep problem. In the group with sleep onset insomnia, those with greater difficulty initiating sleep followed sleep hygiene practices more frequently than those with a lesser difficulty. Because knowledge of sleep hygiene practices was high in all groups, the authors' interpretation was that known sleep hygiene practices were not followed until going to sleep became a more serious problem. No other researchers have reported sleep hygiene practices for adults with insomnia.

Adults with insomnia may know behaviors that facilitate sleep, but not practice those behaviors. Knowledge of sleep hygiene was higher for adults with insomnia than for good sleepers, but they practiced the behaviors less often (Lacks & Rotert, 1986). Individuals with insomnia knew more about the effects of caffeine on sleep than the effects of smoking tobacco, drinking alcohol, vigorous prebedtime exercise, or a relaxing bedtime routine. Knowledge of the disturbing effects of caffeine on sleep was highest in the group with sleep-onset insomnia, but they continued to drink caffeine in the evening. After teaching workers on rotating shifts about sleep hygiene, practices did not change although knowledge increased (Holbrook, White, & Hutt, 1994). Practicing sleep hygiene behaviors, not simply knowing recommended behaviors, is necessary to improve sleep.

The prevalence of inadequate sleep hygiene is unknown, but is presumably a common cause as well as a perpetuating factor for insomnia (Partinen, 1994). The International Classification of Sleep Disorders has recently added a diagnostic category, "inadequate sleep hygiene", to identify insomnia caused by culturally normal practices. A common practice may precipitate insomnia for one person, but not for another. In a study comparing diagnostic categories, inadequate sleep hygiene was a primary diagnosis in 6% of 257 patients and a primary or secondary diagnosis in 34% of cases (Buysse et al., 1994). This study was conducted at five different sleep disorders centers and included 216 patients with insomnia. Common practices, such as consuming caffeine or alcohol, likely cause insomnia frequently.

Insomnia

Insomnia is the most frequently reported sleep pattern disturbance. Survey data in the United States indicated that 21% to 36% of adults experience insomnia (Bixler, Kales, Soldatos, Kales, & Healey, 1979; Gallup Organization, 1991; Karacan, Thornby, Anch, Holzer, et al., 1976; Klink, Quan, Kaltenborn, & Lebowitz, 1992; Mellinger, Balter, & Uhlenhuth, 1985; Thornby, et al., 1977). Insomnia was reported by 26% to 61% of women and 13% to 39% of men and increased with age in both sexes (Bixler, Kales, Soldatos, Kales, & Healey, 1979; Gallup Organization, 1991; Karacan, Thornby, Anch, Holzer, et al., 1976; Klink, Quan, Kaltenborn, & Lebowitz, 1992; Mellinger, Balter, & Uhlenhuth, 1985; Thornby, et al., 1977). A more recent national telephone survey of 1027 adults found that 49% reported they had experienced difficulty sleeping, including 12% with "frequent" difficulty (Gallup Organization, 1995). Prevalence of insomnia is determined from a few surveys that may not accurately represent the diverse population in the United States. These surveys were primarily urban dwellers in a specific metropolitan area. The National Sleep Foundation attempted to obtain a broader sample (Gallup Organization, 1991; Gallup Organization, 1995). Their reports do not indicate whether all major ethnic groups were represented. Nevertheless, millions of people in the United States must manage insomnia and its consequences.

Insomnia is the perception of an inability to get the quantity and quality of sleep needed to function satisfactorily. By definition, insomnia is a symptom, a subjective report of a condition. The sensation of being rested or tired is known only by the individual. Objective measures can specify sleep time, sleep efficiency, or resulting functional deficits. Objective sleep measurements identify disturbances in sleep structure which may not correlate with insomnia. An individual may experience insomnia at sleep onset or during sleep or awaken prematurely.

Four common types of insomnia are sleep onset insomnia, sleep maintenance insomnia, mixed insomnia, and nonrestorative sleep. With nonrestorative sleep, a person may or may not perceive sleeping through the night, but is not refreshed upon awakening. Nonrestorative sleep is a basic attribute of the other three types of insomnia. Sleep onset insomnia is, also, characterized by difficulty initiating sleep. Sleep maintenance insomnia refers to nonrestorative sleep interrupted by frequent or prolonged awakenings during the sleep period. Mixed insomnia is a combination of sleep onset and sleep maintenance insomnia with inability to sleep both at the beginning and during the sleep period. Feeling unrested, or tired, after sleeping is an essential feature of insomnia.

Many elements contribute to insomnia, making treatment complex. Psychological, physiological, social, and environmental factors can disturb sleep. Because of the intermingling of these domains, isolating factors contributing to insomnia is often very difficult. Yet understanding the reasons for insomnia facilitates effective treatment.

Spielman (1986) proposed a method for organizing elements contributing to the development of an individual's insomnia. He separated the factors into three categories: (1) predisposing factors, (2) precipitating factors, and (3) perpetuating factors. This classification portrays components in relation to the changing nature of insomnia.

Predisposing, precipitating, and perpetuating factors are distinct, but not mutually exclusive, categories. Predisposing, or constitutional, factors are relatively permanent features such as age, genes, physiology, medical conditions, or personality characteristics that render a person prone to not sleeping. Precipitating factors are situations that trigger the onset of insomnia. Examples of precipitating factors are stressful life events like grief, divorce, or acute illness that initiate insomnia. Perpetuating factors sustain insomnia. For example, caffeine consumption, worrisome thoughts, or an irregular sleep schedule can maintain insomnia triggered by another event. Particular elements are not always placed in the same category, but are classified according to individual situations.

A schema that conceptualizes the course of insomnia based on the combination of predisposing, precipitating, and perpetuating factors is evolving. The initial depiction by Spielman, Caruso, & Glovinsky, (1987) presented combinations of factors contributing to the degree of insomnia "intensity" for four phases in the course of insomnia: preclinical, onset, short-term, and chronic (see Figure 1 for the graph). Further refinement of the schema by Walsh, Hartman, & Kowall (1994) portrayed factors in relation to "sleep disruption" rather than insomnia "intensity" for persons with normal sleep, short-term insomnia, and chronic insomnia (see Figure 2 for the graph). More recently, Spielman, Nunes, & Glovinsky (1996) presented the same schema with renamed phases and a new measure labeled sleep disturbance intensity assigning arbitrary units from 0 to 100 to this measurement (see Figure 3 for the graph). In these schemata, insomnia results when the sum of contributing factors exceeds a theoretical threshold, regardless of the label. The schema portrays the relative importance of predisposing, precipitating, and perpetuating factors in the development of chronic insomnia The basic concept has not changed with refinements, but the proposed model has not yet been tested.

The magnitude of contributing factors is a primary determinant of insomnia in this schema. A precipitating event compounds a person's predisposition for insomnia to bring a person over the threshold, hence the onset of insomnia. If the precipitating event subsides, insomnia will not continue unless perpetuating factors are great enough to keep a

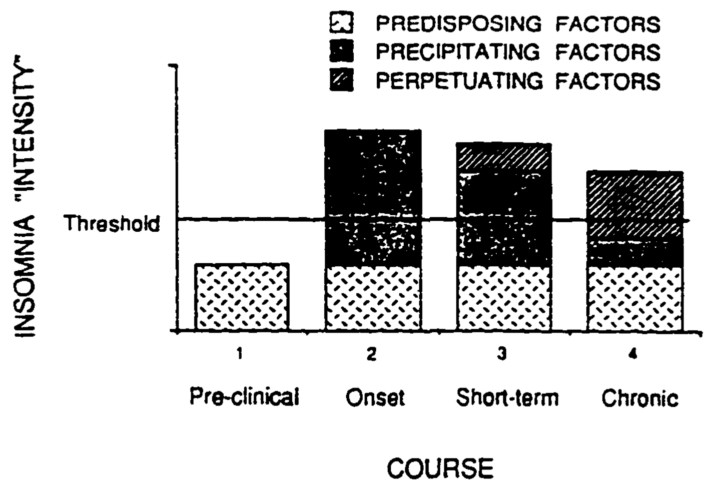

Figure 1. The course of insomnia. From "A Behavioral Perspective on Insomnia Treatment," by A. J. Spielman, L. S. Caruso, and P. B. Glovinsky, 1987, Psychiatric Clinics of North America, 10, p. 546.

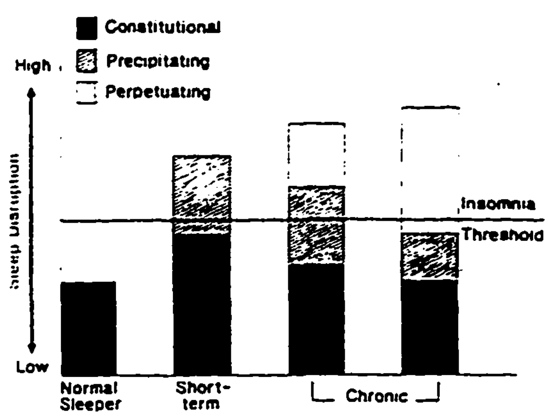

Figure 2. Conceptual factors contributing to insomnia. From "Insomnia," by J. K. Walsh, P. G. Hartman, and J. P. Kowall, in Sleep Disorders Medicine: Basic Science, Technical Considerations, and Clinical Aspects (p. 224), S. Chokroverty (Ed.), 1994, Boston: Butterworth-Heinemann.

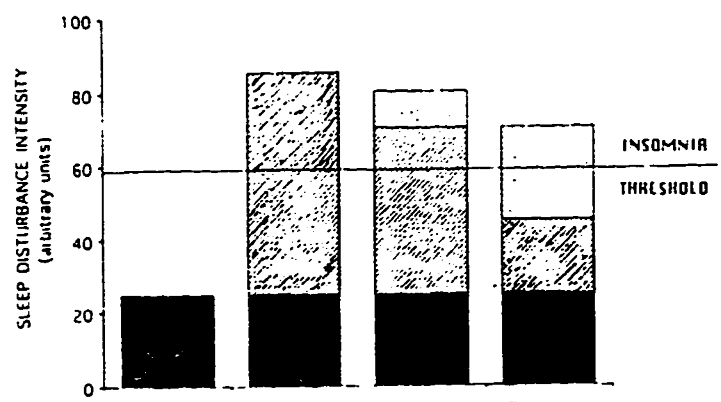

Figure 3. Development of chronic insomnia. Black bar = predisposing factors; hatched bar = precipitating factors; dotted bar = perpetuating factors. From "Insomnia," by A. J. Spielman, J. Nunes, and P. B. Glovinsky, 1996, Neurologic Clinics, 14, (3), p. 520.

person above the threshold for insomnia. Perpetuating factors are considered to have a major role in chronic insomnia. While perpetuating factors are likely present in short term insomnia, their role is relatively minor. An element which is present before a person experiences insomnia does not make a difference until the sum of elements is great enough, or the threshold decreases.

Sleep hygiene practices can be precipitating or perpetuating factors for insomnia. For example, caffeine consumption is associated with sleep onset insomnia. Caffeine consumption would be considered a precipitating factor if caffeine consumption was the major identifiable, contributing element preceding insomnia. If another factor (or factors) was considered the major contributing element (or elements), caffeine consumption might not be considered a precipitating factor but would be considered a perpetuating factor. Organizing factors contributing to insomnia helps prioritize their role and significance.

Conceptualizing the course of insomnia as dynamic using the outlined schema potentially explains the increased variations in sleep that occur with insomnia. Sleep varies significantly from night to night for middle age and older people with insomnia (Coates et al., 1981; Edinger, Marsh, McCall, Erwin, & Lininger, 1991). Sleep variability may be due to a decrease in the threshold for insomnia, a change in contributing factors, or both. Actions that increase a person's insomnia threshold and/or minimize contributing factors sufficiently would decrease the number of nights a person experiences insomnia.

<u>Summary</u>

Insomnia is a common problem for midlife women. The schema of insomnia proposed by Spielman (1986) is suggestive that insomnia is determined by the summation of predisposing, precipitating, and perpetuating factors. Reducing factors sufficiently, i.e. below the threshold for insomnia, would prevent insomnia.

Following recommended sleep hygiene practices decreases one set of behaviors potentially contributing to insomnia. Currently recommended sleep hygiene practices include avoiding caffeine, alcohol, and smoking; getting regular exercise; keeping a regular sleep-wake schedule; and having a relaxing bedtime routine. Following these suggestions may not be necessary for good sleepers, but are important for those with a propensity for insomnia.

This analytical study was focused on questions about sleep hygiene practices related to nocturnal sleep for midlife women that are not yet answered. To what extent do midlife women report following recommended sleep hygiene practices? Do sleep hygiene practices differ between women with insomnia and women without insomnia? How much do sleep hygiene practices vary from day to day? Do perceived and recorded indicators of sleep quality covary with sleep hygiene practices? Answering these questions will provide better understanding of the sleep hygiene practices of midlife women and their relationship to sleep patterns.

Chapter II: Methods

This descriptive, correlational study was a secondary analysis of data from a naturalistic study of midlife women. The purpose of the primary study was to differentiate subtypes of insomnia by physiological responses to stress. Subjects kept daily diaries of their sleep hygiene practices and perceptions of sleep for six days. Their nocturnal sleep was recorded during the six nights using polysomnographic equipment in their homes.

Sample

Subjects were selected from a convenience sample of paid volunteers responding to public announcements. Volunteers were screened by telephone for admission to the study. Basic criteria included that each woman (1) be 40 to 55 years of age, (2) have no major medical or psychiatric disease, (3) not work night shifts, and (4) have at least one ovary. Furthermore, women had to report experiencing insomnia for at least the three months prior to entry into the study. Before participating in somnography, potential subjects completed a two week Sleep Log (see Appendix A for the log) to determine whether or not their sleep was consistent with insomnia. Sleep Log criteria for insomnia were that the following be reported at least twice a week: sleep latency longer than 30 minutes, or two awakenings per night, or early morning awakening, and poor or very poor sleep quality. Criteria for the control group of no insomnia included no prolonged sleep onset, their "usual" number of awakenings, good or very good sleep quality, and feeling rested or very rested in the morning. Based on the telephone screening and Sleep Log, subjects were identified as insomnia or no insomnia. Subjects who completed the protocol were paid $200.00.

Setting

Sleep was monitored in each woman's current residence, such as apartment, condominium, or house. Monitoring sleep in their homes enabled them to continue with their usual activities and sleep in their customary environment. The intent was to monitor women's sleep in their natural environment.

Human Subjects

The protocol for the study was approved by the Human Subjects Review Committee of the University of Washington. Subjects signed consent forms voluntarily and had the opportunity to ask questions after explanation of the study. At any time during the process, subjects could withdraw without penalty. Compensation for partial completion was proportional to the number of nights data had been collected.

Demographics

Basic demographic data were collected from each subject on the Demographic and Supplemental Info form (see Appendix B for the form). Pertinent characteristics included age, ethnic identity, marital status, educational level, work status, yearly family income, history of physical disease, history of mental illness or substance abuse, presence of a painful condition, height, and weight.

Daily Diary

Women recorded their daily activities and perspectives on their sleep in the Daily Diary for six days. The diary had a journal format (see Appendix C for the diary). The women recorded the following sleep hygiene practices: number of cigarettes smoked (item # 10), servings of alcohol (item # 11), servings of caffeine (item # 12), and minutes of physical activity (item # 12) for each day. Women recorded their perspectives on the number of minutes to go to sleep (item # 14), number of awakenings (item # 14), feeling rested or tired in the morning (item # 16), and overall goodness or poorness of sleep (item # 17). Completing a diary every day required minimal recall, but did require that participants be able to read and write.

Sleep Hygiene Practice Index

A daily Sleep Hygiene Practice Index (SHPI) score was calculated for each woman for five days. One point was assigned for following each recommended sleep hygiene practice: (1) no smoking, (2) no alcohol, (3) no caffeine, (4) exercise, (5) regular bedtime, and (6) regular getting up time. The maximum score was six points per day. The minimum score was zero. A higher score reflected better sleep hygiene.

Sleep Disturbance Index

The Sleep Disturbance Index (SDI) was determined from the subjects' perspectives as reported in the Daily Diary. The SDI score reflected women's perceptions of sleep onset latency, awakenings, sleep quality, and restorative outcome. One point was assigned for each of the following indicators: (1) estimated time to go to sleep 30 minutes or more; (2) rating of overall sleep quality as "poor" or "very poor", (3) feeling "very tired" or "quite tired" in the morning, (4) one awakening and (5) a second awakening. The maximum score was five points per night, with a higher score reflecting poorer, more fragmented sleep.

Somnographic Sleep

Polysomnographic recordings of nocturnal sleep were made for six nights. A standard montage was used for recording EEG, electromyogram (EMG), and electrooculogram (EOG) continuously each night. The EEG was recorded from C3 and C4 to A2 and A1, respectively. The EOG was recorded with FP1 and FP2 as reference points for Right Outer Canthus (ROC) and Left Outer Canthus (LOC), respectively. The EMG was monitored from the chin to the left or right masseter muscle, depending on the subject's preference. Data from the first night of sleep monitoring was considered an adaptation night and not used for analysis.

Sleep was scored using standard criteria from the manual by Rechtschaffen & Kales (1968). "Lights Out", i.e. bedtime, was considered to be the time the women were connected to the computer and initiated the sleep recording. Specifically, "Lights Out" was defined as the beginning of the first epoch with more than 50% data. Sleep onset latency to Stage 1 (SOL 1) was calculated as the time period from "Lights Out" until the onset of Stage One or any other sleep stage was scored. Sleep onset latency to Stage 2 (SOL 2) was calculated as the time period from "Lights Out" until the onset of Stage Two sleep was scored. The end of the recording, i. e. getting up time, was defined as the end of the last epoch with more than 50% data. A technician reviewed all computer analyzed records. A second technician scored 10% of all epochs scored as wake, or Stage 1 or 2. If percent agreement was less than 90%, the technicians reviewed the record together and made any necessary adjustments. Overall interrater reliability was 92%.

The five somnographic sleep variables selected for analysis were SOL 1, SOL 2, minutes in Stage 0 after sleep onset, number of changes to Stage 0 after sleep onset, and mean duration of Stage 0 after sleep onset. SOL 1 and SOL 2 measured the times from Lights Out until sleep began using both Stages 1 and 2 as criteria for sleep onset. Minutes in Stage 0 provided a measure of awake time during the sleep period. Number of changes to Stage 0 indicated the frequency with which women returned to Stage 0 during the sleep period. The mean duration of Stage 0 was calculated by dividing the minutes in Stage 0 by the number of changes to Stage 0 and reflected the average awake time.

Regularity of bedtimes and getting up times were determined from actual times on the sleep recordings. Bedtime was considered to be "Lights Out" in the recording. Getting up time was the end of recorded sleep. If waveforms were not clearly present at the beginning or termination of the recording, the bedtime or getting up time was omitted. Differences in bedtimes were calculated between each night and the previous night with one exception. The second night was compared to night six, rather than night one. Implementation of the sleep monitoring protocol artificially delayed bedtime for an unknown number of women, particularly on the first night when women were learning the process. Although nights two and six were not sequential, bedtimes on night six were more likely to represent typical bedtimes than those on night one, because women were adjusted to the protocol by night six. The goal was to detect women who had consistent bedtimes each night and women who did not. "Regular" bedtimes and "regular" getting up times were both defined as a difference of 1/2 hour or less from the comparison night. Differences in getting up times were calculated in the same manner.

Procedure

The Project Director coordinated screening and data collection. Women who volunteered were screened first for eligibility. If women were eligible, the purpose and general plan were explained. If they agreed to participate, a Sleep Log was mailed to them. The Project Director evaluated the Sleep Logs and determined whether admission criteria were met. The Projector Director telephoned qualified subjects and asked them to participate in somnography. If women agreed, appointments were made to see the Project Director at the School of Nursing. Subjects signed the consent forms when they came to the School of Nursing. At this appointment, demographic information was obtained. Women were then scheduled for sleep monitoring.

A technician visited the women's homes six consecutive evenings for the sleep monitoring. On the first night, technicians arrived at least three hours before the subjects' usual bedtimes. This allowed time for the technician to review the process, set up the equipment, and place the electrodes. In addition, subjects had time to get used to the sensation of the monitoring equipment before attempting to sleep. On subsequent nights, technicians arrived at the women's homes about two hours prior to preferred bedtimes. In addition to placing electrodes, data from the previous night was transferred from the computer's hard drive to a laser disk or digital tape. Technicians checked the impedance of each electrode, set up the computer for recording, and evaluated the wave forms each evening.

Women were not requested to do any particular preparation for sleep monitoring except to discontinue sleep medications. They were asked to refrain from taking any medication that influenced their sleep for two weeks prior to and during the six days of sleep monitoring. Herbs were allowed. Otherwise women could continue their usual activities except for one to two hours each evening while technicians applied electrodes.

Polysomnographic recordings were made on one of two portable Toshiba computers with a Sleep Analyzing Computer (SAC) program from Oxford Instruments. The Patient Junction Box (PJB), which interfaced between the electrodes and the amplifier, was also, made by Oxford Instruments. The portable computer connected to a Medilog SAC Sleep/Respiration Interface, (amplifier), which in turn connected to a Power Supply Unit (power source). The power source and computer were plugged into a grounded surge protector. The computer rested inside a suitcase lined with aluminum foil and foam padding to minimize noise from the computer processing program. A small fan was seated inside the suitcase so that the internal temperature of the suitcase was not excessive for the computer when the suitcase lid was closed. The sound from the fan provided continuous background noise.

The women managed their own sleep recordings. Technicians reviewed written instructions with subjects. After leaving the homes, technicians were available by telephone. When the women were ready to sleep, they connected the PJB to a cable connected to the amplifier and started the recording. In the morning when they got out of bed, they stopped the recording and turned off the computer. If they got out of bed during the night, the women disconnected the PJB from the cable, but did not adjust the computer.

The women were, also, responsible for completing their Daily Diaries each day. Technicians instructed each woman individually about completing the diary by reviewing each group of items. Women were requested to complete the section about their sleep every morning and about their daily activities before going to bed each night. Because technicians were in the home each evening, they could answer questions about the diary. Providing comprehensive instructions and guidance during the data collection enhanced each woman's understanding about what information to record.

Data Analysis

Women included in this analysis had a minimum of five days of diary records and three nights of somnographic sleep measurements. Women who did not complete the sleep monitoring protocol with accompanying diary data were excluded from the analysis. Additionally, women who did not have a minimum of three nights of scored sleep reviewed by a technician were excluded from the analysis. The first night of sleep recording was not included in the data analysis.

Women were designated as members of the insomnia or no insomnia group based on enrollment criteria. Women in both groups (1) were 40 to 55 years old, (2) reported no major medical or psychiatric disease, (3) did not work night shifts, and (4) reported having at least one ovary. Women with insomnia, also, reported experiencing insomnia for at least the past three months and reported a sleep latency longer than 30 minutes, or two awakenings per night, or early morning awakening, and poor or very poor sleep quality at least two nights per week in the Sleep Log. Women with no insomnia reported they did not experience insomnia and reported sleep latencies less than 30 minutes, a "usual" number of awakenings, good or very good sleep quality, and feeling rested or very rested in the morning in the Sleep Log each night for two weeks. Women with and without insomnia met the same basic criteria and were separated into insomnia groups based on their Sleep Logs.

General characteristics of the insomnia and no insomnia groups were assessed by determining group frequencies for demographic characteristics. Body mass index was calculated from reported height and weight. Demographic variables were compared by group using t-tests for mean differences in continuous data and chi square tests for categorical data. Data analysis then was focused on each aim.

Aim 1 was to compare midlife women with and without insomnia on levels of sleep hygiene practice scores and frequencies of following recommended practices across five days. First, each woman's mean score for each sleep hygiene practice was calculated over the five days. A minimum of four measurements was required for calculating the mean score. In addition, a mean score for each of the five days and an average over the five days (minimum of four) was calculated for each sleep hygiene practice for each group. Differences in mean scores for each sleep hygiene practice between women with and without insomnia were compared using the Mann-Whitney test.

SHPI scores were used to evaluate combined sleep hygiene practices for women with and without insomnia. A daily SHPI score was calculated for each woman for each of the five days. A mean SHPI score for each group was calculated by day and for the average over the five days. A minimum of four measurements was required for inclusion in five day means. Differences in mean SHPI scores between women with and without insomnia were evaluated using one way analysis of variance (ANOVA).

The number of days that women followed recommended sleep hygiene practices was counted. Recommended practices included not smoking cigarettes, not drinking alcohol, not drinking caffeine, getting 30 minutes of exercise, maintaining a regular bedtime, and maintaining a regular getting up time. Furthermore, the number of women who followed sleep hygiene recommendations all five days was counted.

Confidence intervals were constructed to compare the proportions of women with and without insomnia who followed recommended sleep hygiene practices for five days. A 95% confidence interval was calculated for the difference in proportions between the groups for each sleep hygiene practice. The interval was based on the estimated standard error and the size of each group, as well as the difference in proportions. The 95% confidence interval was expected to contain the true population difference 95% of the time, that is, in 95 out of 100 samples. To test each null hypothesis, the interval was evaluated to determine whether or not it contained zero. If the confidence interval included zero, the null hypothesis was retained. If the interval did not include zero, the difference in proportions was considered to be statistically significant at the .05 level. A confidence interval was used as an alternative form of hypothesis testing because it, also, showed the uncertainty in the difference in proportions which was deemed pertinent to this descriptive study.

Aim 2 was to compare women with and without insomnia on the stability of specific sleep hygiene practices across five days. First, correlation coefficients were calculated with either Spearman's or Pearson's methods. Spearman's correlation coefficients were used for smoking cigarettes, servings of caffeine, servings of alcohol and minutes of exercise since the data distribution was not normal. To evaluate stability of bedtimes and getting up times, actual bedtimes and getting up times were used, not the differences from one night to the next. Pearson's correlation coefficients were used for bedtimes and get up times since the actual times were normally distributed. These correlations were the basis for calculations of stability.

Stability of each sleep hygiene practice over five days was evaluated for all women using the mathematical method described by Heise (1969). The Heise method used test retest measurements to separate dynamic change over time (stability) from change due to measurement error (reliability). Assumptions of this method were that (1) the relationship between the actual value of the variable and the measured value was constant over time, (2) measurement errors were not correlated with actual values, (3) measurement errors at different times were not correlated, (4) changes in the value of the variable were not correlated with the initial value of the variable, and (5) the rate of change in actual values was approximately constant. This method was based on path analysis and required a minimum of three measurements to separate stability from reliability.

Using the Heise method, a stability coefficient (S) was calculated from correlation coefficients (r) between measured values at three different times to quantify change between two points in time. The formulas for stability coefficients at times one and two ($S_{1,2}$), times two and three ($S_{2,3}$), and times one and three ($S_{1,3}$) were:

$$S_{1,2} = \frac{r_{1,3}}{r_{2,3}} \qquad S_{2,3} = \frac{r_{1,3}}{r_{1,2}} \qquad S_{1,3} = \frac{(r_{1,3})^2}{(r_{1,2})(r_{2,3})}$$

When a phenomenon was stable over time, the calculated coefficient would be closer to 1. Conversely, when the phenomenon was changing over time, the coefficient would be further from 1. The stability coefficient for a measured variable was theoretically equivalent to the stability of the actual variable at the same times.

The measure of reliability across three measurements ($R_{1,2,3}$), according to the Heise method, was, also, derived from correlations between the first and second measurement ($r_{1,2}$), the second and third measurement ($r_{2,3}$), and the first and third measurement ($r_{1,3}$). An additional assumption was that changes with the second and third measurement were not correlated. The formula for the reliability coefficient was:

$$R_{1,2,3} = \frac{(r_{1,2})(r_{2,3})}{r_{1,3}}$$

Theoretically, the reliability coefficient reflected the degree of error in measurements because change with time had been eliminated.

Analyzing a fourth set of measurements tested whether the assumptions for the Heise model were applicable to the given measurements. The computation was based on correlation coefficients between measurements at four times. The formula was:

$$(r_{14})\ (r_{23}) = (r_{13})\ (r_{24})$$

This calculation revealed whether serially-correlated errors were interfering with the reliability and stability estimates. If such errors were present, the two products would be different. If the model's assumptions are valid, the two products would be almost the same.

To evaluate stability of women's sleep hygiene practice scores using the Heise method, measurements from the five days were divided into two groups. The first grouping consisted of measurements from Days 2, 3, and 4. The second grouping included those from Days 4, 5, and 6. Mathematical calculations of reliability and stability were done for each grouping. The model's assumptions were tested for the first grouping by using Day 5 as the fourth measurement.

Standard deviations were used to compare the stability of sleep hygiene practices between women with and those without insomnia. A standard deviation based on five days was calculated for each sleep hygiene practice and for SHPI scores for each woman. A minimum of four days was required for calculating the standard deviation. A mean standard deviation was then calculated for the insomnia and no insomnia groups. The Mann-Whitney test was used to compare insomnia groups on mean standard deviations in sleep hygiene practice scores and SHPI scores. The Mann-Whitney is a nonparametric test for comparison of two groups and was selected because the mean standard deviations were not normally distributed.

Aim 3 was to compare midlife women with and without insomnia on the stability of perceived sleep across five nights. Recoding guidelines were necessary for ambiguous perceived sleep data. Specifically, rules were established for minutes to go to sleep and number of awakenings, because some women did not record definite numbers in their diaries. For women who gave a range on minutes to go to sleep or perceived awakenings, the highest number was entered. For the nine women who recorded perceived awakenings as "several", "few", "many" or "lots", numbers were assigned so that data for these women could be included. Women who recorded "several" and "few" awakenings were recoded as three awakenings. Women who recorded "many" or "lots" were recoded as five awakenings. The assigned numbers used for recoding the number of awakenings were considered to be conservative estimates. Other responses were specific, if recorded.

First, mean scores were calculated for each perceived sleep indicator and for the SDI. Perceived sleep indicators included restfulness, quality of sleep, sleep onset latency, and number of awakenings. The SDI was a composite score for degree of disturbed sleep. Since sleep perceptions were a major criteria for selection of subjects, differences between the groups were anticipated and, therefore, were not compared statistically. Mean scores for perceived sleep indicators provided a description of the degree of sleep disturbance for each group.

The stability of perceived sleep indicators was evaluated using the Heise method and standard deviations as described above for sleep hygiene practices. The Heise method was used to estimate reliability and stability of perceived sleep measurements across the five nights. Differences in mean standard deviations of perceived sleep measures between women with and without insomnia were tested using the Mann-Whitney test. This nonparametric test was again selected because the mean standard deviations were not normally distributed.

Aim 4 was to describe associations between sleep hygiene practices and perceived sleep over five days and nights. Associations were evaluated using correlation and multiple regression techniques. Five day mean scores for sleep hygiene practices and perceived sleep indicators were used for the calculations of correlation coefficients and regression equations. A minimum of four observations was required for calculation of mean scores for number of cigarettes smoked, servings of alcohol, servings of caffeine, and minutes of exercise. A minimum of three observations was required for mean scores for differences in bedtimes and getting up times from night to night. Spearman's method was used for calculating correlation coefficients because sleep hygiene practices were not normally distributed. While correlation determined the association between two variables, regression allowed simultaneous testing of sleep hygiene practices as predictors for each perceived sleep indicator.

Regression models included five sleep hygiene practices and four demographic variables as predictors and tested their relationship to four outcome measures. Review of regression coefficients in the model with all six sleep hygiene practices showed that beta coefficients for variation in bedtimes and variation in getting up times were almost the same. Therefore, variation in getting up time was omitted from the model to avoid problems of collinearity. The five sleep hygiene practices were (1) number of cigarettes smoked, (2) servings of caffeine, (3) servings of alcohol, (4) minutes of exercise, and (5) minutes variation in bedtimes. The four demographics were (1) age, (2) history of physical disease, (3) history of mental illness or substance abuse, and (4) presence of painful condition. These demographics were selected because they have been associated with insomnia. The outcome measures were self-reported (1) feelings of restfulness after sleep, (2) sleep quality, (3) minutes to go to sleep and (4) number of awakenings. Sample size limited the regression analysis to first order terms.

Development of each regression model was a process with multiple steps. Before building a model, plots of each sleep hygiene practice and each perceived sleep indicator were reviewed. Calculations were done with the SPSS Program Release 4.1 on a mainframe computer. A backward elimination procedure was used for testing models so that residual analysis could be done initially with all possible predictor variables entered into the model. By analyzing residuals first, modifications of predictor variables and outcome measures were completed before variable selection began. Removal of a predictor variable during model testing would not add to the residual error. With forward or stepwise procedures, introduction of new variables required analysis of residual error at each step in model testing. Therefore, backward elimination was preferred because the selection process was more efficient. For comparing full and reduced models, the selection criteria were the square of the sample correlation coefficient (R^2) and the F test statistic. A predictor was eliminated from the model if the variable was not statistically significant and contributed less than 2% to the variance, i.e. R^2. The significance level for the model was set at the $p < .05$ level. A predictor was included in the model if multiple predictors together were significant and the individual predictor added at least 2% to the variance.

Dummy variables were created for sleep hygiene practices because most practices had many "zero" values. Smoking was categorized into "yes" or "no". Servings of caffeine, servings of alcohol, and minutes of exercise were categorized into "low", "moderate", and "high", based on mean values. Low caffeine and alcohol were defined as a mean of zero servings. Moderate caffeine was a mean intake greater than zero, but less than two servings per day. High caffeine was a mean intake of two or more servings per day. Moderate alcohol was a mean intake greater than none, but not more than one serving per day. High alcohol was a mean of more than one serving per day. Low exercise was a mean of less than 20 minutes per day. Moderate exercise was a mean of 20 to 40 minutes per day. High exercise was a mean of 40 minutes or more per day. Mean variation in bedtime was categorized into "yes" or "no", referring to irregularity of bedtimes, by separating those with a mean variation more than 30 minutes per night from those with a mean variation less than 30 minutes. The "moderate" and "no" categories were coded as the reference group which, therefore, included women who did not smoke cigarettes, averaged less than two servings of caffeine per day, averaged less than one serving of alcohol per day, averaged 20 to

40 minutes of exercise per day, and had a regular bedtime. The use of dummy variables enabled testing of categories which differed from this reference group.

A logarithmic transformation was done for the outcome variable, perceived minutes to sleep onset, after residual analysis showed that the histogram of standardized residuals was not normally distributed. A natural log transformation to base *e* was used. To calculate regression equations, coefficients must be back-transformed with the e^x function. The log transformation removed positive skewness in the data distribution.

Aim 5 was to describe associations between a day's sleep hygiene practices and somnographic sleep variables the subsequent night for midlife women with and without insomnia. Associations between sleep hygiene practices and somnographic sleep variables were, also, evaluated using correlations and regression analysis. The third day of somnographic sleep monitoring was selected for analysis because more women had sleep records reviewed by human scorers that particular day. Again, Spearman's method was used for calculating correlation coefficients because sleep hygiene practices were not normally distributed. Development of each regression model used the same process and criteria as that described above for perceived sleep indicators.

Regression models included the same demographics and parallel sleep hygiene practices for predictor variables, but tested five different outcome measures. Sleep hygiene practices were those reported on the third day of sleep monitoring, except for irregularity of bedtime. Irregularity of bedtime was determined by the women's mean variation in bedtime from night to night for the five nights, rather than the difference in bedtime from the previous night. The outcome measures were SOL 1, SOL 2, minutes in Stage 0 after sleep onset, number of changes to Stage 0, and mean duration of Stage 0. Dummy variables for Day 3 were categorized by the same criteria used for the five day means. Consequently, the reference group included women who did not smoke cigarettes, who had one serving of caffeine, one serving of alcohol, and 20 to 40 minutes of exercise on Day 3, and maintained a regular bedtime over the five days.

Logarithmic transformation was done for the outcome variables, SOL 1, SOL 2, and minutes in Stage 0 after sleep onset, when residual analysis showed that histograms of standardized residuals were not normally distributed. A natural log transformation to base e was used requiring back-transformations with the e^x function to calculate regression equations. The log transformation removed positive skewness in the data distribution.

Chapter III: Results

The sample consisted of 121 women. Of these women, 92 experienced insomnia prior to the study, while 29 women did not. Of the 146 women enrolled in the study, 25 women were excluded because they did not have three or more nights of sleep data scored by a sleep analyzing program and reviewed by a technician. Analysis was focused on (1) women's sleep hygiene practices during five days of sleep monitoring, (2) their perceptions of nocturnal sleep during the same five days, (3) sleep measurements from one night with polysomnographic recordings scored by technicians, and (4) the association between sleep hygiene practices and perceived and recorded sleep indicators.

Relative to the 605 nights of data collection, very little data was missing. From the diaries, fifteen women had missing items on 1 of 5 days for cigarettes, caffeine, alcohol, and exercise. More perceived sleep indicators were missing, particularly for the last night. From the somnographic data, 20 bedtimes and 34 getting up times were missing. Calculations that used more than one bedtime or getting up time had higher percentages missing for a given individual.

Demographic Characteristics

In general, the sample included predominantly white, well-educated, working women with moderate to high income levels (see Table 1). Demographic differences between the insomnia and no insomnia groups were evaluated using the t-test for continuous data and Chi square for categorical data. Age was the only characteristic with a statistically significant difference between the two groups. Women in the insomnia group were two years older (Mean=47.1 years) than the women without insomnia (Mean=44.9 years). Although not statistically significant, more women with insomnia reported a history of mental illness or substance abuse. Another difference between the two groups was marital status. More women with insomnia were married or partnered (53%), while fewer women in the group were divorced or separated (35%). Women without insomnia showed the reverse. The proportion of women without insomnia who were divorced or separated was higher (52%) with fewer women married or partnered (38%). The differences between the two groups were not statistically significant.

TABLE 1. Midlife Women's Self-Reported Demographic Characteristics.

Demographics:	Insomnia (n=92)	No Insomnia (n=29)
Mean Age in Years:*	47.1	44.9
Ethnic Identity:		
American Indian	1 (1%)	0
Asian	2 (2%)	4 (14%)
Black	9 (10%)	0
White	73 (79%)	24 (83%)
Hispanic	1 (1%)	1 (3%)
Marital Status:		
Never Married	7 (8%)	2 (7%)
Married\Partnered	49 (53%)	11 (38%)
Divorced\Separated	32 (35%)	15 (52%)
Widowed	1 (3%)	1 (3%)
Level of Education:		
Completed HS	6 (7%)	0
Some College	26 (28%)	10 (35%)
Completed College	21 (23%)	7 (24%)
Some Grad School	17 (19%)	4 (14%)
Graduate Degree	19 (21%)	8 (28%)
Work Status:		
Working:	76 (83%)	25 (86%)
Not Working:	10 (11%)	4 (14%)
Hx Physical Disease:	13 (14%)	4 (14%)
Hx Mental Illness or Substance Abuse:	13 (14%)	1 (3%)
Painful Condition:	32 (45%)	13 (45%)
Family Income\Year:		
less than $ 9,000:	4 (4%)	0
$ 9,000 to 19,999:	16 (17%)	4 (14%)
$20,000 to 29,999:	17 (18%)	9 (31%)
$30,000 to 39,999:	14 (15%)	3 (10%)
$40,000 to 49,999:	10 (11%)	3 (10%)
more than $50,000:	25 (27%)	9 (31%)
Mean Height (Inches):	66 (61-71)	65 (61-70)
Mean Weight (Pounds):	157 (100-285)	149 (110-240)
Body Mass Index:	26 (17-41)	25 (20-39)

Note: * t value= 2.51, df=115, $p < .05$. The range for Height, Weight, and Body Mass Index is in parenthesis.

Levels of Sleep Hygiene Practices

Very few women (less than 10%) with or without insomnia reported smoking cigarettes (see Table 2). These women were almost exclusively non-smokers. A minority of women in either group reported high caffeine consumption, i.e., more than three servings per day (13% of women with insomnia and 24% of women without insomnia). Hence more women with insomnia, compared to without, had a low caffeine intake. The women in this study were not, by their own report, heavy drinkers of alcohol. Only 12-13% of both groups reported that they drank two or more servings of alcohol per day on average. About one-third of women in each group were, by their self-report, in a low or no exercise category. Indeed, about one half of each group with and without insomnia reported 30 minutes or more of exercise, on the average, per day with the remainder in between. Thirteen percent of women with insomnia varied their daily bedtime by 60 minutes or more compared to 28% of women without insomnia. As well, fewer women with insomnia (22%) than without (39%) had getting up times which varied by 60 minutes or more. Forty to forty-five per cent of women in both groups varied their bedtimes between 30 and 60 minutes. More women with insomnia (37%) than without (17%) varied their getting up times by 30 to 60 minutes. The missing cases for averaged variations in bedtimes and getting up times were women who had less than four nights of valid data.

Each reported sleep hygiene practice varied over a considerable range. The minimum value for every reported practice was zero in both groups. The number of cigarettes smoked ranged from 2 to 35 per day. Servings of caffeine consumed ranged from 1 to 9 per day. Servings of alcohol consumed ranged from 1 to 7 per day. Duration of exercise ranged from 5 minutes to 8 hours per day. Night to night variations in bedtimes ranged from less than 30 seconds to 6.8 hours. Day to day variations in getting up times ranged from none to 5.7 hours. The ranges show the magnitude of variation for these women's practices.

TABLE 2. Frequency of Five Day Mean Levels of Sleep Hygiene Practices by Group.

Practice:	Insomnia (n=92)	No Insomnia (n=29)
Smoking Cigarettes:[a]		
0 pack/day	86 (94%)	27 (93%)
< 1 pack/day	4 (4%)	2 (7%)
1 pack/day	2 (2%)	0
Drinking Caffeine:[a]		
0 servings/day	17 (19%)	4 (14%)
1 serving/day	25 (27%)	3 (10%)
2 servings/day	21 (23%)	7 (24%)
3 servings/day	17 (19%)	8 (28%)
> 3 servings	12 (13%)	7 (24%)
Drinking Alcohol:[a]		
0 servings/day	48 (52%)	9 (31%)
1 serving/day	32 (35%)	16 (55%)
2 servings/day	7 (8%)	3 (10%)
3 servings/day or more	4 (4%)	1 (3%)
Exercising:[a]		
0 minutes/day	7 (7%)	2 (7%)
< 15 minutes/day	21 (23%)	6 (21%)
15 - 29 minutes/day	24 (26%)	6 (21%)
30 minutes or more/day	40 (44%)	15 (52%)
Variation in Bedtimes:[b]		
< 30 minutes/day	25 (27%)	6 (21%)
30 - 59 minutes/day	41 (45%)	12 (41%)
60 - 119 minutes/day	11 (12%)	6 (21%)
120 minutes/day or more	1 (1%)	2 (7%)
Missing Cases	14 (15%)	3 (10%)
Variation in Get Up Times:[b]		
< 30 minutes/day	14 (15%)	7 (24%)
30 - 59 minutes/day	34 (37%)	5 (17%)
60 - 119 minutes/day	18 (20%)	9 (31%)
120 minutes/day or more	2 (2%)	2 (7%)
Missing Cases	24 (26%)	6 (21%)
SHPI Score:[c]		
< 2 points	4 (4%)	3 (10%)
2 - 4 points	51 (55%)	15 (52%)
> 4 points	13 (14%)	5 (17%)
Missing Cases	24 (26%)	6 (21%)

Note: [a]Self-recorded in the Daily Diary. [b]From polysomnographic recording. [c]SHPI score equals one point for each of the following: no smoking, no caffeine, no alcohol, 30 minutes of exercise, bedtime varied less than 30 minutes, and getting up time varied less than 30 minutes. Mean levels calculated with a minimum of 4 out of 5 days.

Drinking caffeine was the only practice significantly different between the groups when averaging sleep hygiene practice scores for five days (see Table 3). Women with insomnia drank less caffeine than women without insomnia (Mann-Whitney U=951, p=.02). Mean SHPI scores for women with insomnia were 0.2 points higher (3.4) than for women with no insomnia (3.2). This difference was not meaningful. Indeed, one way analysis of variance comparing five day mean SHPI scores for women with and without insomnia showed no significant difference between the groups [F (1,89) = 1.39, $p > .05$]. Group means for sleep hygiene practices changed very little from day to day, but the standard deviations for all practices were large relative to the mean.

Recommended Sleep Hygiene Practices

Of special interest was whether women, particularly those with chronic insomnia, followed recommended sleep hygiene practices on a daily basis. The following sleep hygiene practices were evaluated: no cigarette smoking, no caffeine consumption, no alcohol intake, exercise 30 minutes per day, and a regular bedtime and getting up time (less than 30 minutes variation). These practices are advised to facilitate sleep.

More women with insomnia than without abstained from alcohol for five days, but other differences between the two groups were not significant. The percentages of women who refrained from smoking cigarettes, or drinking caffeine, or alcohol over all five days are obvious in Table 2. Less than 20% of the women in both groups reported consuming no caffeine. More women with insomnia reported abstaining from alcohol (52%) than women without insomnia (31%). The difference in the proportions reporting no alcohol consumption was significant with a 95% Confidence Interval = .01 to .41. The five day averages in Table 2 do not reveal how many women exercised 30 minutes, had a regular bedtime, or a regular getting up time each day for five days. Less than 25% of women in both groups exercised 30 minutes each day for five days.

TABLE 3. Means (SD) for Women's Sleep Hygiene Practice and SHPI Scores.

	Day 2	Day 3	Day 4	Day 5	Day 6	5 Day Average
Number of Cigarettes						
Insomnia	0.8 (4.10)	1.0 (4.99)	1.1 (4.95)	1.0 (4.60)	1.1 (5.09)	1.01 (4.72)
No Insomnia	0.5 (2.79)	0.6 (2.97)	0.5 (2.79)	0.6 (3.16)	0.7 (3.17)	0.6 (2.97)
Servings of Caffeine*						
Insomnia	1.6 (1.65)	1.6 (1.71)	1.7 (1.53)	1.5 (1.57)	1.5 (1.53)	1.6 (1.45)
No Insomnia	2.3 (1.85)	2.3 (1.97)	2.4 (1.80)	2.3 (1.65)	2.3 (1.80)	2.32 (1.60)
Servings of Alcohol						
Insomnia	.3 (.70)	.3 (.83)	.4 (.77)	.5 (1.03)	.3 (.72)	.4 (.67)
No Insomnia	.3 (.59)	.6 (.95)	.5 (.91)	.5 (.74)	.6 (1.35)	.5 (.65)
Minutes of Exercise						
Insomnia	44 (59.2)	37 (50.1)	33 (46.8)	29 (39.6)	36 (66.7)	36 (37.4)
No Insomnia	52 (59.4)	42 (46.7)	43 (73.1)	32 (50.5)	35 (60.0)	41 (35.2)
Minutes Variation in Bedtimes						
Insomnia	40 (39.3)	46 (43.7)	41 (35.0)	46 (37.0)	39 (29.7)	43 (21.6)
No Insomnia	55 (47.5)	53 (79.1)	63 (66.1)	51 (53.1)	67 (52.1)	56 (36.1)
Minutes Variation in Get Up Times						
Insomnia	58 (52.7)	48 (52.5)	53 (64.1)	47 (44.0)	47 (52.5)	50 (29.3)
No Insomnia	73 (64.8)	55 (63.4)	48 (56.0)	58 (70.2)	52 (54.2)	57 (37.7)
SHPI Score						
Insomnia	3.5 (1.13	3.5 (1.00)	3.2 (1.20)	3.2 (1.22)	3.4 (1.19)	3.4 (0.80)
No Insomnia	3.5 (1.03)	3.4 (1.26)	3.2 (1.09)	3.0 (1.23)	2.9 (1.33)	3.2 (1.00)

Note. Insomnia (n=92). No Insomnia (n=29). * $p < .05$ on Mann Whitney test. SHPI score = 1 point for no smoking, no caffeine, no alcohol, 30 min. of exercise, regular bedtime, and regular getting up time. Maximum score per day is six points. The SD is given for the five day average.

Fewer women with insomnia (13%) than without insomnia (24%) exercised each day. For women with and without insomnia, only 2-3% had a regular bedtime and 8-10% had a regular getting up time each day for five days. Other women followed sleep hygiene guidelines, but not all five days.

Figures 4, 5, 6, 7, & 8 show the number of days that women in both groups reported no caffeine intake, no alcohol intake, 30 minutes of exercise, and demonstrated regular bedtimes and regular getting up times, respectively. Women with and without insomnia demonstrated similar patterns for maintaining a regular bedtime (See Figure 7). More than 65% of women in both groups had regular bedtimes for 1, 2, and 3 nights (see Figure 7). Patterns for the other practices showed more variation between the two groups over the five days.

Subtle trends are visible in the bar graphs with the number of days women reported drinking caffeine or alcohol, exercising 30 minutes, and maintaining a regular getting up time. More women with insomnia (72%) than without (47%) reported caffeine intake everyday. Most women with and without insomnia reported no alcohol intake for as many as 4 or 5 days (see Figure 5). Therefore, few women with insomnia (22%) or without insomnia (28%) reported from none up to three days without alcohol consumption. The number of days with 30 minutes of exercise varied for women in both groups. Less than half of the women with insomnia (38%) and without insomnia (45%) reported exercising 30 minutes for 3 days or more (see Figure 6) with a small percentage in both groups reported exercising 30 minutes for 1 day (20%) or 2 days (15%). Approximately 58% of women in both groups had regular getting up times for 1, 2, or 3 mornings, but the groups showed differing tendencies (see Figure 8). More women with insomnia (25%) than without (10%) had 3 mornings with a regular getting up time, while more women without insomnia (31%) than with insomnia (12%) had 1 morning with a regular getting up time. Less than 20% of women in either the insomnia or no insomnia group had 4 or 5 nights with regular bedtimes or getting up

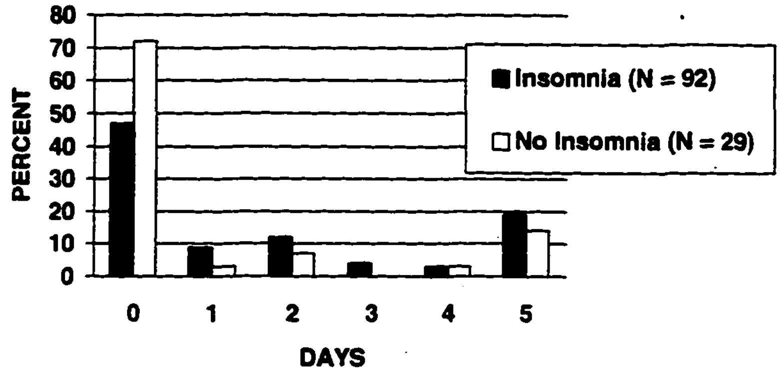

Figure 4. Percent of Women by Group According to Number of Days with No Caffeine Intake.

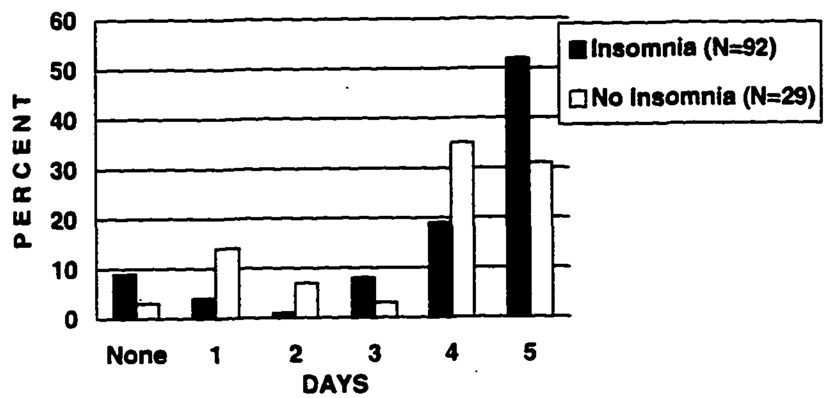

Figure 5. Percent of Women by Group According to Number of Days with No Alcohol Intake.

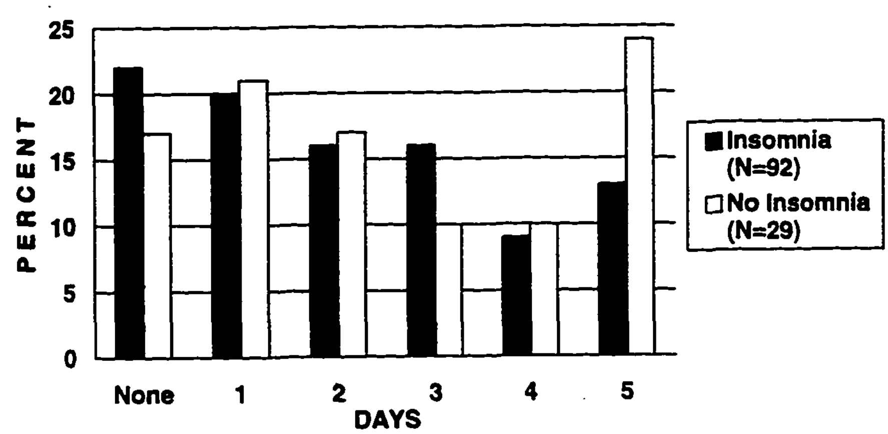

Figure 6. Percent of Women by Group According to Reported Number of Days with 30 Minutes of Exercise.

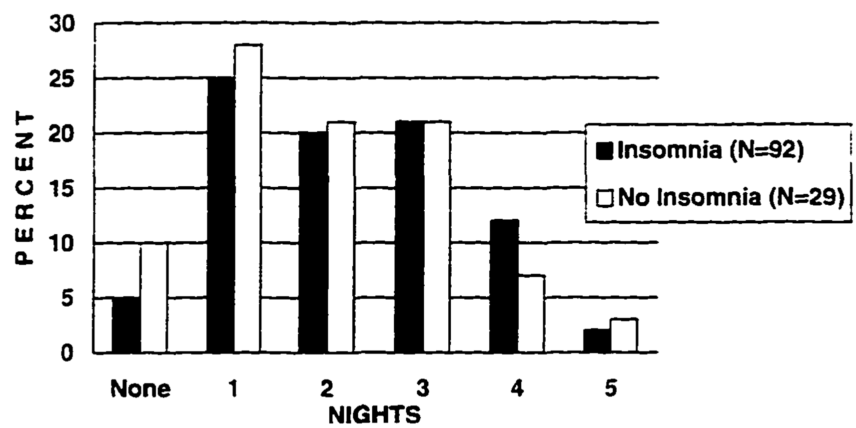

Figure 7. Percent of Women by Group According to Number of Nights with Regular Bedtime (< 30 minutes variation by somnography).

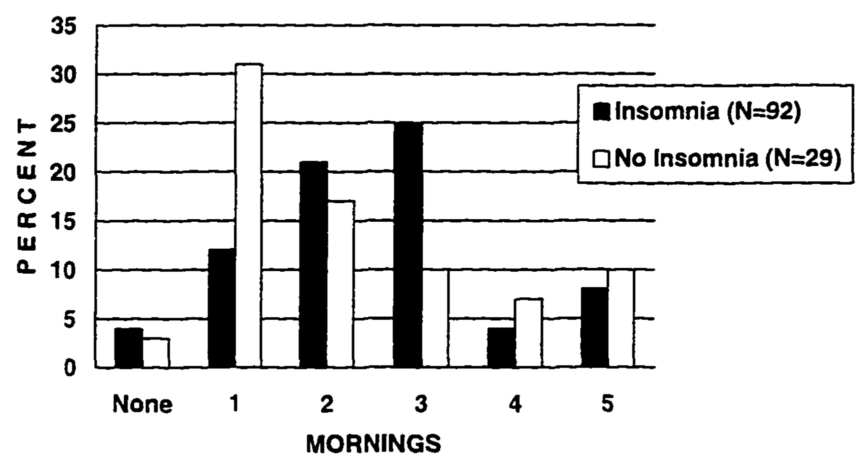

Figure 8. Percent of Women by Group According to Number of Mornings with Regular Getting Up Time (< 30 minutes variation by somnography).

times. No particular pattern differentiated the insomnia group from the no insomnia group for any practice.

Stability of Sleep Hygiene Practices

Reported cigarette smoking and caffeine consumption were stable for the five days as estimated by the Heise method (see Table 4). For the eight smokers, reported number of cigarettes smoked was highly correlated from one day to the next leading to high stability and reliability coefficients. Correlations for reported servings of caffeine were moderately high. Calculated stability coefficients for reported caffeine consumption were high, indicating day to day changes in caffeine consumption were very small. Stability coefficients were better indicators of variability than correlation coefficients for reported smoking and caffeine consumption.

Reported alcohol consumption and exercise were not as stable as smoking and caffeine intake over the five days (see Table 4). Day to day correlations for both reported alcohol consumption and minutes of exercise were moderate. Stability coefficients for reported alcohol consumption indicate small changes from one day to the next. Stability coefficients for reported minutes of exercise showed more variability from one day to the next. Recall that the further the stability coefficient is from one (higher or lower), the greater the variation. Reliability coefficients for reported alcohol consumption and exercise are lower on Days 4, 5, 6 than Days 2, 3, and 4.

Bedtimes and getting up times from somnographic recordings showed lower stabilities than the other practices (see Table 4). Correlation coefficients were moderate for recorded bedtimes and getting up times. Recorded getting up times showed greater variability than recorded bedtimes as determined by stability coefficients. Reliability coefficients for bedtimes were consistent in both groupings assessed. In contrast, the reliability coefficient for getting up times was higher on Days 4, 5, and 6 than Days 2, 3, and 4.

TABLE 4. Stability of Midlife Women's Sleep Hygiene Practices.

	Cigarettes[a]	Caffeine[a]	Alcohol[a]	Exercise[a]	Bedtime[b]	Get Up Time[b]
Stability Coefficients:						
Days $_{2,3}$	.93	1.00	.94	.83	.75	.75
Days $_{3,4}$	1.00	.93	.80	.83	.89	.65
Days $_{2,4}$	.92	.93	.75	.69	.67	.49
Days $_{4,5}$	1.00	.95	1.12	1.10	.86	.58
Days $_{5,6}$	.86	.98	1.11	1.23	.83	.58
Days $_{4,6}$	.86	.93	1.25	1.35	.71	.34
Reliability Coefficients:						
Days $_{2,3,4}$	1.00	.80	.62	.60	.62	.83
Days $_{4,5,6}$	1.00	.86	.41	.36	.66	1.06
Correlation Coefficients:						
Days $_{2,3}$	.93	.80	.58	.50	.47	.62
Days $_{3,4}$	1.00	.74	.49	.50	.55	.54
Days $_{4,5}$	1.00	.81	.46	.40	.56	.62
Days $_{5,6}$	.86	.84	.46	.44	.55	.62
Days $_{2,4}$	.93	.74	.47	.42	.41	.40
Days $_{2,5}$	.93	.72	.51	.43	.49	.53
Days $_{3,5}$	1.00	.72	.55	.40	.57	.49
Days $_{4,6}$	.86	.79	.51	.49	.47	.36
Test Model Assumptions:						
Days $_{2,3,4,5}$	.929	.538	.258	.215	.271	.286
	-.927	-.535	-.253	-.167	-.238	-.196
	.002	.003	.005	.048	.033	.090

Note. N = 121. Model is Heise's method (1969). [a]Correlation coefficients are Spearman's method. [b]Correlation coefficients are Pearson's method.

Assumptions of the Heise method were valid for sleep hygiene practice measurements. The assumptions that no correlated errors were interfering with the data set were tested by using a fourth set of measurements from Day 5. Differences between the two products, $(r_{2,5})(r_{3,4})$ and $(r_{2,4})(r_{3,5})$, were less than .09 for all practices (see Table 4). These very small differences indicated that assumptions were valid in this data set.

Using group mean standard deviation comparisons, women with insomnia had less variation on most sleep hygiene practices than women with no insomnia (see Table 5). The differences between the two groups for servings of alcohol and variations in bedtimes were statistically significant at the $p < 0.05$ level. Women with insomnia had higher mean standard deviations on number of cigarettes smoked and SHPI scores than women without insomnia, but the differences were not statistically significant. A higher mean standard deviation indicates greater variation during the five days.

TABLE 5. Comparisons of Women's Five Day Mean Standard Deviation on Sleep Hygiene Practices.

	Mean Standard Deviation	Mann-Whitney U value	P value
Number of Cigarettes			
Insomnia	.15	1320	.83
No Insomnia	.07		
Servings of Caffeine			
Insomnia	.58	1099	.15
No Insomnia	.76		
Servings of Alcohol			
Insomnia	.33	1035	.05
No Insomnia	.54		
Minutes of Exercise			
Insomnia	28	1301	.84
No Insomnia	34		
Variations in Bedtimes			
Insomnia	29	715	.02
No Insomnia	43		
Variations in Get Up Times			
Insomnia	42	777	.96
No Insomnia	43		
SHPI Scores			
Insomnia	.86	655	.24
No Insomnia	.73		

Note. Insomnia (n=92). No Insomnia (n=29).

<u>Stability of Perceived Sleep</u>

As expected, women with insomnia displayed values conveying poorer perceived sleep than women without insomnia (see Table 6). The indicators for perceived sleep were self-reported perceptions of feeling rested after sleep, sleep quality, SOL, and number of awakenings. Higher values reflect more disturbed sleep as defined by tiredness, poor quality sleep, prolonged SOL, and awakening(s). Women with insomnia reported more nights with poor quality sleep, tiredness, or both, as well as prolonged SOL and awakenings than women with no insomnia (see Figures 9 through 15). Women with insomnia had fewer nights with quality sleep with 25% reporting they did not experience one night with quality sleep (see Figure 16). More than 35% of women with no insomnia reported quality sleep all five nights. These characteristics were major selection criteria for enrollment into the study.

TABLE 6. Five Day Means (SD) for Women's Perceived Sleep Indicators.

Indicator:	Insomnia (n=92)	No Insomnia (n=29)
Feel Rested after Sleep[a]	2.2 (0.6)	1.7 (0.5)
Quality of Sleep[b]	2.8 (0.7)	1.9 (0.5)
Sleep Onset Latency (minutes)	25.2 (14.2)	12.9 (5.8)
Awakenings per Night (number)	2.8 (1.0)	1.2 (0.7)
SDI Score[c]	2.5 (0.8)	1.3 (0.8)

<u>Note:</u> Indicators were self-recorded in a Daily Diary. [a]On a 4-point scale, 1 is the most rested and 4 is the most tired. [b]On a 5-point scale, 1 is the highest quality and 5 is the poorest quality. [c]Scoring: 1 point for tired, 1 for poor quality, 1 point for SOL > 30 minutes, and 0 - 2 points for awakenings. Maximum score per day is five.

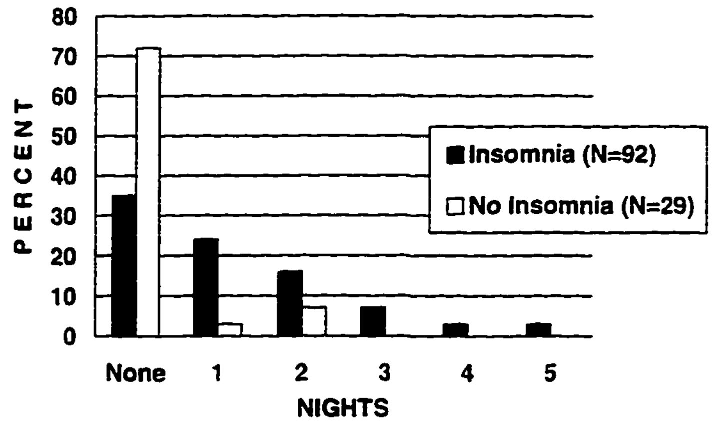

Figure 9. Percent of Women by Group According Number of Nights with Reported Poor Quality Sleep.

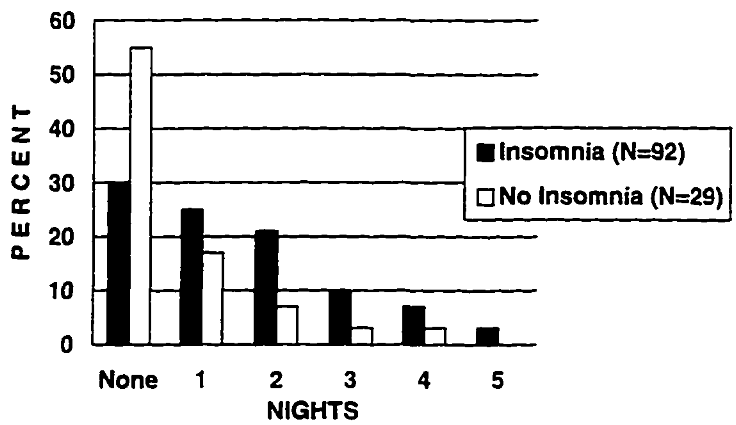

Figure 10. Percent of Women by Group According to Number of Nights Reported Being Tired.

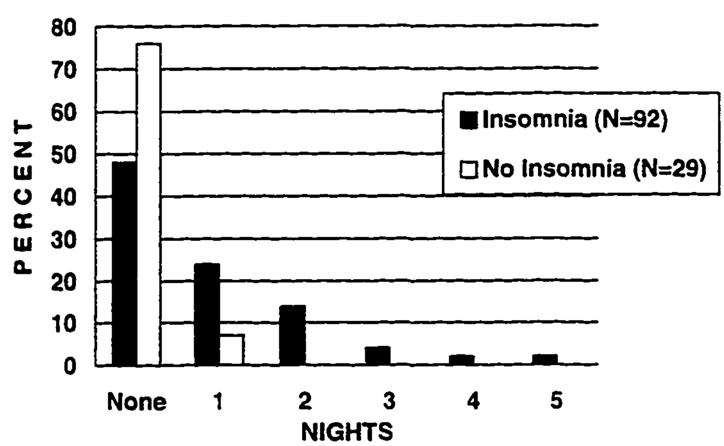

Figure 11. Percent of Women by Group According to Number of Nights with Reported Poor Quality Sleep & Being Tired.

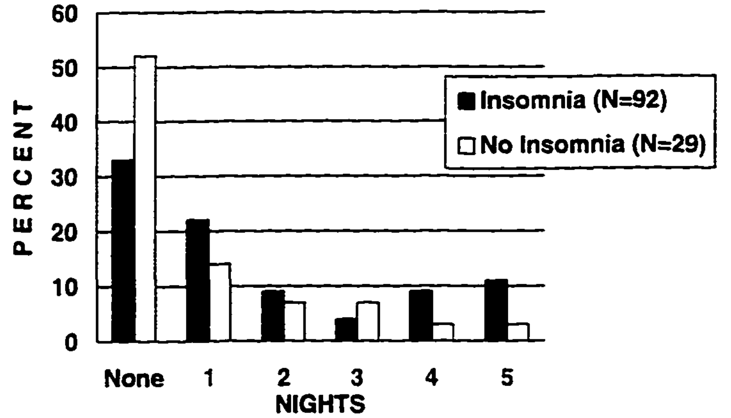

Figure 12. Percent of Women by Group According to Number of Nights Reported Sleep Onset Latency 30 Minutes or More.

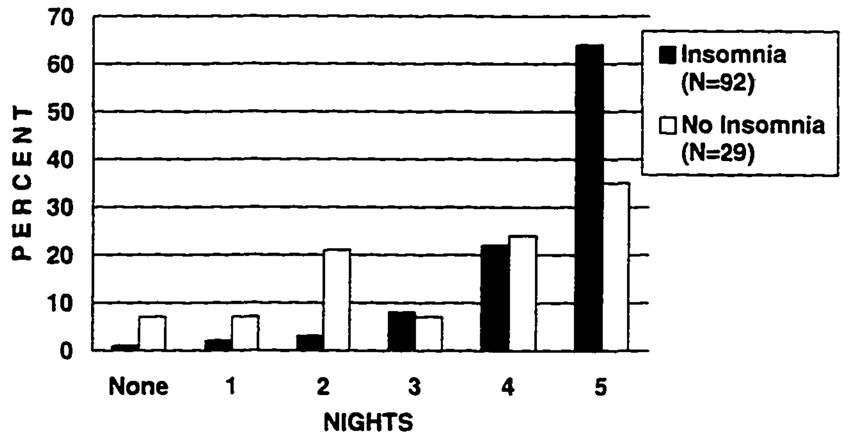

Figure 13. Percent of Women by Group According to Number of Nights Perceived Awakening Once or More.

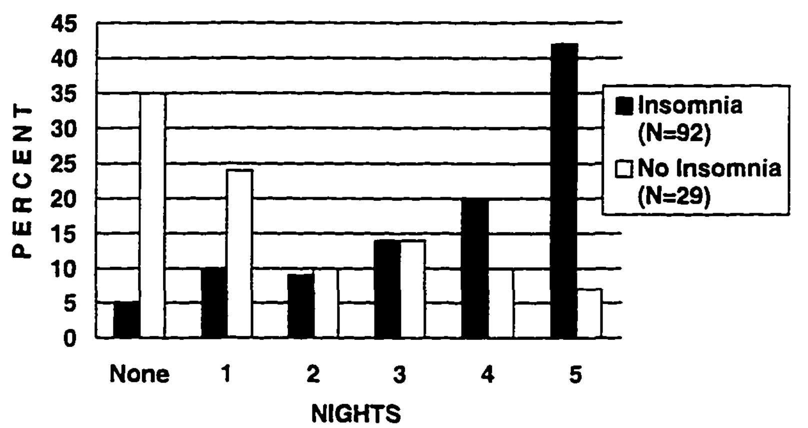

Figure 14. Percent of Women by Group According to Number of Nights Perceived Awakening Twice or More.

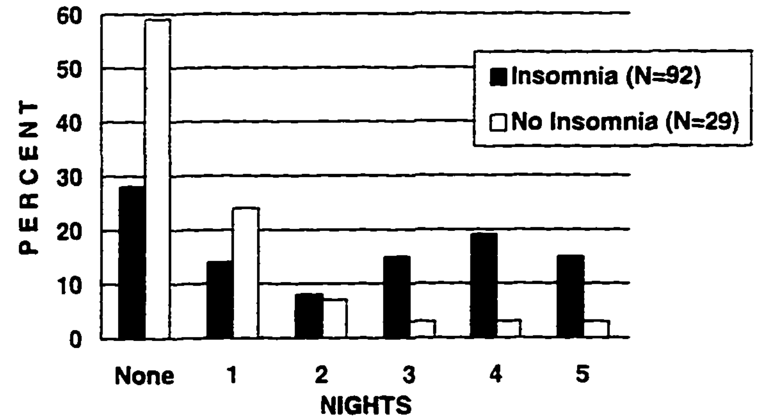

Figure 15. Percent of Women by Group According to Number of Nights Reported Awakening Three or More Times.

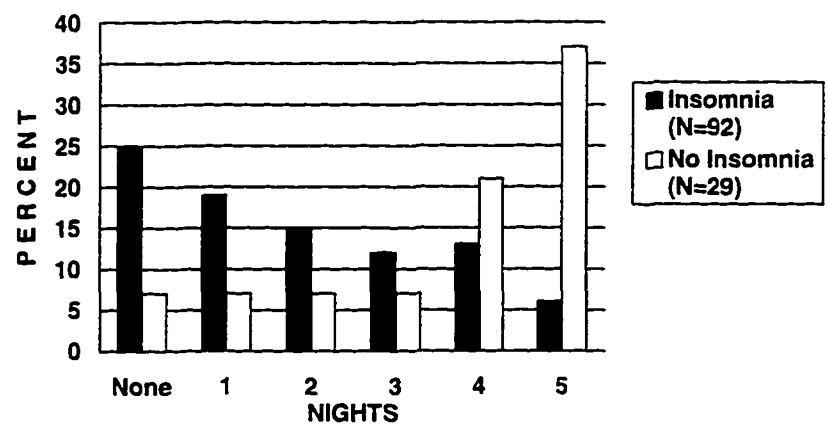

Figure 16. Percent of Women by Group According to Number of Nights Reported Quality Sleep.

The feeling of restfulness after sleep was not stable over the five nights (see Table 7). Correlation coefficients for feeling rested were moderately low leading to low to moderate reliability coefficients. The reliability estimate was particularly low Nights 2, 3, and 4. Stability coefficients for restful sleep marked a high degree of change early in the five days with more stability at the end of the five days.

Perceived sleep quality was somewhat stable over the five nights (see Table 7). Correlations were moderate. Like restfulness, the reliability coefficient for sleep quality was lower during the first three days and higher, the latter three. Unlike restfulness, sleep quality was more stable on Nights 2, 3, and 4, but less stable on Nights 4, 5, and 6.

TABLE 7. Stability of Women's Perceived Sleep Indicators.

	Feel Rested	Sleep Quality	Sleep Onset Latency	Number of Awakenings
Stability Coefficients:				
Nights $_{2,3}$	1.34	.92	.87	.82
Nights $_{3,4}$	1.25	.96	.82	.84
Nights $_{2,4}$	1.68	.88	.71	.69
Nights $_{4,5}$	.98	.76	.90	.93
Nights $_{5,6}$	1.00	.88	.90	.85
Nights $_{4,6}$	.98	.66	.81	.79
Reliability Coefficients:				
Nights $_{2,3,4}$	.25	.54	.78	.85
Nights $_{4,5,6}$	.48	.74	.71	.80
Correlation Coefficients:				
Nights $_{2,3}$	.33	.50	.68	.70
Nights $_{3,4}$	.31	.52	.64	.71
Nights $_{4,5}$	.47	.56	.64	.74
Nights $_{5,6}$	.48	.64	.64	.68
Nights $_{2,4}$	.42	.48	.56	.59
Nights $_{2,5}$	.25	.44	.44	.59
Nights $_{3,5}$	.37	.57	.54	.73
Nights $_{4,6}$	.47	.49	.58	.63
Test Model Assumptions:				
Nights $_{2,3,4,5}$	.156	.271	.300	.427
	-.078	-.229	-.283	-.422
	.078	.042	.017	.005

Note. N = 121. Model uses Heise's method (1969). Correlation coefficients are Spearman's method.

Perceived SOL and number of awakenings were not stable over the five nights (see Table 7). Correlation coefficients were moderate to moderately high for both measures. Stability coefficients indicated variability in SOL and awakenings each night. SOL was less variable on Nights 4, 5, and 6, but still showed change. Reliability coefficients were higher for SOL and awakenings than for rest or sleep quality.

The Heise model assumptions were valid for perceived sleep indicators (see Table 7). Measures from Night 5 were used to test assumptions. Very small differences (less than .078) resulted from the difference between product of $(r_{2,5})$ $(r_{3,4})$ and $(r_{2,4})$ $(r_{3,5})$. Again, the very small differences indicate the model's assumptions were appropriate for these data.

Women with insomnia had greater variation in all perceived sleep indicators as measured by standard deviations than women with no insomnia (see Table 8). The Mann-Whitney test compared mean standard deviations for perceived sleep indicators between the two groups. The differences in sleep quality and SOL were statistically significant ($p < .01$), but differences for restfulness and awakenings were not.

TABLE 8. Comparison of Women's Five Day Mean Standard Deviation on Perceived Sleep.

	Mean Standard Deviation	Mann-Whitney U value	P Value
Feel Rested[a]			
Insomnia	.55	1225	.50
No Insomnia	.49		
Sleep Quality[b]			
Insomnia	.71	815	.002
No Insomnia	.47		
Sleep Onset Latency			
Insomnia	14.1	855	.005
No Insomnia	5.8		
Number of Wakes			
Insomnia	.97	982	.07
No Insomnia	.73		

Note. Insomnia (n=92). No Insomnia (n=29). [a]On a 4-point scale, 1 is the most rested and 4 is the most tired. [b]On a 5-point scale, 1 is the highest quality and 5 is the poorest quality.

Sleep Hygiene Practices and Perceived Sleep

Correlations between mean sleep hygiene practices and mean perceived sleep indicators were very small or nil (see Table 9). Variation in bedtime was inversely correlated with sleep quality and number of awakenings at a low, but statistically significant, level ($p < .05$). In other words, a larger difference in bedtime from night to night was associated with poorer sleep quality. Surprisingly, greater variations in bedtimes were associated with fewer awakenings. The SHPI score showed a very small inverse correlation with perceived feelings of restfulness after sleep, but no correlation with other indicators or SDI scores.

TABLE 9. Correlations between Women's Sleep Hygiene Practices and Perceived Sleep.

	Feel Rested	Sleep Quality	Perceived SOL	Awakening	SDI Score
Practice:					
Cigarettes	.03	.05	.01	.02	.03
Caffeine	.06	-.04	-.09	.04	-.11
Alcohol	.01	.03	.06	.04	.03
Exercise	-.08	-.04	-.06	-.02	.03
Bedtime Variations	-.14	-.17*	-.05	-.20*	-.15
Get Up Time Variations	.04	.02	.01	-.10	.05
SHPI Score	-.10	-.04	-.05	.00	.01

Note. Spearman's correlations. * $p < .05$.

Low caffeine, high caffeine, high alcohol, and history of physical disease were significant predictors of perceived restfulness after sleep (see Table 10). Both high and low caffeine intake were inversely associated with feeling rested after sleep. Thus, women who averaged two cups of caffeine or more per day or had no caffeine intake were less rested after sleeping when compared to women who averaged one serving of caffeine per day. Women who averaged more than one serving of alcohol were more tired after sleeping compared to women who averaged less than one serving of alcohol. Women with a history of physical disease were, also, more tired on the average than those women with no history of physical disease. Standardized residuals from the model for restfulness after sleep were quite normally distributed.

TABLE 10. Regression Model for Perceived Restful Sleep.

	df	β Coeff.	95% CI	β Wt.	R^2	*F* Test	P value
<u>Predictor</u>:	4,108				.19	6.43	.0001
Low Caffeine		-.38	-.66, .10	-.25			
High Caffeine		-.42	-.65, .20	-.36			
High Alcohol		.43	.10, .75	.24			
Hx Physical Disease		.33	.04, .61	.20			
Intercept:		2.25	2.09,2.41				

The same predictors, low caffeine, high caffeine, high alcohol, and history of physical disease, were significant predictors for perceived sleep quality (see Table 11). Analysis of residuals indicated that assumptions of normality were valid. Mean quality was highly correlated with mean rest (Pearson's r=.78), so finding the same predictors for both perceptions was anticipated. The interpretation of the association is the same as for restfulness after sleep.

None of the sleep hygiene practices individually or together were significant predictors for perceived sleep onset latency. No further evaluation was done. For unknown reasons, relatively few women in this sample perceived prolonged sleep onset latencies.

TABLE 11. Regression Model for Perceived Sleep Quality.

	df	β Coef.	95% CI	β Wt.	R^2	*F* Test	P value
Predictor:	4,108				.15	4.73	.0015
Low Caffeine		-.54	-.94,-.15	-.27			
High Caffeine		-.55	-.87,-.24	-.34			
High Alcohol		.33	-.12, .79	.13			
Hx Physical Disease		.34	-.06, .75	.15			
Intercept:		2.83	2.61,3.05				

Irregular bedtime and age together were significant predictors for perceived number of awakenings (see Table 12). Bedtime variation was inversely associated with number of awakenings, as previously noted. After controlling for age, irregular bedtime was not a significant predictor of awakenings, *F* (2,109) = 3.71, p > .05, accounting for just 3% of the variance. Analysis of residuals showed normal distributions.

TABLE 12. Regression Model for Perceived Awakenings.

	df	β Coef.	95% CI	β Wt.	R^2	*F* Test	P value
Predictor:	2,109				.11	6.46	.002
Irregular Bedtime		-.54	-1.09, .02	-.18			
Age		.10	.04, .16	.29			
Intercept		-1.99	-4.89, .91				

Sleep Hygiene Practices and Somnographic Sleep

Means for somnographic sleep indicators did not differ greatly between the two groups except for minutes in Stage 0 (see Table 13). Sleep indicators from the somnographic recordings were SOL 1, SOL 2, minutes in Stage 0 after sleep onset, number of changes to Stage 0, and mean duration of Stage 0. Standard deviations were large for all indicators in both groups except that number of changes to Stage 0 was the same in both groups. The number of changes to Stage 0 was the only somnographic indicator that was normally distributed.

TABLE 13. Means (SD) for Women's Somnographic Sleep Indicators on Day 3.

	Insomnia (n=92)	No Insomnia (n=29)
<u>Indicator</u>:		
SOL 1 (minutes)	16 (19.4)	12 (10.4)
SOL 2 (minutes)	20 (23.4)	15 (12.6)
Stage 0 (minutes)	46 (35.1)	34 (23.6)
Changes to Stage 0 (number)	31 (12.5)	29 (12.0)
Mean Duration of Stage 0 (minutes)	1.7 (2.49)	1.3 (1.02)

Correlations between sleep hygiene practice scores and somnographic sleep indicators were very low, if any, ranging from .00 to .20 (see Table 14). Level of significance for correlations was set at $p < .05$. Exercise was inversely correlated to SOL 1 at a statistically significant level. Bedtime variation was significantly correlated with SOL 1 and SOL 2 in a positive direction. Variation in getting up time was inversely correlated with number of changes to Stage 0 at a significant level. The SHPI and SDI for Day 3 were not correlated.

Together, cigarette smoking, low and high alcohol intake, high exercise, and history of physical disease were statistically significant predictors for the log of SOL 1 on Day 3 (see Table 15). The histogram of standardized residuals was relatively flat as a result of the natural log transformation. The comparison group had been defined as women who drank one serving of alcohol, exercised 20 to 40 minutes, with no history of physical disease. Therefore, women who smoked had a longer SOL 1 than women who did not smoke when other practices were considered as well. Women who had more than one serving of alcohol or no alcohol intake and more than 40 minutes of exercise on Day 3 and a history of physical disease had a shorter SOL 1 that night than the comparison group. Note that predictors alone were not statistically significant as reflected in the confidence intervals. The exponential functions (e^x) for back transforming the log units are shown in Table 15.

TABLE 14. Correlations between Women's Sleep Hygiene Practices and Somnographic Sleep Indicators Day/Night 3.

	SOL 1	SOL 2	Minutes Stage 0	# Changes to Stage 0	Mean Duration Stage 0	SDI Night 3
Practice:						
Cigarettes	.07	.02	.09	.14	.00	.02
Caffeine	.08	.08	.13	.09	.06	-.12
Alcohol	.12	.12	.13	.02	.15	.02
Exercise	-.19*	-.16	-.17	-.06	-.13	.01
Bedtime Variation	.18*	.20*	-.02	-.08	-.00	-.10
Get Up Time Variation	-.03	-.02	-.06	-.20*	.09	.05
SHPI Day 3	-.16	-.06	-.06	.03	-.05	.00

Note. N = 121. Spearman's correlations. * p < .05. ** p < .01.

TABLE 15. Regression Model for Log of Sleep Onset Latency to Stage 1 for Day/Night 3.

	df	β Coef.	e^x	95% CI	β Wt.	R^2	*F* Test	p
Predictor:	5,83					.13	2.42	.04
Smoked Cigarette		.82	2.27	-.12,1.76	.18			
Low Alcohol		-.39	1.48	-.86, .07	-.21			
High Alcohol		-.69	1.99	-1.37, .01	-.26			
High Exercise		-.29	1.34	-.64, .06	-.17			
Hx Physical Disease		-.34	1.40	-.82, .14	-.15			
Intercept:		2.83	16.95	2.39,3.27				

Together, high exercise and age were significantly associated with minutes in Stage 0 (see Table 16). The residual analysis indicated that assumptions of normality were valid, but three outliers were present. Exercise was not a statistically significant predictor after controlling for age, *F* (2,86) = 3.80, p > .05, contributing 4% of the variance in minutes in Stage 0. Women who were younger and exercised more than 40 minutes on Day 3 had less time in Stage 0 than older women who exercised 20 to 40 minutes that day.

TABLE 16. Regression Model for Log of Minutes in Stage 0 on Day/Night 3.

	df	β Coef.	e^x	95% CI	β Wt.	R^2	*F* Test	p
Predictor:	2,86					.09	4.28	.02
High Exercise		-.29	1.34	-.58, .01	-.20			
Age		.04	1.04	.00, .07	-.21			
Intercept:		1.84	6.30	.21,3.47				

None of the sleep hygiene practices individually or together were significant predictors for SOL 2, number of changes from Stage 0, or mean duration of Stage 0. Bedtime variation for Night 3 showed a small correlation with SOL 2 (r=.20), but irregular schedule was not a predictor for SOL 2. Likewise, variation in getting up time on Night 3 showed a low inverse correlation to number of changes to Stage 0 (r= -.20), while irregular schedule was not a predictor for number of changes to Stage 0.

Chapter IV: Summary and Discussion

This analysis was focused on the relationship between sleep hygiene practices and sleep indicators comparing midlife women with chronic insomnia to those with no difficulty sleeping. The women in both groups were comparable in being primarily white and relatively well-educated with a moderate income. A variety of ethnic groups participated and the proportion is nearly representative of ethnic groups in the greater Seattle area when compared to the 1990 U. S. Census. Distribution by ethnicity between the insomnia and no insomnia groups was not equivalent. American Indians and Blacks were not represented in the no insomnia group, while Asians were over represented. Women with chronic insomnia were on average two years older than the good sleepers. The two year age difference, which was statistically significant, might be reflective of menopausal status. There is no assurance that this convenience sample accurately represents women with chronic insomnia in the Seattle area.

Reported sleep hygiene practices were consistent with expected trends in the Seattle area for regularly drinking caffeine, drinking alcohol in moderation, and not smoking cigarettes. More than 80% of women with and without insomnia reported drinking an average of one or more servings of caffeine per day. Less than 10% of these women with or without insomnia reported drinking alcohol every day. Slightly more than half of the women with insomnia and about one third of women without insomnia reported abstaining from alcohol intake during the five days. Less than 10% of the 121 women reported smoking one or more cigarettes per day.

Reported exercise levels were higher and more frequent than expected for midlife women, particularly for those with insomnia. Almost half of all women, reported averaging 30 minutes of exercise per day. That average is inflated by women who had prolonged periods of exercise, e.g. hiking for 8 hours. Yet, approximately 35% of women with insomnia and 45% of women without insomnia reported exercising for 30 minutes at least three of the five days.

Women's bedtimes and getting up times were unexpectedly irregular. A regular daily bedtime was maintained by few women (< 5%), as was a regular getting up time (< 10%) every day. Regular was defined as less than 30 minutes difference from one day to the next. Indeed, nearly 15% of women with insomnia and 30% of women without insomnia had bedtime variations averaging 60 minutes or more per day. As well, almost 25% of the women with insomnia and 40% of women without insomnia had variations in getting up times averaging 60 minutes or more per day. Due to recording difficulties, several women in both groups had missing data on these two variables. Whether bedtimes changed because their sleep was being monitored is unknown.

As a group, more women in this sample reported engaging in recommended sleep hygiene practices than previously reported. The only comparable report of sleep hygiene practices for adults with and without insomnia is a gender mixed study done more than ten years ago by Nau & Walsh (1983). Women with insomnia in the present study were less likely to smoke cigarettes, drink large amounts of caffeine, or drink alcohol every day, but more likely to exercise regularly and have a consistent bedtime than in the Nau and Walsh study. The lower percentage of smokers in the present study may reflect a change in smoking habits for middle aged women over the past ten years, but possibly more health-conscious women volunteered for this study. In both studies, those with insomnia drank less caffeine compared to those without insomnia. These findings imply that women with insomnia tend to lower caffeine consumption. Whether women consciously reduce caffeine intake to help solve their sleep problems is unclear. Overall, the healthier practices reported in this study compared to those in the Nau and Walsh study may be due to differences in geographic locale, gender, behavioral change, or subject self-selection.

These data provide little evidence that midlife women with insomnia demonstrate better sleep hygiene practices than women without insomnia, except perhaps for level of caffeine intake. Women with insomnia drank almost one serving less caffeine per day than women without insomnia. When sleep hygiene practice scores were combined to measure overall practices, the groups were not different.

Lack of differences in sleep hygiene practices between the groups is suggestive that either women with insomnia have not changed their sleep hygiene practices since recognizing their insomnia or their practices were much poorer and have improved. Both groups of women were generally well-educated with many life experiences. Women with insomnia reported experiencing poor sleep for three months or longer. Since optimizing sleep hygiene practices is a basic part of insomnia treatment, changes in sleep hygiene practices after recognition would be expected. The question whether or not practices have changed since developing insomnia remains unanswered.

Women with insomnia demonstrated less day to day variation in all sleep hygiene practices, as measured by standard deviation, compared to women with no insomnia except cigarette smoking. Differences between the two groups were greatest for alcohol consumption and night to night differences in bedtimes. Caffeine consumption was relatively stable from day to day for both groups, but exercise was less so. Variations in get up times from day to day were unexpectedly large given that most women were going to a day time job. No other studies were found for comparison.

The smaller variation in alcohol consumption for women with insomnia compared to without is presumably related to their self discipline. More women with insomnia reported abstaining from drinking alcohol every day, but some, also, reported consuming alcohol every day compared to women without insomnia. Whether some women avoided alcohol as a treatment for their insomnia and some drank alcohol every night to promote sleep onset is not discernable from these data. The direct effects of alcohol on sleep are difficult to unravel, but alcohol is known to interfere with somnographic patterns of sleep and the influence may last more than one night (Dijk, Brunner, Aeschbach, Tobler, & Borbély, 1992). Women who drink alcohol every night may be resolving the short term problem of promoting sleep onset at the risk of disturbing sleep later that night or the following night. How aware people are of this phenomenon is not clear from any reported study.

Even though women with insomnia limited the variations in their bedtimes more than women without insomnia, they did not maintain a bedtime within 30 minutes of the comparison night on most nights. A regular bedtime is recommended to facilitate sleep onset by strengthening circadian rhythmicity of the sleep-wake cycle. In other words, maintaining a consistent time for sleeping trains the body to begin sleeping at the same time each day. The opposite result can occur. Trying to sleep each night at a specific time can perpetuate insomnia through negative conditioning if the attempt to sleep is unsuccessful (Hauri, 1994). Most women in this study were able to initiate sleep successfully. The majority perceived sleeping within 30 minutes of going to bed. Women who are able to go to sleep quickly in the evening and awaken early in the morning may have an advanced sleep phase of their circadian rhythm. Women with advanced sleep phases would be expected to benefit from a regular bedtime because their body's internal circadian pacemaker would be "reset" each day by lengthening the wake portion of their sleep-wake cycle. The number of women with advanced sleep phases in this study was not ascertained.

Finding more night to night variation in perceived sleep for women with insomnia than for women without insomnia is consistent with previous studies (Clark, Flowers, Boots, & Shettar, 1995; Roth, Kramer, & Lutz, 1976; Williams, Hursch, & Karacan, 1972). Women with insomnia perceived more variation particularly on overall sleep quality and SOL than women without insomnia, as measured by standard deviation. Very few women reported taking more than 30 minutes to go to sleep. Most women perceived that they awakened one or more times during the night, but some women could not recall whether or not they awakened during the sleep period. Women with insomnia perceived more disturbed sleep in general.

As anticipated, correlations between sleep hygiene practices and indicators of perceived or somnographic sleep were very small. Sleep hygiene practices are only one of many factors influencing sleep. Physiology, physical illness, stress, attitudes, and beliefs about sleep are only some of the reasons for sleeping or not sleeping. While the sleep hygiene practices selected for study are known to be associated with sleep, an individual practice may not be notable in the presence of other influences. Inadequate sleep hygiene practices may be a main contributor to insomnia, but more often contribute to insomnia in the presence of other factors according to the Report from the APA/NIMH DSM-IV Field Trial by Buysee, et al. (1994).

According to the model for the development of chronic insomnia proposed by Spielman (1986), a combination of poor sleep hygiene practices, rather than one practice, would be a better predictor for insomnia. As anticipated, a combination of sleep hygiene practices was associated with perceived feelings of restfulness after sleep and sleep quality, and SOL 1 (defined by somnography). The same practices, high and low caffeine consumption, and high alcohol consumption, were associated with restfulness after sleep and sleep quality. Alcohol was positively related to both restfulness and sleep quality, while high and low caffeine were inversely related to both. The interpretation that women who drank no caffeine and those who drank two or more servings were less rested after sleep initially seems contradictory. The high and low caffeine groups were compared to women who averaged less than two servings per day and the outcome measures were, also, averages. Categorizing variables and using averages may have uncovered two insomnia groups, one limiting their caffeine intake as a treatment for their insomnia and another group unconcerned about their caffeine consumption.

Contrary to expectations, two individual practices were significantly associated with two sleep indicators. Variation in bedtime was inversely associated with perceived nocturnal awakenings. The reason for a greater variation in bedtime being associated with fewer awakenings is unknown, but generates the question about whether the women with an irregular schedule are more adaptable. A high level of exercise was inversely associated with minutes in Stage 0 at a significant level, when age was considered. Finding that more exercise was associated with less awake time for a given night was consistent with previous reports that exercise improves sleep, but, also, was unexpected given that data analysis was limited to duration of exercise. Physical fitness, exercise intensity, type of exercise, and proximity to the sleep period are, also, important considerations in the relationship between exercise and sleep (Taylor & Driver, 1995).

Limitations:

Sampling was not random and, therefore, might not represent midlife women with good and poor sleep. Self-report, in this case using diaries to collect data about sleep hygiene practices, limits the accuracy of measuring behaviors. Degree of honesty, accuracy or recall, and motivation to provide data potentially affect any self-report data. However, women reported their practices concurrently, presumably obviating inaccuracy due to long duration recall. Comprehensive instructions and guidance enhanced subjects' abilities to complete the diaries consistently.

The study design did not allow for recording of practices according to the time of day that practices occurred. Proximity to sleep time is pertinent for drinking caffeine and alcohol. Drinking alcohol with dinner, for example, may have a different outcome than drinking alcohol later in the evening. Time of day was, also, unknown for exercise, but exercise was not commonly done during the two hours prior to bedtime since electrodes were positioned at that time.

A typographical mistake was found in the Daily Diary during data collection and was not changed. Item #16 on the Daily Diary had the responses for selections #3 and #4 reversed. Response 3 should have been "quite tired", rather than "very tired". Response 4 should have been "very tired", rather than "quite tired". The number recorded by the women for each response was used in the data analysis. Therefore, women who reported being either "quite tired" or "very tired" were combined to identify those who reported "being tired". This discrepancy might account for the decreased reliability in the measurement of restfulness after sleep. The consequences for correlation and regression calculations which included perceived restful sleep are uncertain.

Regression analysis allowed simultaneous testing of multiple sleep hygiene practices, but was limited by study design. The sleep indicators used as outcome measures were the same as, or very similar to, criteria for participation in the study. Assessing the influence of insomnia group on the relationship between sleep hygiene practices and sleep indicators was not possible given the sample size, number of sleep hygiene practices, and similarity between the enrollment criteria and sleep outcome measures. Regression analyses were done for the combined group of good and poor sleepers without testing whether models were the same for women with and without insomnia.

<u>Future Research</u>

Three areas for future research emerged from the results of this study. The similarities in sleep hygiene practices between women with and without insomnia generated questions about reasons for the comparable patterns. Do sleep hygiene practices change for women after they experience chronic insomnia? Do these women consciously manage their sleep hygiene practices to improve their sleep? Another focus of research is derived from the smaller variation in sleep hygiene practices for women with insomnia. Would these findings be replicable in another sample of women? Would similar findings be found for samples with men? Would findings be the same over a longer period of time? What factors explain the decreased variation in sleep hygiene practices? For example, is daily stress a contributing factor? A third area for inquiry is related to beliefs and expectations about sleep. Given that women reporting poorer sleep quality show greater variation in perceived sleep than women reporting higher sleep quality, do expectations and beliefs about sleep differ between the groups? These questions provide differing directions for future research efforts.

Understanding changes, or lack of change, in sleep hygiene practices made by women with chronic insomnia includes evaluation of their knowledge and beliefs, as well as change. What percentage of women with insomnia changed their practices in response to their difficulty sleeping? Were changes based on specific knowledge of sleep hygiene practices or personal experiences? What beliefs about sleep, sleep hygiene practices, and the relationship between sleep and sleep hygiene practices determined their behaviors? Measuring sleep hygiene practices, knowledge, and beliefs before and after the onset of insomnia would be ideal, but is not realistic. A survey questionnaire or structured interview could evaluate women's knowledge, beliefs, and awareness of changing any of their practices in response to insomnia. Such a descriptive study could provide insight into the role that knowledge and beliefs have in determining day to day sleep hygiene practices. Results could be used to target education about sleep hygiene practices.

Daily life stressors may be related to the decreased variation in sleep hygiene practices shown by these women with insomnia. Midlife is a time with stressful experiences for women. The relationship between perceived stress and sleep hygiene practices is not documented. Do women with insomnia demonstrate a decreased ability to vary their daily practices in response to stressors when compared to women with no insomnia? Do women normally change their sleep hygiene practices as a consequence of perceived stress or change practices in order to manage perceived stress? Do women with higher perceived stress have better or poorer sleep hygiene practices than women with lower perceived stress? Data from the primary study could be analyzed to evaluate the relationship between perceived stress and sleep hygiene practices. The results would show whether women with greater perceived stress demonstrate more or less variation in their sleep hygiene practices.

The many questions generated by this analysis demonstrate the limited knowledge we have about actual sleep hygiene practices. Sleep hygiene practices are a common sense approach to managing one's sleep, yet implementation of the behaviors is not done easily. By looking more closely at knowledge, beliefs, and practices of men and women who are and are not managing their sleep successfully, we can enhance our understanding and better assist those with insomnia to manage their own sleep.

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Appendix A: Sleep Log

MORNING INFORMATION

Today's date________

PLEASE COMPLETE ON AWAKENING

1. I did or took something to help me fall asleep.
   1 Yes 2 No (circle number)

   If yes, describe____

2. Bedtime____________(AM or PM?) Minutes to fall asleep?____________

3. I awoke_____________times during the night.

Circle ONE of the numbers for each item below.

4. The number of awakenings was:
   1 way more than usual
   2 more than usual
   3 about the same as usual
   4 fewer than usual
   5 way less than usual

5. Upon awakening this morning, I feel:
   1 very drowsy
   2 somewhat drowsy
   3 fairly clearheaded
   4 somewhat alert
   5 very alert

6. Overall, this morning I feel:
   1 very rested
   2 somewhat rested
   3 very tired
   4 quite tired

7. Overall, my sleep was:
   1 very good
   2 good
   3 fair
   4 poor
   5 very poor

8. I awoke this AM at_________________o'clock;
   I got up at_________________o'clock.

Comments:

Appendix B: Demographic/Supplemental Info

CODE________

DEMOGRAPHIC/SUPPLEMENTAL INFO

1. Have you had any major physical diseases? Yes No

Describe:____

____

____

2. Do you have any condition that is painful? Yes No

Ifso, explain:

____

____

3. Do you have any history of mental illness/substance abuse?
Yes No

4. Which of the following best describes your racial or ethnic identification?

American Indian or Alaskan native.................1
Asian or Pacific Islander.........................2
Black...3
Caucasian/White...................................4
Hispanic..5
Other (Specify)...................................

5. What is your present marital status?

never married.....................................1
married or living with partner....................2
divorced/seperated................................3
widowed...4

6. Your present work situation is best described as:

employed..1
self-employed.....................................2
laid off..3
suspended/dismissed from job......................4
retired...5
unemployed..6
part-time work....................................7
temporary work....................................8

7. What is your present occupation?____________________________

____

8. How much formal education have you had?

No formal education	0
Some grade school	1
Completed grade school	2
Some high school	3
Completed high school	4
Some college	5
Completed college (specify major)	6
Some graduate work	7
Graduate degree (specify degree &major)	8

9. What was your approximate net family income from all sources, after taxes, in 1991?

less than $5,000	01
5,000 to 6,999	02
7,000 to 8,999	03
9,000 to 10,999	04
11,000 to 12,999	05
13,000 to 15,999	06
16,000 to 19,999	07
20,000 to 24,999	08
25,000 to 29,999	09
30,000 to 34,999	10
35,000 to 39,999	11
40,000 to 44,999	12
45,000 to 49,999	13
over 50,000	14

10. What is your birthdate?______________________________

11. Are you experiencing any of the following problems during the day?

	Not at all (1)	A Little (2)	Moderately (3)	Quite A Bit (4)	Extremely (5)	Y	N	DK
Sleepiness/ drowsiness during the day	1	2	3	4	5	Y	N	DK
Daytime fatigue	1	2	3	4	5	Y	N	DK
Inability to think clearly/ concentrate	1	2	3	4	5	Y	N	DK

	Not at all	A Little	Moderately	Quite A Bit	Extremely	Y	N	DK
	(1)	(2)	(3)	(4)	(5)			
Anxiety	1	2	3	4	5	Y	N	DK
Lack of Motivation	1	2	3	4	5	Y	N	DK
Feeling physically not well	1	2	3	4	5	Y	N	DK
Difficulty performing work or tasks	1	2	3	4	5	Y	N	DK
Tension/ Irritability	1	2	3	4	5	Y	N	DK
Difficulty with relationships	1	2	3	4	5	Y	N	DK

12. Do you think your sleep problems affect this? Y N DK

13. Do you smoke? Y N
If so, how much?____

Height?________________________ Weight?________________________

Appendix C: Daily Diary

Daily Diary

Please circle one number for items 1-9

		not at all					very much
1. How healthy do you feel today?		1	2	3	4	5	6
2. How happy do you feel to day?		1	2	3	4	5	6
3. How stressful do you feel today?		1	2	3	4	5	6
4. How rewarding today was your relationship with your closest friend(s)		1	2	3	4	5	6
5. How rewarding today was your family life?		1	2	3	4	5	6
6. How rewarding today was your work?	NA	1	2	3	4	5	6
7. How stressful today was your relationship with your closest friends(s)?		1	2	3	4	5	6
8. How stressful today was your family life?		1	2	3	4	5	6
9. How stressful today was your work?	NA	1	2	3	4	5	6

10. How many cigarettes did you smoke today?__________ NA

11. How many servings of alcohol did you drink today?___________(1 serving 1 1/2 oz. liquor, 3-4 oz. wine, 8-12 oz. beer)

12. How many servings of caffeine drinks did you have today?___________(1 serving=6-8 oz. coffee/tea,8-12 oz. soda)

13. How many(total) minutes of each type of activity did you have today?

Type of activity	minutes
Running, jogging, walking	_______
Racquet sport	_______
Lifting weights	_______
Swimming, dancing biking	_______
Stretching, conditioning	_______
Other (specify)	_______

Date__________

14. Last night it took me__________minutes to fall asleep.
I awoke_____________ times last night.

15. Upon awakening this morning I felt: (1) very drowsy
(2) somewhat drowsy (3) fairly clearheaded (4) alert (5) very alert

16. Overall this morning I felt: (1) very rested (2) somewhat rested
(3) very tired (4) quite tired

17. Overall my sleep was: (1) very good (2) good (3) fair (4) poor
(5) very poor

18. Today I napped from______to;______from______to______.

Did you take any vitamins, minerals, medicines or nutritional supplements today

NO______ YES______

Record number(s) and amount

____

____

19. Read the list of feelings and behaviors. Please fill in the blank with the number that best describes how you felt today Fill in 0 for not present.

0	1	2	3	4
not present	minimal	mild	moderate	extreme

a.	joint aching or pain	________
b.	muscle aching or pain	________
c.	body stiffness	________
d.	pain in neck and shoulders	________
e.	backache	________
f.	stomach pain or discomfort	________
g.	bloated/distended stomach	________
h	nausea	________
i.	heartburn	________
j.	headache	________
k.	tiredness	________
l.	pelvic discomfort	________
m.	sudden hot spells (actual no.______)	________
n.	sudden sweat (actual no.________)	________
o.	dizziness	________
p.	other (please specify)	________

Curriculum Vitae

Rita Elaine Cheek

Professional License:
Montana - RN 007709
Washington - RN00068561

Education:

Doctor of Philosophy in Nursing Science, 1996 — University of Washington, School of Nursing, Seattle, Washington

Master of Nursing — University of Washington, School of Nursing, Seattle, Washington

Bachelor of Science in Nursing, 1970 — Montana State University, School of Nursing, Bozeman, Montana

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Professional Experience:

12/95 to 7/96 — University of Washington, School of Nursing, Seattle, Washington

Predoctoral Research Associate for a research study of delta sleep deprivation in healthy women. My work included recruiting subjects, technical work in the sleep laboratory monitoring sleep including observing sleep recordings in progress and disrupting delta sleep patterns.

10/92 to 12/95 — University of Washington, School of Nursing, Seattle, Washington

Predoctoral Research Associate for a study of insomnia in 140 midlife women who had their sleep monitored for six nights in their homes. My responsibilities involved technical aspects of the sleep monitoring with portable equipment, preparing women for the monitoring, collecting written data, and urine specimens. In addition, I assayed urine creatinines in the laboratory and was responsible for storing more than 1300 urine specimens and managing data files for multiple urine assays.

10/91 to 10/92 — University of Washington, School of Nursing, Seattle, Washington

Predoctoral Research Associate for Critical Care Nursing Systems Study. Primary responsibilities were collecting data in multiple forms from critically ill subjects, their families, and their charts in multiple critical care units. I, also, cataloged multiple written data forms collected from 26 intensive care units.

9/90 to 9/91 — University of Washington, School of Nursing, Seattle, Washington

Research Assistant for Curriculum Evaluation Project. My assignment was to collect data, prepare forms for data entry, and assist with data analysis for an evaluation project of undergraduate students.

9/82 to 6/90	Montana State University, College of Nursing, Montana

Assistant Professor teaching undergraduate nursing at the junior and senior levels. My employment was on the Butte campus for 5 years with two years as Education Director, Great Falls campus for 1 year, and part-time on the Missoula campus for two years. My classroom and clinical teaching involved medical surgical nursing, research, leadership, and senior seminar. My clinical focus was care of adults with cardiac, pulmonary, gastrointestinal, urinary system problems.

1/82 to 8/82	Predoctoral Teaching Assistant, University of Washington, School of Nursing, Seattle, WA
10/79 to 1/82	Float Nurse, Medical/Surgical/Intensive Care/ Psychiatric, University Hospital, Seattle, WA
9/77 to 8/79	Home Health Nurse, Southeastern District Health Department, Pocatello, ID
8/77 to 8/79	Emergency Department Staff Nurse, Bannock Memorial Hospital, Pocatello, ID
8/74 to 6/77	Intensive Care Nurse, Herrick Memorial Hospital, Berkeley, CA
10/72 to 7/74	Staff Nurse, Medical Intensive Care, Tampa Veteran's Administration Hospital, Tampa, FL
6/72 to 10/72	Medical-Surgical Staff Nurse, University Community Hospital, Tampa, FL
9/70 to 4/72	Medical-Surgical Staff Nurse, Tampa General Hospital, Tampa, FL

Professional Memberships:
Society of Behavioral Medicine, 1996
Sleep Research Society, 1993 - present
Sigma Theta Tau, 1981 - 1990
Toastmaster's International, 1994 - present
American Nurses' Association, 1970 - present
Washington Nurses' Association, 1990 - present
Montana Nurses' Association, 1982 - 1990

Publications: None