NAPPING AND SLEEP: AN ACTIGRAPHIC STUDY OF A SAMPLE OF COMMUNITY DWELLING OLDER ADULTS

By

NATALIE DEIDRE DAUTOVICH

A THESIS PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2007
ACKNOWLEDGMENTS

I would like to acknowledge my mentor, Dr. Christina McCrae, for her support throughout the completion of the project. Additionally, I would like to thank both Dr. Christina McCrae and Dr. Meredith Rowe for the generous use of their database and their guidance. I would like to thank my parents, Mike and Angella Dautovich, and my sister, Sonia Dautovich, for their ongoing support, encouragement, and belief in my ability to complete this project. Finally, I would like to especially acknowledge the emotional support from David Sams.
TABLE OF CONTENTS

ACKNOWLEDGMENTS .......................................................................................................................... 3

LIST OF TABLES ............................................................................................................................... 7

LIST OF FIGURES ............................................................................................................................ 8

ABSTRACT ......................................................................................................................................... 9

CHAPTER

1 INTRODUCTION ............................................................................................................................ 11

2 REVIEW OF THE LITERATURE .................................................................................................... 12

   Insomnia and Older Adults ........................................................................................................... 12
   Napping Behavior in Older Adults .............................................................................................. 13
      Prevalence and Duration of Napping ....................................................................................... 13
      Time of Day of Napping .......................................................................................................... 14
      Evening Napping ..................................................................................................................... 15
   Theoretical Link between Napping and Sleep in Older Adults .................................................... 16
   Prior Research: Association between Napping and Sleeping Behavior in Older Adults ........ 17
   Measurement of Sleep—Objectively ........................................................................................... 19
      Polysomnography ................................................................................................................... 19
      Actigraphy .............................................................................................................................. 20
   Measurement of Sleep—Subjectively .......................................................................................... 20
      Sleep Diary ............................................................................................................................. 20
      Sleep Classification System ................................................................................................. 21
   Measurement of Napping ............................................................................................................. 21
      Objectively Measured Napping (Actigraphy) ......................................................................... 21
      Subjectively Measured Napping (Sleep Diary) ...................................................................... 22
   Innovations of Research ............................................................................................................. 22

3 STATEMENT OF PURPOSE ......................................................................................................... 24

   Specific Aim 1 ............................................................................................................................... 24
      Subaim 1.1a ............................................................................................................................. 24
      Subaim 1.1b ............................................................................................................................. 24
      Subaim 1.2a ............................................................................................................................. 24
      Subaim 1.2b ............................................................................................................................. 25
      Subaim 1.3a ............................................................................................................................. 25
      Subaim 1.3b ............................................................................................................................. 25
   Hypothesis for Specific Aim 1 ..................................................................................................... 25
   Specific Aim 2 ............................................................................................................................... 26
      Subaim 2.1a ............................................................................................................................. 26
Subaim 2.1b.....................................................................................................................26
Hypothesis for Specific Aim 2 ...............................................................................................26

4 METHODS .............................................................................................................................28

Procedure ................................................................................................................................28
Participants .............................................................................................................................29
Measures ................................................................................................................................29

Operationalization of Sleep Variables .............................................................................29
  Objective sleep variables .................................................................29
  Subjective sleep variables .............................................................31
Operationalization of Nap Variables ...............................................................................32
  Objective nap variables .................................................................32
  Subjective nap variables .............................................................34
Demographics and Health survey ....................................................................................35
Cognitive Impairment ......................................................................................................36
Daytime Functioning Measures ........................................................................................37
  Beck depression inventory—second edition (BDI-II) .........................37
  State-trait anxiety inventory, form Y1 (STAI) .....................................37
  Epworth sleepiness scale (ESS) ......................................................38
  Fatigue severity scale (FSS) ..........................................................38
Data Analysis ........................................................................................................................38

Specific Aim 1 .........................................................................................................................38
  Subaim 1.1a .................................................................................................39
  Subaim 1.1b .................................................................................................40
  Subaim 1.2a .................................................................................................40
  Subaim 1.2b .................................................................................................40
  Subaim 1.3a .................................................................................................41
  Subaim 1.3b .................................................................................................41
Specific Aim 2 .........................................................................................................................42
  Subaim 2.1a .................................................................................................42
  Subaim 2.1b .................................................................................................42

5 RESULTS ...............................................................................................................................44

Characteristics of Napping Behavior within the Sample.........................................................44
Specific Aim 1 ..........................................................................................................................45
  Subjective Napping and Objective Sleep (Subaim 1.1a) .........................45
  Subjective Napping and Subjective Sleep (Subaim 1.1b) .........................46
  Objective Napping and Objective Sleep (Subaim 1.2a) .........................46
  Objective Napping and Subjective Sleep (Subaim 1.2b) .........................47
  Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3a) ...47
  Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3b) ...48
Specific Aim 2 ..........................................................................................................................48
  Sleep Subtypes and Objective Napping (Subaim 2.1a) .........................49
  Sleep Subtypes and Subjective Napping (Subaim 2.1b) .........................49
DISCUSSION........................................................................................................................................................................55

Review of Study Findings ...............................................................................................................................................................56
  Characteristics of Napping Behavior within the Sample .................................................................................................................57
  Subjective Napping and Objective Sleep (Subaim 1.1a) ......................................................................................................................60
  Subjective Napping and Subjective Sleep (Subaim 1.1b) ....................................................................................................................61
  Objective Napping and Objective Sleep (Subaim 1.2a) ......................................................................................................................61
  Objective Napping and Subjective Sleep (Subaim 1.2b) ....................................................................................................................62
  Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3a) ..............................................................63
  Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3b) ..............................................................64
  Four Sleep Subtypes (Specific Aim 2) ........................................................................................................................................65

Study Limitations ................................................................................................................................................................................65

Implications for Theory and Research ........................................................................................................................................67

Clinical Implications .............................................................................................................................................................................67

Future Directions ................................................................................................................................................................................68

Conclusions .........................................................................................................................................................................................69

APPENDIX

A  EXAMPLE OF SLEEP DIARY ...............................................................................................................................................................70

B  HEALTH SURVEY ..............................................................................................................................................................................71

LIST OF REFERENCES ...........................................................................................................................................................................72

BIOGRAPHICAL SKETCH ...........................................................................................................................................................................79
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-1</td>
<td>Mean nap frequency, duration, and time of day as measured by actigraphy and sleep diaries</td>
<td>50</td>
</tr>
<tr>
<td>5-2</td>
<td>Correlations of sleep diary napping, actigraphy sleep, and sleep diary sleep variables with the canonical variate</td>
<td>52</td>
</tr>
<tr>
<td>5-3</td>
<td>Means and standard deviations for the time of day of nap groups for objective sleep</td>
<td>53</td>
</tr>
<tr>
<td>5-4</td>
<td>Means and standard deviations for the time of day of nap groups for subjective sleep</td>
<td>54</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>5-1</td>
<td>Percentage of total naps taken by all participants that occurred during each half-hour interval of the 24-hour clock</td>
<td>51</td>
</tr>
</tbody>
</table>
Individuals face many challenges as they age and a common complaint is difficulty sleeping. Nocturnal sleep disturbances in older adults have been associated with a number of factors including daytime napping. The main aim of the study was to examine the relationship between napping and sleeping behaviors in a sample of community-dwelling older adults. The relationships between both subjective (sleep diary) and objective (actigraphy) napping and sleep variables were examined. Innovations of the study included the use of both subjective and objective measures of napping and sleep, an extended data collection period, the examination of the multiple components of napping behavior (frequency, duration, and time of day), and the study of a sleep classification system in relation to napping behavior. Consistent with previous findings, napping was found to have a differential relationship with sleep. Subjectively measured nap frequency and duration were found to be negatively correlated with objectively measured total sleep time, objectively measured sleep efficiency, and subjectively measured total sleep time. Objectively measured nap frequency, duration, and time of day of napping were found to be unrelated to both subjective and objective sleep. An analysis of categories of time of day of napping revealed that individuals who napped both in the daytime and evening compared to those who napped only in the daytime showed a decrease in objectively measured sleep onset.
latency, a decrease in wake time after sleep onset, and an increase in sleep efficiency. Finally, the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) were not differentiated by their subjectively or objectively measured napping behavior. The results suggest that 1) it is difficult to uniformly state the direction of the relationship between napping and sleep and 2) the mode of measurement (objective and subjective) plays an important role in determining this relationship.
CHAPTER 1
INTRODUCTION

Individuals face many challenges as they age. One of these challenges is difficulty sleeping or insomnia. Sleep complaints are multifactorial in origin and one of the factors that is associated with nocturnal sleep complaints is napping. Although napping has been studied in relation to sleep since the 1960s, the association between napping and sleep remains unclear.

The discrepancies in previous research on the relationship between napping and sleep in older adults may be due in part to the multifactorial nature of napping and sleep. Additionally, methodological limitations of the previous studies may partially account for these inconsistencies. Within the prior literature, the multifaceted nature of napping behavior (frequency, duration, time of day) has not been studied simultaneously in healthy and older adults diagnosed with insomnia. Additionally, napping and sleep behavior have not been observed for longer than one week using both objective and subjective measures of napping and sleep. Finally, napping has not been studied in relation to a variety of sleep subtypes. Traditionally, studies have only compared good sleepers and individuals diagnosed with insomnia. These limitations will be addressed by the present study.

The present study examines the relationship between objectively and subjectively measured napping and sleep. Additionally, the relationship between napping and four subtypes of good and poor sleepers is examined. By addressing methodological limitations of previous research, the current study aims to further specify the nature of the relationship between napping and sleep in older adults.

Note: For detailed specific aims, see Chapter 3.
CHAPTER 2
REVIEW OF THE LITERATURE

Insomnia and Older Adults

Individuals age 65 and older represent the fastest growing segment of the population. According to the U.S. Census Bureau (2000a), the percentage of older adults in the population is predicted to increase by more than 20% by the year 2030 (an increase from 4% in 1900). A significant challenge facing individuals as they age is difficulty sleeping. Fifty-seven percent of older adults complain of some difficulty sleeping (Kryger, Monjan, Bliwise, & Ancoli-Israel, 2004). Insomnia is the most common of sleep complaints with estimates ranging from 15-65% (Ohayon, 2002). Insomnia involves difficulty initiating or maintaining sleep that causes significant distress for the individual resulting in impaired social or occupational functioning (American Psychiatric Association [APA], 2000). The impact of insomnia on older adults is significant. The effects range from a minimum impact of daytime fatigue and decreased mood (APA, 2000) to decreased quality of life, impaired cognitive functioning, increased risk for falls, accidents, medical illness, and long-term care placement (Foley et al., 1995; Pollack, Perlick, Linsner, Wenston, & Hsieh, 1990). Finally, insomnia places a huge economic burden on society. The estimated costs for directly treating insomnia in 1995 exceeded $13.9 billion (Walsh & Engelhardt, 1999).

Effective treatment interventions are required to mitigate the significant impact of insomnia on individuals and society. Understanding the etiology of insomnia enables the development of efficacious interventions. A basic factor implicated in the cause of insomnia is age-related changes in sleep. Specifically, the architecture of sleep changes with age. Sleep becomes structurally lighter with more time devoted to the lighter stages of sleep (stages 1 and 2) and less time spent in deeper or slow wave sleep (stages 3 and 4; Feinberg, 1974; Hayashi &
Endo, 1982). Additionally, older adults experience less total sleep time and more awakenings (Evans & Rogers, 1994), and longer sleep onset (i.e. the amount of time it takes to fall asleep; Lichstein & Morin, 2000). Despite the structural changes in sleep affecting the majority of older adults, sleep complaints are not universal. Health, situational, and psychological factors combine and add to ontogenetic changes affecting sleep. Consequently, sleep complaints are multifactorial in origin (Lichstein & Morin, 2000).

**Napping Behavior in Older Adults**

One of the situational factors associated with insomnia among the elderly is napping. Napping is defined as “any short sleep episode” out of bed (American Sleep Disorders Association, 1997). The out of bed sleep period does not have to be of a maximum or minimum duration to be labeled as a nap (The International Classification of Sleep Disorders, 1990).

**Prevalence and Duration of Napping**

Napping is prevalent in older adults, with one in four individuals engaging in a daily nap (Beh, 1994; Foley et al., 1995). The frequency and duration of naps in older adults varies according to the methodology used to record napping behaviors. Using self-report, Buysee and colleagues (1992) found that on average, older adults engaged in 3.4 naps over a two-week period while an actigraphic study of healthy older adults without sleeping difficulties found 76.6% of participants napped at least once during a one-week recording period (Yoon, Kripke, Youngstedt, & Elliott, 2003a).

In terms of nap duration in older adults, Yoon and colleagues (2003a) found that in a sample of healthy older adults the average napping duration was 23.3 minutes while the average nap duration in a study of postmenopausal women was 31.3 minutes (Yoon, Kripke, Elliot, & Langer, 2004). In Shirota and colleagues’ (2002) study of napping behavior in elderly participants, there was not a significant difference between high and low volitional (a measure of
mental vigorousness) elderly participants in terms of their in nap duration. On average, high volitional individuals napped for 36 minutes a day and low volitional individuals napped for 44 minutes a day. Using a different measure of napping duration, Jean-Louis, Kripke, Assmus, and Langer (2000) found that on average, over a 24-hour period, older adults napped for 45 minutes. Interestingly the 45 minute total nap time accounted for 10% of their total 24-hour sleep (Jean-Louis et al., 2000). In summary, previous research has found that on average, older adults engage in one nap per week, with the average duration of naps ranging from 23.3 to 45 minutes per day.

Although napping behavior is prevalent in older adults, it is variable. While many older adults report napping behaviors, a number do not. Buysee and colleagues (1992) found that according to sleep diaries, approximately thirty-six percent of a sample of older adults reported no naps during a two-week recording time. Additionally, there may be significant variability between napping behaviors occurring on the weekday compared to the weekend. In the same study Buysee and colleagues (1992) found a significant difference between the frequency of napping behavior during the week and on the weekend, with more naps occurring on average during the week. Longitudinal assessment of napping behavior is more likely to capture the variability of napping behavior in older adults.

**Time of Day of Napping**

The time of day of napping is an important component of napping behavior in part because the time of day the nap occurs may moderate the hypothesized association between napping and sleep. A theoretical explanation for the association between time of day of napping and nocturnal sleep is that naps taken later in the day contain more slow wave sleep than naps taken earlier in the day (Yoon et al., 2003b). Considering that slow wave sleep provides the
most restorative sleep, by engaging in naps at a later point during the day individuals may
engage in a deeper sleep that meets more of their nocturnal sleep needs.

A number of studies have calculated the average time of day of naps. Shirota and
colleagues (2002) found that there was not a significant difference in the average time of day of
naps of both high and low volitional elderly participants. On average, high volitional individuals
began their naps at 13:34 and low volitional individuals began their naps at 13:38. Although
there were no significant differences in the timing of the naps, high volitional individuals took
their naps as their activity levels were decreasing whereas low volitional individuals took their
naps as their activity levels were increasing. Elderly participants reported napping slightly later
in the afternoon (14:42) in the study by Buysee and colleagues (1992) and reported no significant
difference in the timing of naps during the week compared to on the weekend. Napping ‘peaks’
were observed at three times during the day in a study of postmenopausal women (Yoon, 2004).
The highest peak occurred approximately one hour before bedtime, the second approximately 8
or 9 hours after wake-up time, and the smallest peak 2 hours after wake-up time. These peaks
corresponded with the clock times of 22:00, 15:00/16:00, and 09:00. In summary, in the studies
that reported the average time of day of naps, the average time of day of naps was variable
ranging from 13:34 to 22:00.

**Evening Napping**

In addition to studying the relationship between out-of-bed sleep in general and nocturnal
sleep, a number of researchers have identified a subset of napping behavior – the evening nap.
Previous research defines evening naps as out-of-bed sleep that occurs within the timeframe of
two hours to just before bedtime (Yoon et al., 2003b). Evening naps may impact sleep by
causing earlier awakenings, earlier illumination exposure, and consequently causing a phase
advance of the circadian system (Buxton, L’Hermite-Baleriaux, Turek, & van Cauter, 2000; Yoon et al., 2003a.)

The frequency of evening napping appears to increase with age (Jean-Louis et al., 2000; Monk, Buysse, Carrier, Billy, & Rose, 2001; Yoon et al., 2003b). In a paper by Yoon and colleagues (2003b), the evening nap timeframe corresponded to the clock-time of 20:38 – 22:38. In a study of post-menopausal women, Yoon and colleagues (2004) found that the average evening nap duration was 7.75 minutes. This duration contrasts with an average daytime nap duration of 31.3 minutes in the same study. Ancoli-Israel, Kripke, Mason, and Kaplan (1985) found that in a sample of individuals diagnosed with sleep apnea, periodic limb movements (PLM), or no diagnosis, 45% of elderly participants engaged in evening naps. The frequency of evening naps ranged from 3-5 per evening and the duration ranged from 5 to 18 minutes. Yoon and colleagues (2003b) found that 52% of the sample engaged in at least one evening nap per week. Considering the prevalence of evening napping among the elderly, it is important to assess this napping behavior among older adults. Additionally, considering the unique characteristics of evening naps reported in previous studies (e.g. higher frequency and shorter duration) it may be informative to examine evening naps separately from daytime naps.

**Theoretical Link between Napping and Sleep in Older Adults**

In addition to studying the characteristics of napping behavior in older adults, several theoretical explanations have been provided to account for the association between napping and nighttime sleep. Borbély (1982) advanced two biological mechanisms to explain the relationship between napping and sleep. The circadian system, controlled by an internal pacemaker within the hypothalamus, regulates sleepiness and wakefulness within a 24-hour rhythm. The second mechanism, the homeostatic drive, results in an increasing motivation towards sleepiness during periods of wakefulness. Older adults may experience a decreased homeostatic drive (accounting
for less deeper sleep during the night and increased number of awakenings) that results in a
decreased drive towards wakefulness during the day. Buysee and colleagues (1992)
hypothesized that napping disrupts both the circadian system and the homeostatic drive, resulting
in an increase of polyphasic sleep. Consequently, older adults experience more fragmented
patterns of daytime and nocturnal sleep compared to younger adults (Hays, Blazer, & Foley,
1996).

An alternate theoretical explanation for the increasing number of naps as individuals age is
that daytime sleep propensities may no longer be being masked by social obligations among the
elderly (Jean-Louis et al., 2000). Although older adults may maintain high levels of activity
during retirement, the less compulsory nature of these activities may provide increased
opportunities for daytime napping behavior.

Prior Research: Association between Napping and Sleeping Behavior in Older Adults

Despite the theoretical basis for the relationship between napping and sleep, previous
research is mixed regarding the strength or existence of this relationship. Several studies have
found that napping behavior is associated with impaired nocturnal sleep. Frequency of napping
was associated with increased risk of sleep complaint (Hays et al., 1996) while duration (Beh,
1994) of napping was negatively correlated with nocturnal sleep length. Yoon and colleagues
(2003a) examined the relationship between time of day of napping (evening naps), wake times,
and nocturnal sleep length. Older adults who engaged in evening naps within a timeframe of two
hours to bedtime were found to have significantly earlier wake-up times (undesirable for older
adults) and decreased total sleep time. Yoon and colleagues (2003b) also compared the sleep
onset and offset times of older adults with or without evening naps. There was a significant
difference in the sleep offset times with individuals who engaged in an evening nap awakening
on average 54 minutes earlier than those who did not engage in an evening nap. No significant
differences were reported in nocturnal sleep between those who napped and did not nap as measured by sleep diaries but a significantly lower total sleep time was recorded by polysomnography for those who engaged in naps (Monk et al., 2001). Finally, a significantly longer sleep onset latency was observed in individuals who napped compared to those in a sedentary condition (Campbell, Murphy, & Stauble, 2005).

In contrast to the negative relationship between napping behavior and sleep variables, a small number of recent studies suggest a positive association between napping behavior and sleep quality. Studies involving the Okinawa elders of Japan have found that prescribed napping of 30 minute duration between the hours of one and three in the afternoon was significantly associated with decreased wake time after sleep onset and improved sleep efficiency (sleep efficiency refers to the percentage of time in bed that is spent sleeping; Tanaka et al., 2002). Additionally, napping in the afternoon reduced the average evening nap duration from 39 to 11 minutes (Tanaka et al., 2001). Another study involving the Okinawa elders found that a higher percentage of elderly participants in the rural areas took a daily nap (55.2%) compared to elderly participants in the urban areas (32.4%). The rural elderly had significantly fewer sleep complaints and a significantly lower sleep health risk index (an analysis of sleep health including sleep disturbances, parasomnia, apnea, difficulty waking, and difficulty falling asleep; Arakawa, Tanaka, Toguchi, Shirakawa, & Taira, 2002). Similarly, Foley and colleagues (1995) found that an increase in napping frequency was accompanied by an overall decrease in sleep complaints and frequent nappers (>2 naps per two week period) reported shorter sleep onset latency compared to less frequent nappers (≤ 2 naps per two week period; Buysee et al., 1992). Additionally, several studies have reported a significant increase in 24-hour total sleep time for individuals who nap compared to those who do not (Campbell et al., 2005; Monk et al., 2001).
Finally, a large portion of the available literature on napping has found no relationship between napping and sleep. Good and poor sleepers did not differ in terms of napping frequency (Bliwise, 1992; Morin & Gramling, 1989), napping duration (Aber & Webb, 1986), or both napping frequency and duration (Johnston, Landis, Lentz, & Shaver, 2001; Morgan, Healey, & Healey, 1989; Morin & Gramling, 1989). Similarly, Jean-Louis and colleagues (2000) found that afternoon and evening naps were not associated with nocturnal sleep duration, sleep efficiency, or total wake time. Contrasting with the improved sleep associated with napping as reported using sleep diaries, Buysee and colleagues (1992) found no significant difference between frequent and infrequent nappers in terms of polysomnographic sleep variables.

Measurement of Sleep—Objectively

Polysomnography

Some of the discrepancies in previous findings result in part from differing methods of measuring sleep. Sleep can be assessed using objective and subjective methods. Considering the variations in the previous findings, both subjective and objective approaches will be used in the current study.

The traditional ‘gold standard’ for objectively measuring sleep is polysomnography (PSG). This procedure provides the most thorough and objective diagnosis of sleep disorders other than insomnia (Lichstein & Morin, 2000). Polysomnography assesses sleep by recording brain waves (electroencephalography – EEG), eye movements (electro-oculography – EOG), chin muscle tone (chin and anterior tibialis electromyography – EMG), respiratory effort, airflow, oximetry, and electrical activity of the heart (electrocardiography – ECG). Despite the thoroughness of this procedure, there are several limitations for its use with older adults. The procedure typically occurs in a laboratory setting. This setting may be uncomfortable for older adults and may not resemble their natural sleep environment (Libman, Creti, Levy, Brender, & Fichten, 1997).
Interestingly, individuals with sleep problems often sleep better away from their own home due to a lack of association between poor sleep and the new environment. Therefore, assessing an individual’s sleep away from home may result in an overestimation of their sleep quality. Also, the customary two night duration of a PSG study may not capture the highly variable nature of older adult sleep (Edinger, Marsh, McCall, Erwin, & Lininger, 1991). Finally, the cost of PSG for a large sample size can be prohibitive.

**Actigraphy**

Considering the limitations associated with the use of PSG, another objective measure of sleep, actigraphy, was employed in the current study. Actigraphy, used for over 25 years, involves the wearing of a wristwatch-like device, typically on the nondominant wrist. In contrast with PSG, actigraphy is relatively inexpensive, enables the individual to remain in their natural environment, and can record data continuously for up to 14 days. There are several actigraphic devices available for use. The Actiwatch-L® (Mini Mitter Co. Inc., 2001) was chosen because it utilizes the most up-to-date technology (i.e. digital integration) and has been validated with healthy older adults with insomnia (Mini Mitter Co. Inc., 2001).

**Measurement of Sleep—Subjectively**

Assessment of subjective appraisals of sleep can complement the objective data collected using actigraphy. Sleep diaries were used to subjectively measure sleep in the study. Additionally, participants were classified into four sleep subtypes using sleep diary and other self-report information.

**Sleep Diary**

Sleep diaries are a self-report description of sleeping behaviors recorded on a written log by the participant. Example behaviors that the participant may report include the time he or she
goes to bed, the amount of time required to fall asleep, and the number of awakenings during the
night. The diaries are typically completed in the morning once the participant wakes up.

Sleep Classification System

A number of self-identified poor sleepers do not experience objectively poor sleep as
measured by polysomnography or actigraphy. Interesting, these individuals do not differ from
individuals objectively diagnosed with insomnia in terms of the symptoms experienced
(Lichstein, Wilson, Noe, Aguillard, & Bellue, 1994). The diagnostic label for this condition is
sleep state misperception (American Sleep Disorders Association, 1997), but it is commonly
referred to as subjective insomnia. Considering that clinicians focus their treatment on the
complaint aspect of insomnia, the study of subjective insomnia is critical.

McCrae and colleagues (2005) developed a classification system for identifying
individuals based on subjective complaints and subjective sleep quantity. Individuals are
classified into one of four sleep subtypes based upon the following criteria: 1) subjective
complaint of insomnia, 2) duration of insomnia complaint, 3) daytime functioning, and 4) sleep
pattern as measured by the sleep diaries. The classification system resulted in four sleep
subtypes: noncomplaining good sleepers, complaining good sleepers, noncomplaining poor
sleepers, and complaining poor sleepers (insomniacs) (Figure 2-1).

Measurement of Napping

Objectively Measured Napping (Actigraphy)

Previous studies have found that older adults often underreport their napping behavior.
Comparing subjective reports and EEG recordings of napping behavior, Jean-Louis and
colleagues (2000) found that volunteers correctly reported only 38% of their afternoon-evening
napping periods (with a false-positive reporting rate of 19%). Yoon and colleagues (2003a)
found that only 22.6% of older evening nappers reported their evening naps in sleep diaries. The
The present study addresses some of the concerns associated with the self-reporting of naps by older adults by using an objective measurement of napping, the Actiwatch-L® (Mini Mitter Co. Inc). In addition to the sleep parameters, a number of napping parameters can be derived from the Actiwatch data.

**Subjectively Measured Napping (Sleep Diary)**

In addition to objectively measured napping, it is possible to subjectively estimate napping using sleep diaries. Participants report on the number of minutes they spent napping for each day.

**Innovations of Research**

Despite the accumulation of research over four decades, the association between napping and sleep remains unspecified. Several methodological limitations may account for the lack of consensus. These shortcomings will be addressed by the current study.

Previous research has relied heavily on surveys or self-report sleep diaries to assess napping and sleep behavior in older adults. Studies of sleep patterns in postmenopausal women and healthy older adults reported that 62 – 77% of napping behavior was unreported when compared to objective measures of sleep (actigraphy and polysomnography; Jean-Louis et al., 2000; Yoon et al., 2003a). This limitation will be addressed in the current study by the use of an objective measure (actigraphy) of both napping and sleep, in addition to subjective measures (sleep diary), in order to more accurately assess napping and sleep behavior.

An additional limitation involves the variability inherent in napping and sleep behavior in older adults. Approximately 50% of older adults engage in napping behavior only one to two days per week (Beh, 1994). Napping and sleep behavior also varies from weekday to weekend (Buysse et al., 1992) with napping occurring more frequently during the week than on the weekends. The typical data collection period in previous research ranges from one to two days.
to a maximum of six days. Limited data collection periods may not accurately capture the variability in older adult napping and sleep behavior. The current study will address this limitation by extending the data collection period to 12 consecutive days.

Furthermore, prior research has typically examined the components of napping behavior in isolation. The current study aims to assess the differential impact of the three components of napping behavior (frequency, duration, and time of day) on sleep quantity.

Additionally, the current study will use a classification system for the study of sleep and napping. Sleep subtypes (a combination of qualitative and quantitative subjective estimates of sleep) will be examined for the first time in relation to napping behavior. This will allow for the simultaneous study of both healthy individuals and those diagnosed with insomnia within the same study.

Although these limitations have been addressed individually in previous research, this is the first study to simultaneously address these limitations.

![Insomnia Criteria](image)

**Figure 2-1.** Visual depiction of sleep classification system.
CHAPTER 3
STATEMENT OF PURPOSE

The main objective of the study is to examine the relationship between napping and sleeping behavior in older adults. Napping behavior will be studied 1) in relation to objectively and subjectively measured sleep quantity and 2) in relation to the four sleep subtypes. The two main objectives will be achieved through specific aims and associated subaims.

Specific Aim 1

The first specific aim is to investigate the relationship between napping behaviors and sleep quantity.

Subaim 1.1a

To investigate the relationship between subjectively measured napping behaviors (frequency\textsubscript{s} and duration\textsubscript{s} as measured by sleep diaries) and objective sleep quantity as measured by actigraphy (total sleep time\textsubscript{o}, sleep onset latency\textsubscript{o}, wake time after sleep onset\textsubscript{o}, and sleep efficiency\textsubscript{o}; the subscripts “s” and “o” are used to distinguish between the subjective and objective sleep variables). See Chapter four for operational definitions of the napping and sleep variables.

Subaim 1.1b

To investigate the relationship between subjectively measured napping behaviors (frequency\textsubscript{s} and duration\textsubscript{s} as measured by sleep diaries) and subjective sleep quantity as measured by the sleep diaries (total sleep time\textsubscript{s}, sleep onset latency\textsubscript{s}, wake time after sleep onset\textsubscript{s}, and sleep efficiency\textsubscript{s}).

Subaim 1.2a

To investigate the relationship between objectively measured napping behaviors (frequency\textsubscript{o}, duration\textsubscript{o}, and time of day\textsubscript{o} as measured by actigraphy) and objective sleep quantity
as measured by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Subaim 1.2b**

To investigate the relationship between objectively measured napping behaviors (frequency, duration, and time of day as measured by actigraphy) and subjective sleep quantity as measured by the sleep diaries (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Subaim 1.3a**

To investigate the relationship between time of day of napping categories (day and evening nappers versus daytime nappers) and objective sleep quantity as measured by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Subaim 1.3b**

To investigate the relationship between time of day of napping categories (day and evening nappers versus daytime nappers) and subjective sleep quantity as measured by the sleep diaries (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Hypothesis for Specific Aim 1**

The hypothesis for the first specific aim is that both the subjective and objective napping variables (frequency, duration, and time of day of napping) will be most strongly correlated with the sleep quantity variable of total time spent asleep for both objective and subjective sleep quantity.

Previous research has found significant associations between frequency (Hays et al., 1996), duration (Beh, 1994), and time of day (Yoon et al., 2003a) of napping and various sleep variables. Considering that prior research is mixed regarding the direction of the relationship between the napping and sleep variables, the direction of the proposed relationship between
napping and sleep cannot be predicted for the present study. Since total sleep time has been found to be the single best indicator of sleep quantity (Lichstein & Morin, 2000), it is hypothesized that the napping variables will most strongly be associated with total sleep time.

**Specific Aim 2**

The second specific aim is to identify the differences between the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) in terms of their napping behavior (frequency, duration, and time of day of napping) as measured by actigraphy and sleep diaries.

**Subaim 2.1a**

Investigate the extent to which the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) differ in terms of their objectively measured napping behavior (frequency, duration, and time of day as measured by actigraphy).

**Subaim 2.1b**

Investigate the extent to which the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) differ in terms of their subjectively measured napping behavior (frequency and duration as measured by sleep diaries).

**Hypothesis for Specific Aim 2**

The hypothesis for the second specific aim is that both subjective and objective napping variables (frequency, duration, and time of day of napping) will be differentially related to the four sleep subtypes. This aim is exploratory in that the sleep subtypes have not been studied previously in relation to napping behavior. Previous research has demonstrated a relationship between the four sleep subtypes and sleep behavior. Complaining good sleepers were found to
have poorer subjective sleep quantity in comparison to noncomplaining good sleepers. Specifically, complaining poor sleepers had a greater number of awakenings, greater wake time after sleep onset, poorer sleep efficiency, and more total wake time. The four sleep subtypes also differed in terms of objective sleep quantity. Complaining poor sleepers had greater sleep onset latency, poorer sleep efficiency, and greater total wake time (McCrae et al., 2005).
CHAPTER 4
METHODS

Procedure

A secondary data analysis was performed using data collected during a study conducted by McCrae and Rowe (2003). A convenience sample was recruited from the North Florida area. A variety of recruitment techniques were employed including media advertisements, community groups, and flyers. Recruitment materials described the research as a study of sleep patterns in the elderly. Participants were compensated $30 for their participation. Interested individuals were screened in two phases to determine if they met the criteria for inclusion. Phase one consisted of a brief telephone interview (15–20 minutes), and phase two involved an in-person interview either in the individual’s home (76%) or at a local continuing care retirement center (24%).

Individuals were excluded on the basis of six exclusionary criteria: 1) age younger than 60 years; 2) self-report of sleep disorder diagnoses other than insomnia (e.g., sleep apnea or narcolepsy); 3) self-report of sleep symptoms indicative of sleep diagnoses other than insomnia (e.g., heavy snoring, gasping for breath, leg jerks, daytime sleep attacks); 4) presence of severe psychiatric disorders (e.g., thought disorders or depression); 5) cognitive impairment (e.g., scoring in the impaired range on three or more subtests of the Cognistat); 6) use of psychotropic or other medications known to alter sleep (e.g., beta-blockers); and 7) medical conditions that impaired independent daily functioning (McCrae et al., 2005).

Data were collected at three periods during the study: baseline, end of first week, and end of second week. During the initial 1–1½ hour interview, participants read and signed an informed consent form approved by the University of Florida Institutional Review Board. Once consent was obtained, the Cognistat, and the demographics and health survey were administered
by a member of the research team. At this time, both the sleep diaries and the Actiwatch-L® were explained to the participants. The participants were advised to complete the sleep diaries and wear the Actiwatch-L® continuously for 14 days. At the end of the first week, the sleep diaries were collected from the participants and the data was downloaded from the Actiwatch-L®. At the end of the second week, the final week of sleep diaries and Actiwatch-L® data were collected. The Beck Depression Inventory-Second Edition, State-Trait Anxiety Inventory, State-Form Y1, and the PANAS were also completed at this time.

**Participants**

Of the 116 individuals recruited, 103 were enrolled in the study. Thirteen individuals were ineligible to participate in the study due to age, dementia, medication, and sleep apnea diagnosis. The mean age of the participants was 72.81 years ($SD = 7.12$). The majority of participants were European Caucasian (96%), female (66%), college educated (75%; $M = 16.34$ years, $SD = 2.92$), and married (59%). All of the participants lived in their own homes during the study.

**Measures**

Overviews of the nap and sleep variables, the demographics and health survey, the Cognistat, and the measures of daytime functioning are presented below. Additional information on the methodology for assessing napping and sleep is presented in the literature review.

**Operationalization of Sleep Variables**

**Objective sleep variables**

Objective sleep was measured using the Actiwatch-L®. Within the Actiwatch-L®, data is sampled 32 times per second over a 30 second epoch using an omnidirectional, piezoelectric accelerometer with a sensitivity of $\geq 0.01$ g-force. A sum of the peak activity counts for each 30 second epoch is downloaded to a PC and then analyzed by Actiware-Sleep vol. 3.3. (Mini Mitter Co. Inc., 2001). Three sensitivity settings (high, medium, and low) are provided by the software
for detecting wake/sleep periods. A high sensitivity setting was used in the current study since it provides high correlations with PSG measured total sleep time (.95) for healthy older adults (Colling et al., 2000) and for total sleep time (.73) and sleep onset latency (.93) for individuals with insomnia (Cook et al., 2004). Additionally, actigraphy has valid criterion-validity when compared to PSG (.80) and high test-retest reliability (0.92; Ancoli-Israel et al., 2003).

A validated algorithm is used to identify the activity of each epoch as wake or sleep (Oakley, 1997). With the high sensitivity setting, the threshold for wake is 20 activity counts. If the peak activity count for an epoch is ≥ 20, the epoch will be scored as wake. If the peak activity count for an epoch is < 20, the wake/sleep determination is made based on the activity that occurs in the two minute period surrounding the epoch. The wake/sleep determination if the activity count is < 20 is made based on following equation:

\[
\text{Total Activity for Epoch A} = E_{A-4} (.04) + E_{A-3} (.04) + E_{A-2} (.20) + E_{A-1} (.20) + E (2) + E_{A+1} (.20) + E_{A+2} (.20) + E_{A+3} (.04) + E_{A+4} (.04)
\]

where \( A \) = # of activity counts for the epoch being scored; \( E_{A +/- 1-4} \) = # of activity counts in adjacent epochs. If the Total Activity for Epoch A (weighted sum of activity counts) exceeded the threshold value of 20, then Epoch A is scored as wake; otherwise, it is scored as sleep (McCrae et al., 2005).

Using the Actiware-Sleep vol. 3.3. software (Mini Mitter Co. Inc., 2001), a number of sleep parameters are derived from the data including total sleep time, total wake time, sleep efficiency, and sleep onset latency. The definitions of the objective sleep variables used in the study are: sleep onset latency, total sleep time, sleep efficiency, and sleep onset latency. The definitions of the objective sleep variables used in the study are: sleep onset latency, total sleep time, sleep efficiency, and sleep onset latency.
until last awakening). The subscripts “s” and “o” are used to distinguish between the subjective and objective sleep variables.

**Subjective sleep variables**

**Sleep diary.** Subjective sleep quantity was measured using sleep diaries. The sleep diary (Lichstein, Riedel, & Means, 1999) was completed by each participant each morning for 14 days (see Appendix A). Although data was collected for 14 days, the first and last days of data were eliminated from the analysis as the actigraphy data for those days was incomplete. Four subjective sleep estimates were derived from the sleep diary data: sleep onset latency\(_s\) (initial time from lights out until sleep onset); wake time after sleep onset\(_s\) (time spent awake after initial sleep onset until last awakening); total sleep time\(_s\) (computed by subtracting total wake time from time in bed); and sleep efficiency\(_s\) (a ratio of total sleep time to total time spent in bed x 100).

**Sleep classification system.** The second subjective measurement of sleep that was employed was the sleep classification system. The specific criteria used to create the four sleep subtypes within the system are as follows. The criteria used to assess the three complaints and insomnia are: 1) subjective complaint of insomnia as indicated by affirmative responses to the following items on the demographics and health questionnaire: “Do you have a sleep problem? yes or no. If yes, describe (e.g., trouble falling asleep, long or frequent awakenings, sleep apnea).”; 2) duration of complaint for at least 6 months as indicated by response to the item on the demographics and health questionnaire: “How long have you had this sleep problem?”; and 3) impaired daytime functioning as indicated by scoring in the impaired range on at least one of the following measures: STAI > 36, BDI > 9, ESS > 7.3, or FSS > 5.4.

Participants were categorized as poor sleepers if they reported at least 3 nights a week of: (1) sleep onset latency >30 minutes or (2) wake time after sleep onset > 30 minutes. This criteria
for insomnia has been validated and is consistent with those commonly cited in the insomnia treatment literature (Lichstein, Durrence, Taylor, Bush, & Riedel, 2003). Individuals diagnosed with subjective insomnia correspond with sleep subtype of complaining good sleepers.

**Operationalization of Nap Variables**

**Objective nap variables**

Napping was measured objectively using actigraphy. Methodological questions have arisen regarding the sensitivity of actigraphy to distinguish between inactivity due to napping versus inactivity due to resting or the removal of the watch. Interestingly, the sensitivity setting (high) validated for determining sleep bouts in older adults is not applicable for identifying napping behavior in older adults. The use of a threshold of 20 activity counts per 30 second epoch results in an overestimation of daytime napping behavior. This is due in part to the misidentification of levels of inactivity (resting/watch removal) as sleep bouts. Therefore, an even higher sensitivity setting is required in order to differentiate mere inactivity from napping behaviors. In the present study a sensitivity setting of 12 enabled the detection of naps identified by participants in their sleep diaries.

Additionally, concerns about differentiating resting and watch removal from napping can be addressed by examining narratives in the participants’ sleep diaries (e.g. “watch removed from 6-8 p.m.”) and applying Webster’s rules (Webster, Kripke, Messin, Mullaney, & Wybourn, 1982) to distinguish between resting/watch removal and napping behavior. Specifically, Webster’s rules involve rescoring small wake periods surrounded by sleep periods as ‘sleep’ and rescoring small sleep periods surrounded by wake periods as ‘wake’. An additional method to be used in the study for differentiating ‘watch off’ periods from naps involves increasing the sensitivity level to the highest setting (0) and noting which periods are still identified as naps at this setting. If a period of inactivity is labeled as a nap at the highest
setting, the nap should be eliminated from the analysis. An activity count of ‘0’ contains less activity then would be required for human sleep and actually represents ‘watch off’ intervals (M. Reed, Minimitter, personal communication, June 6, 2005).

Finally, in order to encompass the range in the duration of naps of 5 to 45 minutes found in previous research, naps that ranged in duration from 5 to 180 minutes were included in the analysis.

**Frequency as measured by actigraphy.** Frequency refers to the total number of periods during the day (as measured by actigraphy) that were scored as sleep. The total number of inactive periods during the day was averaged over 12 days to create the nap ‘frequency’ variable.

**Duration as measured by actigraphy.** Duration refers to the total time in minutes that the actigraph was scored as sleep for discrete nap periods throughout the daytime. If there were multiple naps of different durations during the day, the mean nap duration for each day was calculated for each participant. An overall mean nap ‘duration’ was calculated by averaging the average daily nap durations over 12 days.

**Time of day.** Time of day was determined from the actigraphy data by converting the time each nap occurred into 24-hour clock time. The ‘time of day’ variable was created by summing the time of day of all naps for each participant and dividing by the number of naps for each participant. Subjective measures of the time of day of naps could not be determined from the information gathered by the sleep diary.

The above mentioned operationalization of time of day of napping involves averaging the time of day of naps for each participant and dividing by the total number of naps. While this calculation may accurately describe the time of day for nappers who consistently nap at the same
time each day, it may not accurately describe the time of day for more variable nappers. If a participant naps both in the morning and the evening, for example, averaging the time of day naps would suggest that they typically nap in the afternoon. In addition to the analysis of a continuous measurement of time of day of napping (subaims 1.2a and 1.2b), a categorical measurement was used that identified individuals who napped in the daytime versus the evening.

Time of day nap categories (used in subaim 1.3) were created by aggregating participants who napped during both the day and evening into the ‘day and evening nap’ group and participants who solely napped during the daytime into the ‘daytime nap’ group. Evening naps have been previously defined as out-of-bed sleep that occurs within the timeframe of within two hours to just before bed (Yoon et al., 2003b). A similar inclusion criteria was used in this study where a nap was labeled an evening nap if it occurred within two hours of the individual’s bedtime for the day being considered.

**Subjective nap variables**

Two subjective estimates of napping behavior can be derived using the sleep diary: frequency, and duration, (the subscript ‘s’ denotes subjectively measured napping). The ‘nap’ section of the sleep diary provides a place for the individual to record the total number of minutes spent napping prior to bedtime for each day.

**Frequency as measured by sleep diaries.** Frequency was determined from sleep diaries by summing the number of naps that were self-reported over 12 days and dividing by 12 to create the nap ‘frequency,’ variable.

**Duration as measured by sleep diaries.** Duration was derived from the sleep diary data by summing the total nap time reported for each nap on the sleep diary and dividing by the total number of days for which a nap was reported in order to create the nap ‘duration,’ variable.

Importantly, sleep diary nap duration, differs from actigraphy nap duration, in that it refers to the
average total daily nap duration, while the actigraphy nap duration refers to the average nap duration for each nap.

Although according to many participants the sleep diary nap duration typically reflects the duration for a single nap (they reported engaging in only one nap per day) it cannot be discerned whether the duration reported on the sleep diary refers to the average total daily nap duration or the average duration of individual naps.

Although the possibility exists that the duration and duration variables may be referring to different constructs, it is important to retain these variables for a couple of reasons. First, nap duration as recorded by sleep diaries is the traditional and most commonly employed method of assessing nap duration among the literature. Therefore, by retaining this variable in the study it will be possible to compare our results to previous findings. Additionally, sleep diaries are the method most commonly used by sleep clinicians to assess client’s sleeping behavior. Hence, the inclusion of sleep diaries in the present study will provide information that may have implications for the provision of treatment by clinicians. Second, nap duration as recorded by actigraphy provides the most sensitive estimate of nap duration. This method ensures that the nap duration that is recorded captures the duration of individual naps. Consequently, the information provided by both of these variables is valuable to the study.

**Demographics and Health survey**

This survey consists of 13 items collecting information on demographics, sleep disorder symptoms, physical health, and mental health (Lichstein et al., 2004) (see Appendix B). Health conditions were assessed as the number of conditions selected from the following list: heart attack, other heart problems, cancer, AIDS, hypertension, neurological disorder (seizures, Parkinson’s), breathing disorder (asthma, emphysema, allergies), urinary problems (kidney disease, prostate problems), diabetes, pain (arthritis, back pain, migraines), and gastrointestinal
disorders (stomach, irritable bowels, ulcers, gastric reflux). Self-report sleep questions on the survey contained information on whether the participant had a sleep problem and if they or a bed partner noticed heavy snoring, difficulty breathing or gasping for breath, frequent leg jerks, restlessness before sleep onset, sleep attacks during the day, or paralysis at sleep onset. If they answered yes to any of these problems, they were asked to describe the problem and indicate how often and for how long the symptoms had occurred.

**Cognitive Impairment**

Participants were screened for cognitive impairment using the Cognistat (The Neurobehavioral Cognitive Status Examination; Mueller, Kiernan, & Langston, 2001). This measure contains ten subscales measuring the domains of: orientation and attention, language, visual memory and constructional ability, verbal memory, calculations, reasoning, and judgment. Each domain area is initially assessed using a ‘screen’ item (e.g., a three stage command, “Turn over the paper, hand me the pen, and point to your nose”). If the participant does not correctly answer the screen item a set of follow-up items of increasing difficulty are administered. The test takes approximately 20 minutes to administer. Individuals who scored in the impaired range on three or more of the ten subscales were excluded from the study. The Cognistat has been found to more sensitively detect cognitive-impairment than the Mini-Mental State Exam (Fields, Fulop, Sachs, Strain, & Fillit, 1992) and to effectively differentiate between impairment due to psychiatric illness versus impairment due to organic cognitive impairment (Wiederman & Morgan, 1995). Interrater reliability was found to range from 0.997 to 1.00 (Cunic & Denny, 2001).
Daytime Functioning Measures

**Beck depression inventory—second edition (BDI-II)**

Depression was measured using the Beck Depression Inventory-Second Edition (BDI-II; Beck, Steer, & Garbin, 1996). This is a 21-item measure with a scale ranging from 0-3 measuring the severity of depressive symptoms (3 being the most severe). Scores range from 0 – 63. Scores within the 0 – 13 range indicate none or minimal depression, 14 to 19 indicate mild depression, 20 to 28 indicate moderate depression, and 29 to 63 indicate severe depression. Participants were asked to respond to the questions based on the previous two weeks. The BDI-II has demonstrated sufficient internal consistency reliability (.90) and concurrent validity (.69 - .76) (Storch, Roberti, & Roth, 2004). In the present study, the boundary scores for mild depression were used as the cutoffs for evidence of a daytime functioning complaint (BDI-II > 13).

**State-trait anxiety inventory, form Y1 (STAI)**

Anxiety was measured using the State-Trait Anxiety Inventory – Form Y1 (STAI-Y1; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). This is a 20-item measure with a 4-point scale indicating how often the statement is true. Scores range from 20 - 80 with higher scores indicating greater maladjustment. The scale assesses how often the individual experienced apprehension, tension, nervousness, and worry during the previous two weeks. The STAI-Y1 has a test-retest reliability coefficient of .92 and adequate criterion validity (> .70; Spielberger, 1989). Scores greater than 36 were used as evidence of a daytime functioning complaint. This cutoff was chosen, because a score of 37 is 1 $SD$ below the mean for psychiatric inpatients with a primary diagnosis of anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).


**Epworth sleepiness scale (ESS)**

The Epworth Sleepiness Scale (ESS; Johns, 1991) measures trait daytime sleepiness. For eight common, quiet daytime activities (e.g. watching television) respondents indicate how likely they are to fall asleep. The responses are based on the previous two weeks. Responses range from 0 (*would never doze*) to 3 (*high chance of dozing*). Total scores range from 0 to 24, with the higher scores indicating greater daytime sleepiness. Although adequate norms for the ESS are not available, Johns and Hocking (1997) administered the ESS to 331 corporate employees. They reported that normal sleepers scored, $M = 4.6, SD = 2.8$. Additionally, insomnia complaints were positively correlated with the ESS. Scores greater than 7.3 were used as evidence of a daytime functioning complaint. This cutoff was chosen, because it is 1 $SD$ above the reported mean for normal sleepers.

**Fatigue severity scale (FSS)**

The Fatigue Severity Scale (FSS; Krupp, LaRocca, Muir-Nash, & Steinberg, 1989) consists of 9 items assessing the experience of fatigue in different aspects of living. Responses range from 1 (*strongly disagree*) to 7 (*strongly agree*). Responses are averaged across the nine items, yielding a possible score range of 1 to 7. While normative data on the FSS are limited, Lichstein, Means, Noe, and Aguillard (1997) found individuals with insomnia seeking treatment at a sleep disorders center averaged 6.0 ($SD = 0.5$) on the FSS. A complaint of daytime function was supported by scores greater than 5.4. This cutoff was chosen, because it is 1 $SD$ below the reported mean for persons seeking treatment for insomnia.

**Data Analysis**

**Specific Aim 1**

The first specific aim is to investigate the relationship between napping behaviors and sleep quantity.
Subaim 1.1a

To investigate the relationship between subjectively measured napping behaviors (frequency, and duration as measured by sleep diaries) and objective sleep quantity as measured by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

Data analysis. A Canonical Correlation Analysis will be conducted to examine the interrelationships among the two metric independent variables of subjectively measured napping (frequency, and duration as measured by sleep diaries) and the multiple metric dependent variables of sleep quantity as assessed by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

A canonical correlation analysis was chosen because 1) the use of a multivariate analysis such as canonical correlation analysis controls for the inflation of experimentwise error rates and 2) canonical correlation analysis allows for the derivation of an optimal linear combination between a set of multiple independent variables and a set of multiple dependent variables (Afifi and Clark, 1996). Considering that canonical correlation analysis is a large-sample method potentially requiring 15 to 20 participants per measured variable (Barcikowski & Stevens, 1975), and considering the conceptual distinctions between objectively and subjectively napping and sleep, four separate analyses will be conducted for objectively and subjectively measured napping and objectively and subjectively measured sleep.

Canonical correlation analysis is particularly suited for analyzing this aim in that it allows for both an overall examination of the magnitude of the relationships that may exist between napping and sleep and the measurement of the relative contribution of each variable to the overall relationship between napping and sleep.
Subaim 1.1b

To investigate the relationship between subjectively measured napping behaviors (frequency\textsubscript{s} and duration\textsubscript{s} as measured by sleep diaries) and subjective sleep quantity as measured by the sleep diaries (total sleep time\textsubscript{s}, sleep onset latency\textsubscript{s}, wake time after sleep onset\textsubscript{s}, and sleep efficiency\textsubscript{s}).

**Data analysis.** A Canonical Correlation Analysis will be conducted to examine the interrelationships among the two metric independent variables of subjectively measured napping (frequency\textsubscript{s} and duration\textsubscript{s} as measured by sleep diaries) and the multiple metric dependent variables of sleep quality as assessed by sleep diaries (total sleep time\textsubscript{s}, sleep onset latency\textsubscript{s}, wake time after sleep onset\textsubscript{s}, and sleep efficiency\textsubscript{s}).

Subaim 1.2a

To investigate the relationship between objectively measured napping behaviors (frequency\textsubscript{o}, duration\textsubscript{o}, and time of day\textsubscript{o} as measured by actigraphy) and objective sleep quantity as measured by actigraphy (total sleep time\textsubscript{o}, sleep onset latency\textsubscript{o}, wake time after sleep onset\textsubscript{o}, and sleep efficiency\textsubscript{o}).

**Data analysis.** A Canonical Correlation Analysis will be conducted to examine the interrelationships among the multiple metric independent variables of objectively measured napping (frequency\textsubscript{o}, duration\textsubscript{o}, and time of day\textsubscript{o} as measured by actigraphy) and the multiple metric dependent variables of sleep quantity as assessed by actigraphy (total sleep time\textsubscript{o}, sleep onset latency\textsubscript{o}, wake time after sleep onset\textsubscript{o}, and sleep efficiency\textsubscript{o}).

Subaim 1.2b

To investigate the relationship between objectively measured napping behaviors (frequency\textsubscript{o}, duration\textsubscript{o}, and time of day\textsubscript{o} as measured by actigraphy) and subjective sleep quantity
as measured by the sleep diaries (total sleep time, wake time after sleep onset, total wake time, and sleep efficiency).

**Data analysis.** A Canonical Correlation Analysis will be conducted to examine the interrelationships among the multiple metric independent variables of objectively measured napping (frequency, duration, and time of day as measured by actigraphy) and the multiple metric dependent variables of sleep quantity as assessed by sleep diaries (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Subaim 1.3a**

To investigate the relationship between time of day of napping categories (day and evening nappers versus daytime nappers) and objective sleep quantity as measured by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Data analysis.** A Multivariate Analysis of Variance (MANOVA) will be conducted to examine the differences between the two non-metric independent variables (daytime and evening nappers and daytime nappers) in terms of the multiple metric dependent variables of objective sleep quantity as measured by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Subaim 1.3b**

To investigate the relationship between time of day of napping categories (day and evening nappers versus daytime nappers) and subjective sleep quantity as measured by the sleep diaries (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

**Data analysis.** A Multivariate Analysis of Variance (MANOVA) will be conducted to examine the differences between the two non-metric independent variables (daytime and evening nappers and daytime nappers) in terms of the multiple metric dependent variables of subjective sleep quantity as assessed by the sleep diaries.
sleep quantity as measured by the sleep diaries (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency).

Specific Aim 2

The second specific aim is to identify the differences between the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) in terms of their napping behavior (frequency, duration, and time of day of napping) as measured by actigraphy and sleep diaries.

Subaim 2.1a

Investigate the extent to which the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) differ in terms of their objectively measured napping behavior (frequency, duration, and time of day as measured by actigraphy).

Data analysis. A Multivariate Analysis of Variance (MANOVA) will be conducted to examine the differences between the four nonmetric independent variables (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) in terms of the multiple metric dependent variables of objectively measured napping behavior (frequency, duration, and time of day as measured by actigraphy).

Subaim 2.1b

Investigate the extent to which the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) differ in terms of their subjectively measured napping behavior (frequency and duration as measured by sleep diaries).

Data analysis. A Multivariate Analysis of Variance (MANOVA) will be conducted to examine the differences between the four nonmetric independent variables (noncomplaining
good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) in terms of the two metric dependent variables of subjectively measured napping behavior (frequency, and duration, as measured by sleep diaries).
CHAPTER 5
RESULTS

The main objective of the study was to examine the relationship between napping and sleeping behavior in older adults. The main objective was achieved by examining napping behavior in relation to 1) objectively and subjectively measured sleep quantity and 2) in relation to the four sleep subtypes. The two main objectives were achieved through specific aims and associated subaims. The results will be discussed separately for each subaim. Descriptive results of the characteristics of napping behavior of the sample are presented at the beginning of the results section.

Characteristics of Napping Behavior within the Sample

Three separate napping variables (frequency, duration, and time of day) were collected during the study. Two of the napping variables (frequency and duration) were collected using both objective (actigraphy) and subjective (sleep diary) methods. The third variable, time of day, of napping, was collected using actigraphy. See Chapter 4 for operational definitions of the variables. Three individuals were excluded from the following analyses because they did not engage in naps during the course of the study.

In terms of napping frequency, individuals engaged, on average, in 12 naps over the 12 day period as measured by actigraphy (see Table 5-1 for means, ranges, and standard deviations of the nap variables). In contrast, the participants self-reported napping (according to sleep diaries) on average, four out of the 12 days. According to actigraphy, the maximum number of naps recorded was 43 naps, indicating an average daily maximum of four naps. For the subjective sleep diary data, the maximum number of naps reported over the 12-day period was ten naps, with one nap per day as the maximum daily nap frequency.
The average nap duration recorded by actigraphy was 12 minutes and 26 seconds. The average nap duration reported by sleep diary (indicating the average total daily nap duration) was 18 minutes. The average nap duration recorded using actigraphy ranged from 0 to 17 minutes. The average nap duration reported by sleep diaries ranged from 0 to 152 minutes.

A paired samples $t$ test was conducted to evaluate whether the frequency and duration of naps reported by actigraphy and sleep diaries were significantly different. The results indicated that the nap frequency as measured by actigraphy was significantly higher than the nap frequency recorded using sleep diaries ($t \, [99] = -8.11, \, p < .001, \, \eta^2 = 0.40$). Conversely, the nap duration reported by sleep diaries was significantly longer than the nap duration recorded using actigraphy ($t \, [97] = -2.58, \, p < .05, \, \eta^2 = 0.06$).

In terms of the time of day of napping, the peak time of day of naps (the mode nap time of day for all naps of all participants) recorded by actigraphy occurred between 20:30 and 21:00 p.m. (see Figure 5-1 for the time of day of all naps). The average time of day of naps was between 14:30 and 15:00. Forty-seven percent of all of the naps occurred after 6 p.m. Fifty-eight percent of the sample engaged in an evening nap (a nap that occurred within two hours of bedtime) and 85% engaged in a daytime nap. All the participants who engaged in an evening nap, on average, also napped during the day.

Specific Aim 1

The first specific aim was to investigate the relationship between napping behaviors and sleep quantity.

Subjective Napping and Objective Sleep (Subaim 1.1a)

A canonical correlation analysis was conducted with subjectively measured napping behaviors (frequency, and duration as measured by sleep diary) as the independent variable set and objective sleep quantity as measured by actigraphy (total sleep time, sleep onset latency,
wake time after sleep onset, and sleep efficiency) as the dependent variable set. Of the two possible pairs of canonical variates, the first canonical correlation was statistically significant (Wilk’s $\Lambda = .78, p < .01$). The canonical correlation was .46 and accounted for 21% of the variance in the pair of variates. Table 5-1 shows the canonical coefficients and the structure correlations for the napping and sleep variables. According to a cutoff correlation of .35 for interpretation (Tabachnik & Fidell, 1989), nap duration, frequency, total sleep time, and sleep efficiency were the variables that contributed the most to the canonical variate. Individuals who engaged in a shorter nap duration and a smaller number of naps as measured by sleep diaries experienced longer total sleep time and a higher sleep efficiency as measured by actigraphy.

**Subjective Napping and Subjective Sleep (Subaim 1.1b)**

As in subaim 1.1a, a canonical correlation analysis was conducted to investigate subaim 1.1b. The independent variable set consisted of the subjectively measured napping behaviors (frequency and duration as measured by sleep diaries) and the dependent variable set consisted of the subjective sleep quantity variables (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency) as measured by the sleep diaries. The first canonical correlation of 0.42 was significant (Wilk’s $\Lambda = .80, p < .01$) and accounted for 18% of the variance in the pair of variates. Nap frequency, duration, and total sleep time contributed most to the canonical variate (Table 5-2). The greater the number of naps and the longer the duration of naps, the shorter the total sleep time.

**Objective Napping and Objective Sleep (Subaim 1.2a)**

A canonical correlation analysis was conducted with objectively measured napping behaviors (frequency, duration, and time of day as measured by actigraphy) as the independent variable set and objective sleep quantity as measured by actigraphy (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency) as the dependent variable set.
Objectively measured napping behaviors were not found to be significantly related to objectively measured sleep quantity (Wilk’s Λ = .88, \( p > .05 \)).

**Objective Napping and Subjective Sleep (Subaim 1.2b)**

A canonical correlation analysis was conducted to examine the relationship between the set of independent variables (objectively measured napping behaviors frequency, duration, and time of day, as measured by actigraphy) and the set of dependent variables (total sleep time, sleep onset latency, wake time after sleep onset, and sleep efficiency, as measured by sleep diaries). Objectively measured napping behaviors were not found to be significantly related to subjectively measured sleep quantity (Wilk’s Λ = .92, \( p > .05 \)).

**Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3a)**

Based on a distribution within the sample of 58% of the participants engaging in both a daytime and evening nap, and 27% of the sample engaging solely in daytime naps, the participants were divided into two groups: 1) day and evening nappers and 2) daytime nappers. A comparison involving participants who solely napped during the evening was not conducted as all of the participants who engaged in an evening nap also napped during the day.

A 2 (time of day of nap group) x 4 (objectively measured sleep quantity) MANOVA was performed to examine differences in objectively measured sleep among the two nap groups. A MANOVA, as opposed to a univariate analysis of variance, was employed in the study since it adequately controls for the experimentwise error rate and takes into account the correlations among the dependent variables (Stevens, 1986). Separate MANOVAs were performed for each of the subaims as is recommended when the outcome variables are conceptually clustered (Stevens, 1986).

There was a significant main effect for the nap groups [Wilk’s Λ = .81, \( F(4, 77) = 4.82, p < .01, \eta^2 = 0.19 \)]. For the size of the effect, eta-square is roughly equivalent to the \( R^2 \) used in
multiple regression (Grimm & Yarnold, 1995). According to Cohen (1977), for effect sizes measured via $R^2$ or similar indices, an effect size of .09 is considered medium and an effect size of .25 or greater is considered large. Therefore, the eta-square of 0.19 suggests a medium main-effect for nap groups.

Univariate tests revealed significant differences for sleep onset latency, $F(1, 80) = 4.37, p < .05, \eta^2 = 0.05$, wake time after sleep onset, $F(1, 80) = 14.27, p < .001, \eta^2 = 0.15$, and sleep efficiency, $F(1, 80) = 12.01, p < .01, \eta^2 = 0.13$, see Table 5-3 for means and standard deviations. Individuals who napped in the daytime and the evening had significantly less sleep onset latency (21 minutes), less wake time after sleep onset (7 minutes), and greater sleep efficiency (5%) as measured by actigraphy compared to those who only napped during the daytime. The size of the effect for the univariate tests ranged from small (for sleep onset latency) to medium (for wake time after sleep onset and for sleep efficiency).

**Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3b)**

A 2 (time of day of nap group) x 4 (subjectively measured sleep quantity) MANOVA was performed to examine differences in subjectively measured sleep among the two nap groups. There was not a significant main effect for the nap groups [Wilk’s $\Lambda = .93, F(12, 222.535) = 0.50, p > .05, \eta^2 = 0.25$]. This result indicates that there was not a significant difference between the two nap groups (evening and daytime nappers) in terms of their subjective sleep quantity (see Table 5-4 for means and standard deviations).

**Specific Aim 2**

The second specific aim was to identify the differences between the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) in terms of their napping behavior.
Sleep Subtypes and Objective Napping (Subaim 2.1a)

A 4 (sleep subtype) x 3 (frequency, duration, and time of day) MANOVA was performed to examine differences in objectively measured napping behavior among the four sleep subtypes. The multivariate main effect was non-significant [Wilk’s Λ = .93, F(9, 228.92) = .78, p > .05, η² = 0.02] indicating that the four sleep subtypes do not differ in terms of the frequency, duration, and time of day of napping as measured by actigraphy.

Sleep Subtypes and Subjective Napping (Subaim 2.1b)

A 4 (sleep subtype) x 2 (subjectively measured napping behavior) MANOVA was performed to examine differences in subjectively measured napping behavior among the four sleep subtypes. The multivariate effect was non-significant [Wilk’s Λ = .97, F(6, 186) = .43, p > .05, η² = 0.01] indicating that the four sleep subtypes do not significantly differ in terms of the frequency, and duration, of their naps as measured by sleep diaries.
Table 5-1. Mean nap frequency, duration, and time of day as measured by actigraphy and sleep diaries

<table>
<thead>
<tr>
<th>Nap variable</th>
<th>M</th>
<th>SD</th>
<th>Minimum value</th>
<th>Maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nap frequency&lt;sub&gt;a&lt;/sub&gt;</td>
<td>11.71</td>
<td>9.21</td>
<td>0</td>
<td>43.00</td>
</tr>
<tr>
<td>Nap frequency&lt;sub&gt;b&lt;/sub&gt;</td>
<td>4.26</td>
<td>3.31</td>
<td>0</td>
<td>10.00</td>
</tr>
<tr>
<td>Nap duration&lt;sub&gt;a&lt;/sub&gt;</td>
<td>12.44</td>
<td>1.96</td>
<td>0</td>
<td>17.00</td>
</tr>
<tr>
<td>Nap duration&lt;sub&gt;b&lt;/sub&gt;</td>
<td>18.11</td>
<td>21.91</td>
<td>0</td>
<td>152.14</td>
</tr>
<tr>
<td>Time of day of naps&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.62</td>
<td>9.87E-02</td>
<td>.33</td>
<td>.95</td>
</tr>
</tbody>
</table>

<sup>a</sup>Frequency refers to the total number of naps summed over 12 days
<sup>b</sup>Duration refers to the average nap length
Figure 5-1. Percentage of total naps taken by all participants that occurred during each half-hour interval of the 24-hour clock.
Table 5-2. Correlations of sleep diary napping, actigraphy sleep, and sleep diary sleep variables with the canonical variate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sleep Diary Napping</th>
<th>Sleep Diary Sleep</th>
<th>Actigraphy Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Napping&lt;sub&gt;s&lt;/sub&gt; and sleep&lt;sub&gt;o&lt;/sub&gt; (subaim 1.1a)</td>
<td>Napping&lt;sub&gt;s&lt;/sub&gt; and sleep&lt;sub&gt;s&lt;/sub&gt; (subaim 1.1b)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Canonical structure coefficient</td>
<td>Canonical coefficient</td>
<td>Canonical structure coefficient</td>
</tr>
<tr>
<td>Sleep Diary Napping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequency&lt;sub&gt;s&lt;/sub&gt;</td>
<td>-.72</td>
<td>-.00</td>
<td>.79</td>
</tr>
<tr>
<td>duration&lt;sub&gt;s&lt;/sub&gt;</td>
<td>-1.00</td>
<td>-1.00</td>
<td>.99</td>
</tr>
<tr>
<td>Sleep Diary Sleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total sleep time&lt;sub&gt;s&lt;/sub&gt;</td>
<td></td>
<td>-.89</td>
<td>-1.33</td>
</tr>
<tr>
<td>sleep onset latency&lt;sub&gt;s&lt;/sub&gt;</td>
<td></td>
<td>.07</td>
<td>.34</td>
</tr>
<tr>
<td>wake time after sleep onset&lt;sub&gt;s&lt;/sub&gt;</td>
<td></td>
<td>.15</td>
<td>.33</td>
</tr>
<tr>
<td>sleep efficiency&lt;sub&gt;s&lt;/sub&gt;</td>
<td></td>
<td>-.23</td>
<td>1.10</td>
</tr>
<tr>
<td>Actigraphy Sleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total sleep time&lt;sub&gt;o&lt;/sub&gt;</td>
<td>.98</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>sleep onset latency&lt;sub&gt;o&lt;/sub&gt;</td>
<td>-.28</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>wake time after sleep onset&lt;sub&gt;o&lt;/sub&gt;</td>
<td>.07</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>sleep efficiency&lt;sub&gt;o&lt;/sub&gt;</td>
<td>.49</td>
<td>.59</td>
<td></td>
</tr>
</tbody>
</table>

Note. Structure coefficients for aim 1.2a and 1.2b are omitted from this table because the canonical variate was not significant. Subscript ‘s’ denotes subjectively measured variables and subscript ‘o’ denotes objectively measured variables.
Table 5-3. Means and standard deviations for the time of day of nap groups for objective sleep

<table>
<thead>
<tr>
<th>Actigraphy sleep variables</th>
<th>SOL</th>
<th>WASO</th>
<th>SE</th>
<th>TST (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Daytime naps</td>
<td>26.50*</td>
<td>13.01</td>
<td>72.82***</td>
<td>24.65</td>
</tr>
<tr>
<td>Daytime and evening naps</td>
<td>20.00*</td>
<td>12.28</td>
<td>51.43***</td>
<td>21.99</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. ***p < .001
Table 5-4. Means and standard deviations for the time of day of nap groups for subjective sleep

<table>
<thead>
<tr>
<th>Sleep Diary sleep variables</th>
<th>SOL</th>
<th>WASO</th>
<th>SE</th>
<th>TST (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Daytime naps</td>
<td>25.61</td>
<td>16.74</td>
<td>25.19</td>
<td>23.50</td>
</tr>
<tr>
<td>Daytime and evening naps</td>
<td>23.92</td>
<td>19.73</td>
<td>28.72</td>
<td>26.28</td>
</tr>
</tbody>
</table>
CHAPTER 6
DISCUSSION

The main focus of the study was to examine the relationship between subjectively and objectively measured napping and sleeping behavior in a sample of community-dwelling older adults. Although a number of previous studies have examined this relationship, the association between napping and sleep remains unspecified. The present study sought to further define the relationship between napping and sleep by addressing several methodological limitations of the previous research. These limitations were addressed through the introduction of several innovations including: 1) the use of both subjective and objective measures of nap and sleep behavior, 2) capturing the inherent variability in sleep and napping behavior with an extended data collection period, 3) examining multiple aspects of napping behavior (frequency, duration, and time of day), and 4) using a classification of sleep subtypes, studying napping behavior simultaneously in both healthy individuals and those diagnosed with insomnia. The goal of the study was to further specify the relationship between napping and sleep through the use of the abovementioned innovations.

A common theme that emerged during the study was the complexity of the relationship between objectively and subjectively measured variables. Both objective (actigraphy) and subjective (sleep diary) measures were employed for the napping and sleep variables. The multiple subaims of the study allowed for various combinations of the subjective and objective variables. Depending on the mode of study (objective or subjective), napping had a differential association with nocturnal sleep. The results suggest that the relationship between napping and sleep may be moderated by the mode of measurement.

The differential results associated with objective and subjective measurement illustrate the differences between perceptions and objective assessment of sleep previously reported in the
literature. Poor sleepers have both underreported (Lichstein and Johnson, 1991) and overestimated (Morin, 1993) their sleep problems in comparison to PSG results. The fact that poor sleepers can inaccurately estimate their sleep problems suggests that the lack of correlation between objective and self-report measures may be due to an information processing issue rather than motivational factors (i.e. overestimating wake time in order to portray a severe sleep problem; Lichstein and Morin, 2000). The distinction between the perception and objective assessment of sleep is further illustrated by the diagnostic entity of ‘sleep state misperception’ (American Sleep Disorders, 1997). This diagnosis, as represented by the sleep subtype group of complaining good sleepers, involves complaints of insomnia without objective evidence of sleep problems. The existence of a condition such as sleep state misperception suggests that the experience of insomnia is affected both by perceptions of and the existence of objectively measured poor sleep. In fact, it has been suggested that unlike asymptomatic diseases such as hypertension which require tests for verification, it is the complaint aspect of insomnia that is of interest to researchers and clinicians (Lichstein and Morin, 2000). The results from this study replicate previous results on the differences between subjective and objective assessment of sleep and extend the field of research to include differences in the subjective and objective assessment of napping.

The final chapter is organized into four major sections. First the results will be reviewed and interpreted for each of the study’s specific aims. Second, the limitations of the study will be considered. Third, the theoretical and clinical implications of the study will be presented. Finally, future research directions stemming from the findings of the study will be proposed.

**Review of Study Findings**

The main objective of the study was to examine the relationship between napping and sleep in a sample of community-dwelling older adults. This objective was achieved through the
analysis of objective (actigraphy) and subjective (sleep diary) measures of napping and sleep. The findings are discussed in terms of the two broader aims of the study and the associated subaims. In addition, descriptive analyses of the characteristic napping behavior of the sample are discussed.

**Characteristics of Napping Behavior within the Sample**

In order to interpret further analyses of napping behavior, it is helpful to first describe the characteristics of the naps taken by the sample. These characteristics were collected using both subjective and objective methods. For the objective assessment of napping, the participants, engaged in, on average, one nap per day (nap frequency), with an average nap duration of approximately 12 minutes. While the peak time of day for naps for the sample was between 8:30 and 9:00 p.m., the average time of day of naps was between 2:30 and 3:00 p.m. For the subjective assessment of napping, the participants self-reported napping on average 4 out of the 12 days of assessment (nap frequency). The average self-reported nap duration was 18 minutes.

Interestingly, there were significant differences between the subjective and objective measures of nap frequency and duration. A greater average frequency of napping was identified by actigraphy while a greater average duration of napping was reported by sleep diaries. The time of day of naps could not be compared across subjective and objective data as only objective data was collected.

In terms of nap frequency, the subjectively reported average nap frequency of 4 naps over a twelve day period is consistent with previously reported results (Buysee et al., 1992). The frequency of naps recorded using actigraphy (12 over a 12 day period) is considerably higher than previously reported results. A possible explanation for the significantly higher frequency of naps assessed by actigraphy is that actigraphy may be capturing a greater number of evening naps than sleep diary. Yoon and colleagues (2003a) found only 22.6% of evening nappers
reported their evening naps in their sleep diaries. Additionally, large discrepancies in napping have been found between sleep diaries and PSG recordings (Jean-Louis, 2000). Corroborating these studies are anecdotal evidence from our participants suggesting that they tend not to record brief evening naps as a ‘nap’ on their sleep diary.

Additionally, the lack of elevated nap frequencies in previous studies may be due to the fact evening nap frequencies were not reported by the researchers (Yoon et al., 2003a; Yoon et al., 2003b; Yoon et al., 2004). If this data had been reported, elevated frequencies such as those captured in the present study may have been observed.

In terms of nap duration, previous studies have reported average nap durations ranging from 23.3 to 45 minutes per day (Jean-Louis et al., 2000; Shirota et al., 2002; Yoon et al., 2003a; Yoon et al., 2004). The average nap durations reported both by objective and subjective measures in this study are comparatively lower than previously reported results. An explanation for the much lower objectively measured average nap duration (12 minutes) is that the inclusion of evening naps (typically of shorter duration than daytime naps; Ancoli-Israel, 1985; Yoon, 2004;) would decrease the mean duration. While the sleep diary nap duration (18 minutes) is less than previously reported averages, it is still comparable to the lower range of average durations reported in the literature review (23.5 minutes). It is important to note that the subjective and objective duration variables were measuring different constructs. While durations as measured by actigraphy recorded the average duration for individual naps, duration as measured by sleep diaries reported the average daily duration for naps.

The final nap variable that was measured was time of day of napping. Both an average time of day of naps (between 2:30 and 3:00 p.m.) and an alternate measure of time of day, the peak time of day of naps, were calculated. The peak time of day of naps (a calculation of the
mode nap time of day for all naps of all participants) occurred between 8:30 and 9:00 p.m. This is consistent with previous studies that have found the evening to be the most characteristic time of day of napping for older samples (Ancoli-Isreal et al., 1985; Jean-Louis et al., 2000; Yoon et al., 2003a, 2004). Therefore, this study replicates previous findings indicating evening naps are prevalent in older adults.

Several theoretical explanations for the large number of evening naps within the sample exist. First, napping during the evening may represent an advance in circadian rhythms in older adults. Some older adults experience a ‘phase advance’ resulting in earlier bedtimes and earlier waketimes (Van Cauter, Leproult, & Kupfer, 1996; Van Coevorden et al., 1991; Yoon et al., 2003a). Therefore, out-of-bed sleep in the evening could represent the start of the nocturnal sleep period for some older adults.

An alternate explanation is that napping during the evening may represent a weakening of the alerting signal from the suprachiasmatic nucleus (Yoon et al., 2004). The suprachiasmatic nucleus is involved in generating a 24-hour rhythm for several bodily functions, including sleep. Action potentials within the suprachiasmatic nucleus fire in a 24-hour rhythm and reach a maximum firing at mid-day and then fall again at night. It is possible that evening naps could result from a premature drop in the firing of action potentials within the suprachiasmatic nucleus. As a result, evening naps may occur because the alertness of the individual is being insufficiently maintained. Finally, it is possible that increased evening naps within the sample could reflect greater sleep needs or trait sleepiness.

Each of these theoretical explanations for the prevalence of evening naps among the sample have different implications for nocturnal sleep. If the individual is experiencing a phase advance, napping in the evening could meet some of their nocturnal sleep need and may be
reflected in an earlier wake time and/or greater wake time after sleep onset. Similarly, if the individual naps during the evening due to a decrease in alertness, the sleep may meet some of their nocturnal sleep need and result in greater wake time after sleep onset and/or earlier wake times. Alternatively, if evening naps are resulting from greater sleep needs or trait sleepiness, by napping during the evening the individual could meet some of their sleep need without compromising their nocturnal sleep quality. Each of these explanations, or combinations of the explanations, could be implicated in the association between napping and sleep reflecting the complexity of the relationship between napping and sleep behavior.

**Subjective Napping and Objective Sleep (Subaim 1.1a)**

Individuals who engaged in naps of shorter duration and engaged in naps less frequently had greater total sleep time and a higher sleep efficiency. Greater total sleep time and higher sleep efficiency are both indicative of improved nocturnal sleep quantity.

This result is consistent with the hypothesis that subjective napping variables (frequency and duration) would be most strongly correlated with the sleep quantity variable of total time spent asleep. The hypothesis was non-directional because previous findings indicated that napping duration and frequency were both positively and negatively associated with nocturnal sleep. The current result supports the portion of prior findings that found higher frequencies (Hays et al., 1996; Monk, 2001) and longer duration (Beh, 1994) of napping are associated with an increased risk of sleep complaint. Within the present sample the negative relationship between napping and sleep was replicated. Decreased napping (frequency and duration) was correlated with increased sleep quantity (total sleep time and sleep efficiency)

Interestingly, the objective sleep variable of sleep efficiency was found to be significantly related to the napping variables. Although this relationship was not accounted for in the hypothesis, the association makes sense conceptually. Sleep efficiency consists of a ratio of total
time spent asleep to total time spent in bed. Considering that an increase in total sleep time was
associated with a decrease in napping duration and frequency, it follows that sleep efficiency
(which is composed in part from total sleep time) would also be implicated in the relationship
between napping and sleep.

**Subjective Napping and Subjective Sleep (Subaim 1.1b)**

As the frequency and duration of naps increased, the total sleep time decreased. This result
suggests that worse nocturnal sleep quantity as measured by sleep diaries is associated with
increased napping (frequency and duration) as measured by sleep diaries. This result is
consistent with the hypothesis that the napping variables (frequency, and duration) would be
most strongly correlated with total sleep time. Additionally, the negative association between
napping behaviors and nocturnal sleep demonstrated by this aim is consistent with previous
research (Beh, 1994; Hays et al., 1996; Monk, 2001).

Interestingly, the napping variables were not significantly associated with subjectively
measured sleep efficiency, but were associated with objectively measured sleep efficiency.
Using the same sample, McCrae and colleagues (2005) found that subjective measures of sleep
efficiency were not significantly correlated with objective measures of sleep efficiency. The
differences in the canonical variates derived for subjective napping and objective and subjective
sleep may be the result of the differences between objectively measured and self-reported sleep.

**Objective Napping and Objective Sleep (Subaim 1.2a)**

While subjectively measured napping was found to be significantly correlated with both
objective and subjective sleep quantity, there was no significant relationship between the
objective napping variables and objective sleep quantity. This result is contrary to our
hypothesis. While the direction of the relationship between napping and sleep was not predicted,
it was hypothesized that such a relationship would exist. The lack of a relationship is consistent
with previous findings that have shown nap frequency (Bliwise, 1992; Buysee et al., 1992; Morin et al., 1989), duration (Aber & Webb, 1986), and both nap frequency and duration (Johnston, Landis, Lentz, & Shaver, 2001; Morgan, Healey, & Healey, 1989; Morin & Gramling, 1989) failed to differentiate between good and poor sleepers.

Two likely explanations exist for the lack of relationship between objective napping and sleep. First, it is possible that the lack of significant interrelationships between these variables reflects a genuine lack of relationship between objectively measured daytime napping variables and objective sleep. As previous research has shown, several studies have failed to detect a relationship between napping and sleep. An alternative explanation is that actigraphy, with the use of a novel application for analyzing napping, is not a reliable measure of napping behavior. This methodological concern will be discussed further under the limitations portion of the discussion.

**Objective Napping and Subjective Sleep (Subaim 1.2b)**

Similar to the relationship between objective napping and objective sleep, objectively measured napping was found to be unrelated to subjectively measured sleep. This result is inconsistent with the hypothesis that objectively measured napping would be significantly associated with subjectively measured total sleep time. This result is consistent with a number of studies that have failed to find a significant relationship between napping and sleep (Bliwise, 1992; Buysee et al., 1992; Morin et al., 1989; Aber & Webb, 1986; Johnston, Landis, Lentz, & Shaver, 2001; Morgan, Healey, & Healey, 1989; Morin & Gramling, 1989). As suggested objective napping and objective sleep, the lack of findings may reflect a genuine lack of relationship between objectively measured napping and sleep, or may be due to a methodological limitation associated with the use of actigraphy to assess napping behavior. It is problematic to make the assertion that napping is or is not associated with nocturnal sleep. The presence or
absence of a relationship between napping and sleep appears to vary depending on the methodology of assessment used. The difference in the relationship between subjective and objective napping and sleep is further reinforced by the fact that while all of the subjective nap variables were significant, none of the objective nap variables were.

**Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3a)**

Considering the difficulty in capturing variable napping behavior with a single average time of day of naps variable, a categorical measurement was used in addition to the analysis of a continuous measurement of time of day. Individuals were divided into two groups - those who napped during the daytime and those who napped during the daytime and evening.

There was a significant difference found between those who napped during the day and those who napped both during the day and evening in terms of their objective sleep quantity. Essentially, those who napped during both the day and evening had significantly less wake time during the night. On average, day and evening nappers fell asleep 21 minutes faster than day nappers and were awake for seven less minutes during the night. Additionally, day and evening nappers had higher average sleep efficiencies (5% higher) compared to day nappers. The reduced wake time during the night for those who napped during the day and evening suggests that these individuals had greater consolidation of nocturnal sleep compared to day nappers.

This result is consistent with the hypothesis that objective napping would be significantly associated with objective sleep. This result differs from those that were obtained for subaims 1.1a and 1.1b in that increases of the napping variable (naps that occurred both in the day and evening) was associated with improved sleep whereas the earlier results suggested the opposite. This result also conflicts with conventional sleep hygiene recommendations that suggest individuals avoid napping altogether or restrict naps to before noon (Lichstein & Morin, 2000). The positive association between napping and sleep is consistent with previous literature.
(Arakawa et al., 2002; Buysee et al., 1992; Foely et al., 1995; Tanaka et al., 2002). This result is innovative in that for the first time nappers were divided into groups based on the portion of the day (am/pm) that the naps occurred. Furthermore, the results are clinically significant in addition to being statistically significant. A decrease in the average time to fall asleep of 21 minutes and an increase in sleep efficiency of 5% can have clinical significance for elderly sleepers. An average wake time after sleep onset of greater than 31 minutes can result in a diagnosis of insomnia. Therefore, a decrease in sleep onset latency of 21 minutes could have a significant impact on an individual’s sleep.

Possible interpretations of this finding are 1) older adults who engaged in both daytime and evening naps do experience better objectively measured nocturnal sleep and 2) the individuals who comprised the day and evening nap group may have greater sleep needs or trait sleepiness. Interestingly, objectively measured napping was not significantly related to objective or subjective sleep when it was analyzed as a continuous variable. The categorical approach to analyzing time of day of napping used in this subaim may more accurately capture the differential association between time of day of napping and sleep.

**Nap Categories: Day and Evening Nappers versus Daytime Nappers (Subaim 1.3b)**

There was no significant difference between the day and evening and the day nap groups in terms of their subjective sleep. This result is not consistent with the hypothesis that napping would be significantly (positively or negatively) associated with sleep. While a lack of relationship between napping and sleep has been reported in previous studies (Bliwise, 1992; Buysee et al., 1992; Morin et al., 1989; Aber & Webb, 1986; Johnston, Landis, Lentz, & Shaver, 2001; Morgan, Healey, & Healey, 1989; Morin & Gramling, 1989), this result is surprising considering the significant association found in subaim 1.3a.
Four Sleep Subtypes (Specific Aim 2)

The second specific aim involved identifying the differences between the four sleep subtypes (noncomplaining good sleepers, complaining good sleepers, noncomplaining poor sleepers, and complaining poor sleepers) in terms of their napping behavior (frequency, duration, and time of day of napping) as measured by actigraphy and sleep diaries.

The four sleep subtypes did not differ in terms of the frequency, duration, and time of day of napping. This aim was exploratory in that the four sleep subtypes had not previously been studied in relation to napping behavior. Hence, an association between the sleep subtypes and the nap variables was not hypothesized.

This aim allowed for the examination of a sleep classification system (McCrae et al., 2005) in relation to napping. The sleep subtypes are unique in that they classify individuals based on both subjective quantitative and qualitative estimates of sleep. The results suggest that regardless of whether poor sleep is based on qualitative estimates of sleep (complaining good sleepers), or quantitative estimates of sleep (noncomplaining good sleepers), these different experiences of insomnia are not differentially associated with the frequency, duration, or time of day of naps.

Study Limitations

Limitations of the present study include restricted generalizability of results, an inability to determine the direction of the association between napping and sleep, and methodological concerns. The use of a convenience sample restricted the diversity of the sample. The participants were primarily European Caucasian, college educated, and resided in their own homes. The homogeneity of the sample prevents reliable generalization to a diverse population. Additionally, individuals were excluded from the study if they presented with sleep disorders other than insomnia (e.g. sleep apnea, periodic leg movements). Approximately one half of the elderly population experience one or both of these conditions (Ancoli-Israel, Kripke, Mason, &
Kaplan, 1985). Previous research has examined the relationship between napping and respiration. Carskadon and colleagues (1982) have found an association between nocturnal breathing disturbances and the degree of daytime sleepiness. Buysee and colleagues (1992) found no main effect of napping frequency on an index for sleep apnea (AHI) or for periodic limb movements. Unfortunately, the relationship between breathing disorders or periodic limb movements and napping could not be explored in the current study as individuals with these conditions were excluded from participating in the study. Consequently, the results of the current study cannot be extended to a significant portion of the population diagnosed with other sleep complaints.

Because the observations in the current study are derived from cross-sectional data it is impossible to make any causal conclusions about the relationship between napping and sleep. Although there are underlying biological mechanisms to explain the relationship between napping and sleep (circadian rhythm and homeostatic drive), these mechanisms may work bi-directionally. Hence, although significant relationships between napping and sleep were observed, we cannot determine if this relationship is unidirectional (napping impacts sleep, sleep impacts napping) or bi-directional (napping and sleep both impact each other).

Finally, noticeable differences in the relationship between napping and sleep were observed depending on the methodology used to study napping. While these differences may accurately reflect the relationship between napping and sleep, it is also possible that the observed differences may in part be due to methodological limitations of the napping measures. Two measures (objective and subjective) were employed in the study. Strengths and weaknesses were associated with each measure. While actigraphy provides a sensitive measure of the individual napping behavior of each participant, it is a novel approach that has not previously been applied
to the study of napping behavior. Consequently, a limitation of the study is the use of a measure that has limited reliability data. Additionally, while many precautions were taken to prevent the misidentification of ‘watch-off’ periods as napping, it is possible that there were modest inaccuracies in the differentiation of wake/sleep periods. There are also limitations associated with the use of sleep diaries to assess napping behavior. Although sleep diaries are traditionally used to measure napping behavior, they have limited utility for assessing duration of napping and frequently, do not assess time of day of napping, and result in the underreporting of evening naps.

**Implications**

**Implications for Theory and Research**

A major implication for future research on napping and sleep involves the mode of measurement employed. This study was the first to compare multiple variables of napping and sleep using both subjective and objective measures. Accordingly, there were significant differences in the relationship between the constructs of napping and sleep depending on the mode of measurement (objective and subjective). The findings show that the study of the relationship between napping and sleep is further complicated by the methodology used. It would be helpful for future research to make a point of explicitly describing the methodology used and to recognize the strengths and weaknesses associated with each alternative.

**Clinical Implications**

In addition to exploring the theoretical association between napping and sleep, there are clinical implications for further defining this relationship. The services provided by health care professionals are beginning to reflect the changing U.S. demographics. Currently, 68% of psychologists provide services to older adults (Qualls, Segal, Norman, Niederehe, & Gallagher-Thompson, 2002). The existing number of psychologists providing services to older adults will
need to more than double to meet the growing demands of the aging population (Gatz & Finkel, 1995). In order to effectively assess and treat older adults, clinicians will need to understand the age-related changes (e.g. difficulty sleeping) that impact this population.

Considering the prevalence of insomnia among older adults (15 – 65%), there is a need to develop and implement treatments that target this disorder. Cognitive-behavioral treatments (CBT) are often employed to target insomnia in older adults. The restriction or elimination of napping behavior is a common element of the sleep hygiene component of cognitive-behavioral treatments (CBT) for insomnia (Lichstein & Morin, 2000). Interestingly, the empirical basis for this treatment recommendation is unclear. The results from the present study suggest that the relationship between napping and sleep varies and a uniform recommendation to restrict/eliminate napping may not meet the needs of older adults with insomnia. Additionally, there are implications for the selection of measures to assess napping behavior. The results suggest that differential relationships between the client’s napping behavior and sleep could be revealed depending on the mode of measurement (subjective or objective).

**Future Directions**

The results of the present study provide many potential directions for future research. First, considering the role that methodology played in the study of napping and sleep, future research is needed in order to establish reliability data for both objective and subjective measures of napping. Second, future research could further define the relationship between napping and sleep by examining the intraindividual variability of napping and sleep data. It is possible that there are individual differences in the relationship between napping and sleep and these individual differences may explain the lack of consensus in the field regarding the relationship between daytime naps and sleep. Third, it would be helpful to examine the role of cognitions as a possible mediator of the relationship between napping and sleep. There are differing opinions
as to the costs/benefits associated with daytime napping. Additionally, cultural issues play a role (e.g. the siesta nap is considered a necessity in some cultures). A considerable amount of research has examined the role of cognitions in exacerbating insomnia among older adults. It would be helpful to extend this body of research by examining the role of cognitions about napping and the subsequent impact of these cognitions on nocturnal sleep.

Conclusions

This study enabled the examination of the relationship between napping and sleeping behaviors in a sample of community-dwelling older adults. Not unlike previous research, the findings from this study were mixed regarding the relationship between napping and sleep. Depending on the mode of measurement employed (subjective or objective) napping was found to be associated with impaired nocturnal sleep, improved nocturnal sleep, and found to be unrelated to nocturnal sleep. Additionally, the prevalence of evening naps within samples of older adults was replicated in the current study. A strength of the study was the unobtrusive assessment of the elderly participants within their home environment. The use of actigraphy as opposed to PSG preserved the ecological validity of the study by allowing participants to engage in their typical activities while participating in the study.
APPENDIX A
EXAMPLE OF SLEEP DIARY

<table>
<thead>
<tr>
<th>ID#</th>
<th>BASELINE</th>
<th>TX</th>
<th>POST-TX</th>
<th>FOLLOW-UP</th>
</tr>
</thead>
</table>

Please answer the following questionnaire **WHEN YOU AWAKE IN THE MORNING**. Enter yesterday's day and date and provide the information to describe your sleep the night before. Definitions explaining each line of the questionnaire are given below.

### EXAMPLE

<table>
<thead>
<tr>
<th>yesterday's day</th>
<th>TUES 10/14/97</th>
<th>day 1</th>
<th>day 2</th>
<th>day 3</th>
<th>day 4</th>
<th>day 5</th>
<th>day 6</th>
<th>day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. NAP (yesterday)</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. BEDTIME (last night)</td>
<td>10:55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. TIME TO FALL ASLEEP</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. # AWAKENINGS</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. WAKE TIME (middle of night)</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. FINAL WAKE-UP</td>
<td>6:05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. OUT OF BED</td>
<td>7:10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. QUALITY RATING*</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. BEDTIME MEDICATION</td>
<td>Halcion 0.25 mg at 10:40 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Pick one number below to indicate your overall QUALITY RATING or satisfaction with your sleep.

1. very poor, 2. poor, 3. fair, 4. good, 5. excellent

Figure A-1. Sleep Diary (Lichstein, Riedel, & Means, 1999) used during the study.
HEALTH SURVEY

Please PRINT and Supply ALL Information

ID: ____________  Height ______  Weight ______

Race: ____________

1. Do you have a sleep problem? yes or no
   If yes, describe (e.g., trouble falling asleep, long or frequent awakenings, sleep apnea):
   ____________________________________________________________
   How long have you had this sleep problem? _______ years _______ months

2. Please indicate whether you or your bed partner have noticed any of the following:
   Are you a heavy snorer? yes no
   Do you have difficulty breathing or gasp for breath during sleep? yes no
   Do your legs jerk frequently during sleep or do they feel restless before sleep onset? yes no
   Do you have sleep attacks during the day or paralysis at sleep onset? yes no
   If yes to any of the questions under #2, please explain and indicate how often symptoms occur:
   ______________________________________________________________

3. Indicate with a check mark if you have the following health problems, and put the number of years you’ve had each problem:
   Yes Years
   __ Heart disease
   __ Cancer
   __ AIDS
   __ High blood pressure
   __ Neurological disease (e.g., seizures, Parkinson’s)
   __ Breathing problems (e.g., asthma, emphysema)
   __ Urinary problems (e.g., kidney disease, prostate problems)
   __ Diabetes
   __ Chronic Pain (e.g., arthritis, back pain, migraines)
   __ Gastrointestinal (e.g., stomach, irritable bowels, ulcers)

4. Please list any mental health disorders you have and the number of years you’ve had the disorder(s)
   ______________________________________________________________

5. List any other health problems you have (and the number of years you’ve had the problem).
   ______________________________________________________________

6. Medical and mental health disorders may disrupt sleep. Medication may also disturb sleep. Please list any disorder or medication that affects your sleep and describe how it affects sleep.
LIST OF REFERENCES


BIOGRAPHICAL SKETCH

Natalie Dautovich obtained her Bachelor of Arts degree with distinction at the University of Alberta in Edmonton, Alberta, Canada. She is currently enrolled in the doctoral program in counseling psychology through the Department of Psychology at the University of Florida. She is a member of the Sleep Research Lab.