Partnership Status, Relationship Quality, and Sleep among U.S. Older Adults

Jen-Hao Chen[*], Linda Waite, and Diane Lauderdale
University of Chicago

Abstract

Spousal relationships contribute to health at older ages. However, less is known about some of the possible mechanisms through which these relationships may affect health, including sleep. This study investigated the associations between partnership status, relationship quality, and sleep characteristics among older adults. Using innovative actigraphy data from the National Social Life, Health and Aging Project, this study advanced the literature by considering the role of relationship support and relationship strain on older adults' self-reported and objectively-estimated sleep characteristics. Married or partnered older adults had better objectively estimated sleep characteristics, including longer sleep duration, a greater percent of time in bed spent sleeping, less wake time after sleep onset, and a lower level of sleep fragmentation. Yet, partnership status was not associated with any of the self-reported sleep characteristics. Better relationship support was associated with some objectively-estimated characteristics: a greater percent sleep and less wake time after sleep onset. Relationship strain, however, was not harmful for either self-reported or objectively-estimated sleep outcomes. Additional analysis showed that partnership status and supportive relationship were associated with an increase in objective total sleep time in men but not in women. There was no gender variation in associations between relationship status and other objectively estimated sleep characteristics or subjective reports. These findings highlight the social-relational nature of human sleep at older ages and suggest that the impacts of spousal/partner relationships on sleep may play a role in some of the associations between relationships and health.

[*] Comments and suggestions can be sent to Jen-Hao Chen. 5801 South Maryland Ave MC2007 Chicago, IL 60637 Department of Health Studies, The University of Chicago. Email: jenhao@uchicago.edu

INTRODUCTION

Most individuals spend about one-third to one-fourth of the 24-hour day sleeping. Adequate sleep is vital for individual health and well-being. Past research has linked sleep duration and quality to physicalhealth, mental health and mortality (Cappuccio et al. 2009; Knuston et al. 2006; Mallon, Nroman, and Hetta 2002; Phillips and Mannino 2007; Schwartz et al. 1998). While sleep is an important health behavior with considerable health consequences, it has received relatively little attention in social and population studies of health. Research on health behaviors has tended to concentrate on behaviors where there is a wide consensus of which variations represent "better" or "moral" behavior, such as exercise, dietary patterns, alcohol consumption, or tobacco use. The quantity and quality of sleep is not viewed as a choice in the same way. The vast majority of sleep research remains laboratory-based clinical studies based on small number of participants. Our knowledge of the correlates and determinants of sleep in the general, non-clinical population remains quite limited.

This is an oversight because insights from medical sociology suggest that individuals' positions in the stratification system and relational world have profound and enduring impacts on their health (House, Landis, and Umberson 1988; Link and Phelan 1995). Motivated by the social relationship and health literature, a few recent studies have demonstrated a role for family relationships and social isolation on adults' sleep characteristics (Ailshire and Burgard 2012; Burgard 2011; Burgard and Ailshire 2009, 2013; Cacioppo, Hawkley, and Berntson 2002; Hale 2005). Findings suggest that unmarried men and women are more likely to report insufficient sleep and poor sleep quality (Grander et al. 2010; Hale 2005; Krueger and Friedman 2009). Aside from relationship status and network size, relationship quality also matters. Strained family

relationships were associated with more troubled sleep whereas supportive relationships were associated with more optimal sleep outcomes (Ailshire and Burgard 2012). However, most prior studies focud on younger adults, and all used survey questions about sleep as the outcome. Few studies have investigated the role of social relationships on sleep in later life or used objectively-estimated sleep characteristics.

This study builds on prior studies in social relationships and sleep to investigate the role of partner status and relationship quality on sleep characteristics among older adults. The unique contribution of this paper is to use objectively-estimated sleep characteristics in addition to survey responses. Examining older adults' sleep characteristics is important for a number of reasons. First, as of 2010, the older population comprises 13% of the U.S. population and the share is expected to rise 19% by 2030 (Population Reference Bureau 2011). Little is known about the determinants of sleep in the general population of older adults. Sleep disorders and complaints about sleep are more common among older adults (Neikrug and Ancoli-Israel 2010). Results from this study are intended as a contribution to our understanding of the social context of health among older adults and to a broader conceptualization of the social nature of human sleep in medical sociology.

BACKGROUND

Social Relationships and Health

Sociological literature on social relationships and health provide substantial theoretical motivation for understanding the relationship between spousal relationship and sleep at old ages. Social relationships constitute a major influence on health over the

life course (House, Landis, and Umberson 1988; Smith and Christakis 2008). Social ties affect health through a variety of mechanisms, including the provision of social support, social influence on health behaviors, and access to resources and information (Thoits 2011). Of specific social relationships studied, the spousal/partner relationship[†] holds the most significance for older adults. Because individuals' social networks shrink with age (McPherson, Smith-Lovin, and Brashears 2006; Schnittker 2007), older adults often have smaller social networks. Aside from the reduction in network size, older adults are less close to their network members, and have fewer non-primary group ties than younger adults (Cornwell, Laumann, Schumm 2008). Thus older adults become more dependent on their spouse or partner for social support and companionship. Curran, McLanahan, and Knab (2003), for example, found that the reliance on marriage or marriage-related networks increases with age. As the primary focus of social relationships gradually shift with age, spousal/partner relationships play a vital role in shaping health and well-being.

Indeed, a large literature has pointed to the importance of spousal relationships for the health of older adults. Elderly who are married or live with a partner are in general healthier, happier, and live longer (Hughes and Waite 2002; Lund et al. 2002; Michael et al. 2001; Sarwari et al. 1998). As such, marital disruption is more harmful for health at older ages, particularly for men (Bennett 2006; Williams and Umberson 2004). However, there is also evidence that any marriage is not always better than no marriage at all. Social relationships have both positive and negative features (Umberson, Crosnoe, and Reczek 2010), and the quality of the relationship matters. The marital relationship can be

[†] While studies on younger adults show differences between marriage and cohabitation, extant evidence suggests this is not the case for older adults. A recent study by Brown and Kawamura (2010) found that cohabitators and marrieds show no difference in relationship quality. As such, this study considers spousal and partner relationship together.

can also be a source of stress characterized by conflicts and demands. Prior studies have shown that poor marital quality is related to poorer immune function, physical illness and lower levels of self-rated health status among older adults (Coyne and Delongis 1986; Levenson and Gottman 1985; Kiecolt-Glaser et al. 1987; Seaman 2000). In addition, poor spousal relationship can intersect with the aging process. For example, marital conflict and marital strain can accelerate the decline of self-rated health with age (Umberson et al. 2006), and amplify the impact of physical illness and functional limitations on mental health (Bookwala and Franks 2005; Warner and Kelley-Moore, 2012). These findings point to the powerful but complex processes through which spousal/partner relationships and relationship quality can affect health at old ages.

Spousal Relationship and Sleep among Older Adults

Although prior research has linked spousal relationships to numerous health outcomes in older adults, sleep remains a relatively understudied topic. In recent years, a handful of sociological studies illustrate the social-relational nature of human sleep. Extant evidence suggests that marital status appears to be a protective factor for poor sleep (Gradner et al. 2010; Hale 2005; Krueger and Friedman 2009). Marital status, however, can also undermine sleep quality particularly for women because of the role strain associated with caregiving work (Burgard 2011; Maume, Sebastian, and Bardo 2009, 2010; Venn 2008).

Three mechanisms have been suggested to link partnership status to sleep at older ages: (1) physical presence of a co-sleeper, (2) social support, companionship and emotional support, (3) relational demands and strain. First, sharing a bed with a spouse or

partner may impact sleep outcomes directly. A spouse or partner may snore or move around the bed an directly disturb sleep. Different sleep schedules may also disrupt sleep and undermine sleep quality. On the other hand, the presence of a spouse or partner may contribute to feeling safe at night, which may be supportive for sleep. Second, a spouse or partner may provide emotional support, material resources, or information that can buffer against the harms of stressful events (Thoits, 2011). Prior studies demonstrate that supportive spousal relationships moderate the impacts of stressful life events on physical and mental health (Pearlin and Johnson 1977); this may potentially limit the effects of stressors on sleep. Furthermore, a spouse or partner also offers companionship that can be consequential for sleep. Clinical and epidemiological studies demonstrate that loneliness undermines sleep quality (Cacioppo et al. 2002; Kurina et al. 2011). As such, a good spousal/partner relationship may potentially be supportive for better sleep. Third, a negative intimate relationship could undermine sleep. Relational conflicts and demands represent a major source of stress in people's lives and diminish mental as well as physical health. Prior studies suggest that negative social relationships may be more consequential for individual health than positive social relationships (Ailshire and Burgard 2012).

Taken together, previous studies suggest that we expect a positive correlation between relationship support and better sleep characteristics and a negative correlation between relationship strain and better sleep characteristics in older adults. Since the spousal/partner relationship can be a source of support or strain, the theory provides little guidance in the overall direction of association between partnership status itself and sleep characteristics among older adults.

The Present Study

Using data from the second wave of the National Social Life, Health and Aging Project (NSHAP), a nationally representative sample of older adults aged between 62 and 91 in 2010-2011, we empirically assessed the role of partnership status and relationship quality on older adults' sleep characteristics. An innovative feature of the present study is the use of both self-reported survey sleep data and actigraph-estimated sleep characteristics, allowing for an investigation of subjectively and objectively estimated sleep features at the same time. Almost all prior population studies of social conditions and sleep have just used self-reported sleep characteristics. Sleep is a complicated behavior and experience, consisting of multiple domains such as duration, timing, restfulness, awaking during the nights, and subjective impression of the overall sleep experience. As such, prior studies only provide a partial understanding of the relationship between social relationships and sleep. Furthermore, while individuals' subjective sleep experience is an important aspect of human sleep, survey questions have a number of limitations. Answers to these questions may be heavily affected by the interview context. Respondents may not know how much they sleep or accurately remember their "usual" falling sleep and waking up times. Accurately answering these difficult questions may be particularly challenging for older adults. As such, prior estimates of the correlations between social relationships, total sleep time, sleep timing and sleep quality may be biased.

To address this concern, the present study examined both survey-based and objectively-estimated sleep characteristics. In contrast to prior studies which exclusively

focus on individuals' subjective sleep experience, this study provides a more comprehensive view of sleep patterns among older adults.

METHOD

National Social Life, Health and Aging Project

The National Social Life, Health, and Aging Project (NSHAP) is a population-based, longitudinal study of health, social life, and well-being among older Americans. A nationally-representative probability sample of community-dwelling individuals aged 57-85 was selected from households across the U.S. screened in 2004. African-Americans, Latinos, men and the oldest-old (75-84 years at the time of screening) were over-sampled. The first wave of data collections was conducted in 2005-2006 and the second wave was conducted in 2010-2011. The second wave of data collection also extended the sample to include the spouses and cohabiting partners of Wave 1 respondents. Partners were eligible to participate in NSHAP second wave if they resided in the household with the Wave 1 respondent at the time of the second wave interview and were at least 18 years of age. This yielded a total of 3,377 individuals (1,539 men and 1,838 women) with completed Wave 2 interview data.

For the second wave of data collection, one-third of the primary respondents were randomly selected to participate in an additional activity and sleep study. Of 1117 selected individuals, 897 agreed (220 refused) to participate the activity and sleep study. A wrist actigraph and activity and sleep booklet then were mailed to each participant to collect information about the respondent's activity levels over three full days (72 hours total). Eventually, 819 individuals completed the activity study. After excluding 39

individuals with no useable actigraph data, the activity study yielded a sample of 780 individuals with completed actigraphy data. Among these 780 individuals, 53 were out of the age eligible range of the second wave survey (they were all spouses/partners) and were excluded from the statistical analyses. As a result, the present study includes data from 727 individuals aged 62 to 90. Detailed socio-demographic data on individuals were obtained from the Wave 2 master files and linked to the corresponding actigraphy data.

Measures

Self-report sleep characteristics. Survey questions about sleep characteristics included self-reported hours of sleep and several questions about sleep quality. First, each respondent was asked to report his or her usual bedtime and wake up time, separately for weekdays and weekends: "What time do you usually go to bed and start trying to fall asleep?" and "What time do you usually wake up?" Using this information, we calculated each respondent's usual sleep duration for weekdays and weekends separately. Next, we multiplied weekday sleep duration by five and weekend sleep duration by two and divided by seven to obtain an estimate of self-reported average weekly total sleep time. Second, NSHAP also included five questions related to individual sleep quality, each asking about the frequency of a sleep characteristic. The first question was part of the CESD instrument: "During the past week, my sleep was restless?" The remaining four questions were drawn from the sleep questions module from the Health and Retirement Study (HRS), including "How often do you have trouble falling asleep?", "How often do you have trouble with waking up during the night?", "How often do you have trouble with waking up too early and not being able to fall asleep again?", and "How often do

you feel really rested when you wake up in the morning?". Response categories for these questions were: most of the time = 2, sometimes = 1, rarely or never = 0. Factor analysis showed that these five items loaded onto a single factor. We created a troubled sleep scale by summing all items (after reverse coding the last one, ranging from 0-10) and standardizing the score based on our final sample. The troubled sleep scale has an alpha of 0.72.

Actigraph-estimated sleep characteristics. The objective sleep measures were derived from the actigraphy data. The Actiwatch (Actiwatch Specturm, Philips/Respironics, Andover MA) records intensity and frequency of movement using a piezoelectric linear accelerometer with 15-second epochs. The Actiwatch continually registers wrist movements, and the sum of all wrist movements during each epoch is saved as an activity score. Data from the Actiwatch were downloaded and analyzed using the manufacturer's Actiware software version 5.59 (Philips/Respironics 2010). In the present study, we focused on four actigraph-estimated sleep characteristics: (1) total sleep time (defined as the total duration of all epochs scored as sleep within the major sleep interval, that is the time from the first epoch scored as sleep to the last epoch scored as sleep for the primary sleep interval in each 24 hours, (2) percent sleep (defined as the percent of the sleep interval that is actual sleep), (3) sleep fragmentation index (ranging from 0-100). an indicator of sleep disruption that is the sum of two percentages: the percentage of the sleep interval spent moving and the percentage of immobile periods (i.e., contiguous epochs with no movement) that are no longer than one minute), and (4) wake after sleep onset (defined as the total minutes awake during the sleep interval.

Percent sleep, sleep fragmentation, and wake after sleep onset can be considered as actigraph-estimated sleep quality indicators.

Partnership status and relationship quality. Each respondent was asked whether he or she lived with a spouse or unmarried partner in the household. The answer was used to create a binary indicator of partnership status. Our measures of relationship quality were derived from 9 items. Each respondent answered a series of questions assessing their spousal/partner relationship. First, each respondent was asked about his or her spouse. These questions included: (1)" How often can you open up to your spouse if you need to talk about your worries?" (2) "How often can you rely on your spouse for help if you have a problem?" (3) "How often does your spouse make too many demands on you?" (4) "How often does your spouse criticize you?" and (5) "how often does your spouse get on your nerves?" The four responses categories ranged from "hardly ever or rarely = 1" to "often = 4".

In addition, respondents were asked: (6) "How close they felt their relationship with their spouse was" with answers ranging from not very close, somewhat close, very close to extremely close, (7) "How happy their relationship with their spouse was" with answers ranging from very unhappy (coded as 1) to very happy (coded as 7), (8) "How they liked to spend their free time together" with options including doing things together, doing some things together, and doing things separately, and (9) "How emotionally satisfying they found their relationship with their current or most recent sexual partner" with options of extremely satisfied, very satisfied, moderately satisfied, slightly satisfied, or not at all.

Because answer categories varied from question to question, to obtain consistent response categories across all items, we recoded these measures in the following ways. For relationship happiness, emotional satisfaction, and relationship closeness, we collapsed the categories at the low end of the scale since answers to these questions were skewed. Specifically, we recoded relationship happiness as 0=unhappy (originally 1,2,3,4), 1=happy (originally 5,6), and 2=very happy (originally 7). We recoded emotional satisfaction as 0=not at all, slightly, or moderately, 1=very, 2=extremely. We recoded relationship closeness as 0=not very or somewhat, 1=very, 2=extremely. For the remaining six questions, we collapsed the categories of never or hardly ever and rarely.

To form relationship quality scales, we performed exploratory factor analysis, which loaded these 9 items into 2 factors. We referred the first factor as relationship support (α =0.68) and the second factor as relationship strain (α =0.58). Relationship support scale included five items: rely on partner, open up to partner, relationship happiness, relationship closeness, and time with partner. Relationship strain scale included three items: criticizing partner, making demands, and getting on nerves. Both scales were the sum of all items. The relationship support scale ranged from 0 to 10 and the relationship strain scale ranged from 0 to 6.

Covariates. Respondent's education was categorized as less than high school, high school or equivalent, some college education, bachelor's degree or higher. Race and ethnicity distinguished white, African American, Hispanic, and Others. A dichotomous variable indicated whether the respondent was retired at the time of the interview. We also adjusted for self-rated physical health and self-rated mental health which were assessed with questions: "Would you say your health is excellent, very good, good, fair,

or poor?", and "What about your emotional or mental health? Answers to both questions included five levels. Higher values indicated better health. We treated the two variables as continuous measures. Log household income and values of household assets were used as indicators of respondents' economic standing. We also controlled for gender and age.

Analytical strategy. We began with weighted descriptive statistics of older adults in the NSHAP sample. Next, we examined the relationship between partnership status, relationship quality, and sleep characteristics adjusted for social and demographic characteristics using OLS regressions. More specifically, the first analysis assessed the impact of partnership status on self-reported and actigraph-estimated characteristics. The second analysis examined the influence of relationship quality (as measured by relationships support and relationship strain scales) on sleep characteristics among those married or partnered. The study used multiple imputation to account for potential biases resulting from missing data in the control variables. Multiple imputation involves replacing missing values with predictions based on other observed variables using the Monte Carlo technique (Rubin 1987). In contrast to single imputation, which replaces each missing value with a predicted value, multiple imputation replaces several missing values with repeated imputation inference, creating several complete datasets. The combined results produce better estimates of the missing values that create uncertainty around the missing data (Allison 2002). All regression analyses were survey weighted using Stata 12 (StataCorp 2011).

RESULTS

Descriptive statistics

Table 1 presents weighted descriptive statistics. The first column shows the descriptive statistics for 727 respondents. About 54% of the sample was female. The average age was 72. A majority of respondents were White (83%), retired (74%), and had at least a high school level of education (86%). The respondents had an average household income of approximately sixty thousand dollars and average household assets of approximately six hundred thousand dollars. The great majority of respondents reported their physical and mental health as good, very good, or excellent.

On average, respondents reported usual total sleep time of 493 minutes (or 8.27 hours). The mean troubled sleep scale score was 5.85 (ranging from 0 to 12). The average actigraph-estimated sleep duration was 435 minutes (or 7.25 hours). Respondents spent 82% of the total bedtime asleep (percent sleep) and the average wake time after sleep onset (WASO) was 39 minutes. The mean sleep fragmentation index was 14 (ranging from 0 to 100). Two-thirds of respondents were currently married or lived with a partner. Among those married or lived with a partner, the average rating of relationship support scale was 8.08 (ranging from 0-10) and relationship strain scale was 1.54 (ranging from 0-6).

The second and third columns show descriptive statistics by gender. On average, women in the sample were younger than men and were more likely to remain in the labor force. However, women in general had lower socioeconomic status. Older women in the sample were less likely to have a college education, less likely to live with a partner or have a spouse, and had less income and assets than older men. In terms of sleep characteristics, women reported more sleep complaints and shorter total sleep duration than men. However, women showed better actigraph-estimated sleep characteristics than

men, as reflected in longer total sleep time, higher percent sleep, less wake after sleep onset, and lower sleep fragmentation.

Partnership status, relationship quality and sleep

Table 2 presents results of OLS regression regressing self-reported and actigraph-estimated sleep characteristics on partnership status controlling for all previously described demographic and social variables. Our estimates show that partnership status was not associated with either self-reported sleep time or the troubled sleep scale. In other words, married or partnered older adults did not report more favorable sleep outcomes. This is an unexpected finding as prior studies of adults have found that marital status significantly correlated with self-report sleep duration and quality (Hale 2005). Turning to actigraph-estimated sleep characteristics, patterns were quite different. Our results showed that partnered individuals had longer total sleep time and spent a greater share of their time in bed asleep than did the unpartnered. They also showed less sleep fragmentation and spent less time awake after sleep onset. While partnership status was not associated with better self-reported sleep outcomes, those with a spouse or partner status actually had longer total sleep time and better sleep quality using objectively-estimated sleep measures. Aside from partnership status, several demographic factors were associated with sleep characteristics. Table 2 shows that women had better sleep outcomes than men. Women slept 20 more minutes in actigraph-estimated sleep time than men despite their reporting shorter sleep duration than men. Women also had lower levels of sleep fragmentation. Age was positively correlated with actigraph-estimated total sleep time. Higher levels of education were associated with decreased self-report

total sleep time and time awake after sleep onset. Self-rated mental health was significantly associated with self-reported sleep characteristics. Respondents reported better mental health also reported less total sleep time and lower levels of troubled sleep. As expected, retirement was associated with more self-reported total sleep time. Interestingly, household income and household assets were not associated with any self-reported or actigraph-estimated sleep outcomes.

After examining the association between partnership status and sleep characteristics, we turned to examine the role of relationship quality on sleep characteristics among those with a spouse or partner. Table 3 presents the results. As Table 3 shows, neither supportive relationship nor strained relationship was associated with self-reported sleep characteristics among the partnered. Turning to actigraph-estimated sleep characteristics, we again observed different patterns. First, while we hypothesized a negative effect of relationship strain on sleep outcomes, our estimates found no statistically significant correlations between the relationship strain scale and actigraph-estimated sleep characteristics. Relationship strain did not compromise one's sleep time or sleep quality. Second, as expected, relationship support was associated with more favorable sleep outcomes. Specifically, an increase in the relationship support scale was associated with an increased percent sleep and a decreased wake time after sleep onset. Taken together, these findings suggest that relationship support is more consequential for objectively estimated sleep characteristics than relationship strain among partnered older adults.

Additional Analysis

Prior studies have suggested that the health of women is more vulnerable to poor marital quality than the health of men because women exhibit greater physiological arousal in response to relational conflicts than men (Robles and Kiecolt-Glaser; Umberson and Williams 2005). This concern motivated us to test the gender variation in the association between partnership status, relationship quality, and sleep characteristics. Results (not shown) indicate that partnership status was associated with longer actigraphi-estimated sleep duration in men but not in women. Specifically, partnership status was associated with an increase in men's actigraph-estimated total sleep time by approximately 45 minutes but had no impact on women's sleep time. None of the other interaction terms, however, were statistically significant, suggesting that partnership status and relationship quality had similar effects on men and women's sleep quality.

In addition, our original troubled scale included an item from the Center for Epidemiologic Studies Depression Scale (CESD) that was not part of the four items sleep quality questionnaire. We generated a new troubled sleep scale using the four questions only and replicated previous statistical analyses. Our patterns (not shown) did not change with this new scale. To address the concern that married and living with a partner may have relevant differences, we excluded 25 partnered individuals and replicated all analyses with the married only. While the coefficients were a little different, the results were otherwise unchanged. Finally, prior studies from health sciences suggest that both long sleep duration and short duration were considered risk factors for poor health and mortality, implying that an optimal amount of sleep is intermediate. As such, the relationship between partnership status and relationship quality on total sleep time may be U-shaped rather than linear. To address this issue, we first transformed self-reported

and actigraph-estimated total sleep time into ordinal variables with three categories: short sleep duration, intermediate sleep duration, and long sleep duration. We then examined the role of partnership status and relationship quality on odds of having short sleep duration and long sleep duration using multinominal logistic regressions. Results (not shown) were that neither partnership status nor relationship quality scales were associated with increased odds of short sleep duration and long sleep duration for self-report and objectively estimated measures.

DISCUSSION AND CONCLUSION

This study provides the first consideration of spousal/partner relationship and both subjective and objectively-estimated sleep characteristics in a nationally-representative data of older adults. The innovative design of NSHAP allows for an in-depth investigation of the associations between relationships and multiple dimensions of sleep characteristics at older ages. In contrast to prior studies that exclusively focused on subjective aspects of sleep, the present study provides a more comprehensive view of social relationships and sleep. Results offer new insights about sleep among older adults.

We explored several research questions. First, we asked whether partnership status is associated with sleep outcomes among older adults. Second, we asked whether a supportive relationship was associated with more optimal sleep outcomes and whether a demanding relationship undermines sleep. Finally, we also examined whether the impact of partnership status, relationship quality on sleep differed by gender. Our findings show that partnership status was related to longer sleep duration and better sleep quality. But the relationships were only observed for objectively estimated sleep characteristics. More

specifically, partner status was associated with longer total sleep time, increased percent sleep, decreased sleep fragmentation, and less wake time after sleep onset. We also found that a supportive relationship is more consequential for sleep outcomes than a strained relationship. Among married and partnered older adults, the relationship support scale was associated with higher percent sleep and less wake time after onset whereas relationship strain scale showed little impact on either subjective or objective sleep characteristics.

Prior studies found that social and family relationships are a strong predictor of subjective sleep quality and sleep duration (for example, Ailshire and Burgard 2012; Hale 2005). In contrast, we found no evidence of partnership status on subjective sleep outcomes. It is possible that spousal/partner relation has differential effects on different domains of sleep characteristics. Objective sleep outcomes (i.e., actigraph-estimated sleep characteristics) may be more responsive to changes in spousal/partner relationships than self-reported sleep characteristics. This finding is consistent with prior epidemiological research where the authors found that objective sleep outcomes were more vulnerable to social isolation than subjective sleep outcomes (Kurina et al. 2011).

Despite the strength and novelty of these findings, we acknowledge several limitations of the study. First, the results should be interpreted as associational instead of causal. While the study controlled for a wide range of confounders, we can not establish the causal relationship simply with the cross-sectional data. In addition, it may be possible that better sleep outcomes lead to more supportive relationships among spouses and partners rather than vice versa. Prior studies suggest that physical illness may also affect marital quality (Booth and Johnson 1994). As such, poor sleep quality of older

adults may lead to an increase of relationship demands or conflicts and a decline in emotional support. However, we found that the effects of relationship quality were only significant for objectively estimated sleep characteristics and not self-reported outcomes. It is thus less likely that poor objectively estimated sleep characteristics led to poor relationships because respondents were not reporting worse sleep characteristics. Furthermore, prior studies on health benefits of social relationships found significant positive effects after accounting for social selection (Smith and Christakis 2008; Waite 1995), it is less likely that the association between spousal relationship and objectively estimated sleep outcomes is completely due to selection into marriage. A high proportion of the unmarried in NSHAP are widowed.

In this study, we bring together theoretical and empirical research on social relationships and health and innovative measures of sleep outcomes to highlight the importance of considering older adults sleep in the context of partnership status and relationship quality among older adults. We find that relational factors profoundly affect older adults' objective sleep patterns despite no significant differences in their self-reported sleep outcomes. To this end, this study makes important contributions to research on social ties and sleep by extending the ideas to the elderly population and providing a more comprehensive view of the role of how social contexts affect multiple domains of sleep in later life. As sleep is a complicated behavior with health implications, full understanding of sleep requires knowledge and insights from both biological and social sciences.

REFERENCES

Ali, M. Mir and Olugbenga Ajilore. 2011. "Can Marriage Reduce Risky Health Behavior for African-Americans?" *Journal of Family and Economic Issues* 32(2): 191-203.

Ancoli-Israel S, Cole R, Alessi C, et al. The role of actigraphy in the study of sleep and circadian rhythms. *Sleep* 2003;26:342-92

Basner, Mathias, Kenneth M. Fomberstein, Farid M. Razavi, Siobhan Banks, Jeffrey H. William, Roger R. Rosa and David F. Dinges. 2007. "American Time Use Survey: Sleep Time and Its Relationship to Waking Activities." *Sleep* 30(9): 1085-1095.

Bennett, M. Kate. 2006. "Does Marital Status and Marital Status Change Predict Physical Health in Older Adults?" *Psychological Medicine* 36: 1313-1320.

Bookwala, Jamila and Melissa M. Franks. 2005. "Moderating Role of Marital Quality in Older Adults' Depressed Affect: Beyond the Main-Effect Model." *Journal of Gerontology B Psychological Sciences* 60(6): P338-P441.

Booth, Alan and David R. Johnson. 1994. "Declining Health and Marital Quality." *Journal of Marriage and Family* 56: 218-223.

Brown, L. Susan and Sayaka Kawamura. 2010. "Relationship Quality among Cohabitors and Marrieds in Older Adulthood." *Social Science Research* 39(5): 777-786.

Burgard, Sarah A. 2011. "The Needs of Others: Gender and Sleep Interruptions for Caregiving." *Social Forces* 89: 1189-1215.

Burgard, Sarah A. and Jennifer A. Ailshire. 2009. "Putting Work to Bed: Stressful Experiences on the Job and Sleep Quality." *Journal of Health and Social Behavior* 50: 476-492.

Cacioppo, John T. 1994. “Social Neuroscience: Autonomic, Neuroendocrine, and Immune Responses to Stress.” *Psychophysiology* 31: 113-128.

Cappuccio, Francesco P., Lanfranco D’Elia, Pasquale Strazzullo, and Michelle A Miller. 2009. “Quantity and Quality of Sleep and Incidence of Type 2 Diabetes: A Systematic Review and Meta-Analysis.” *Diabetes Care* 33: 414-420.

Cornwell, Benjamin, Edward O. Laumann, and L. Philip Schumm. 2008. “The Social Connectedness of Older Adults: A National Profile.” *American Sociological Review* 73(2): 185-203.

Crimmins, Eileen, Jung Ki Kim, and Vasunilashorn. 2010. “Biodemography: New Approaches to Understanding Trendsand Differences in Population Health and Mortality.” *Demography* 47(1): S41-S64.

Das, Aniruddha. forthcoming. “How Does Race Get Under the Skin? Inflammation, Weathering, and Metabolic Problems in Late Life.” *Social Science and Medicine*

Duncan, J. Greg, Bessie Wilkerson, and Paula England. 2006. “Cleaning Up Their Act: The Effects of Marriage and Cohabitation on Licit and Illicit Drug Use.” *Demography* 43(4): 691-710.

Grandner, Michael A., Nirav P. Patel, Philip R. Gehrman, Dawei Xie, Daohang Sha, Terri Weaver, and Nalaka Gooneratne. 2010. “Who Gets the Best Sleep? Ethnic and Socioeconomic Factors Related to Sleep Complaints.” *Sleep Medicine* 11: 470-478.

Hale, Lauren. 2005. “Who Has Time to Sleep?” *Journal of Public Health* 27: 205-211.

House, James, Karl R. Landis, Debra Umberson. 1988. “Social Relationships and Health.” *Science* 241:540-545.

Hughes, Mary Elizabeth and Linda J. Waite. 2002. “Health in Household Context: Living Arrangements and Health in Late Middle Age.” *Journal of Health and Social Behavior* 43(1): 1-21.

Kripke DF, Langer RD, Elliott Ja, et al. Mortality related to actigraphic long and short sleep. *Sleep Med* 2011;12:28-33.

Krueger, Patrick M. and Elliot M. Friedman. 2009. “Sleep Duration in the United States: A Cross-Sectional Population-Based Study.” *American Journal of Epidemiology* 169: 1052-1063.

Lauderdale DS, Knutson KL, Yan LL, et al. Objectively measured sleep characteristics among early-middle-aged adults: the CARDIA study. *Am J Epidemiol* 2006;164:5-16.

Lauderdale DS, Knutson KL, Yan LL, et al. Self-reported and measured sleep duration: how similar are they? *Epidemiology* 2008;19:838-45.

Link, Bruce G. and Jo Phelan. 1995. “Social Conditions as Fundamental Causes of Diseases.” *Journal of Health and Social behavior* 35:80-94.

Luke A, Dugas LR, Durazo-Arvizu RA, et al. Assessing physical activity and its relationship to cardiovascular risk factors: NHANES 2003-2006. *BMC Public Health* 2011;11:387

Lund, Rikke, Pernille Due, Jens Modvig, Bjorn Evald Holstein, Mogens Trab Damsgaard, and Per Kragh Andersen. 2002. “Cohabitation and Marital Status as Predictors of Morality—An Eight Year Follow-Up Study.” *Social Science & Medicine* 55(4): 673-679.

Maume, David J. Rachel A. Sebastian, and Anthony R. Bardo. 2009. “Gender Differences in Sleep Disruption among Retail Food Workers.” *American Sociological Review* 74(6): 989-1007.

_____. 2010. “Gender, Work-Family Responsibilities, and Sleep.” *Gender & Society* 24(6): 746-768.

Mallon, L., J.E. Broman, and J. Hetta. 2002. “Sleep Complaints Predict Coronary Artery Disease Mortality in Males: A 12-Year Follow-Up Study of a Middle-Aged Swedish Population.” *Journal of Internal Medicine* 251: 207-216.

McPherson, J. Miller, Lynn Smith-Lovin, and Matthew E. Brashears. 2006. “Social Isolation in America: Changes in Core Discussion Networks over Two Decades.” *American Sociological Review* 71:353-375.

Michael, L. Yvonne, Lisa F. Berkman, Graham A. Colditz and Ichiro Kawachi. 2001. “Living Arrangements, Social Integration, and Change in Functional Health Status.” *American Journal of Epidemiology* 153(2): 123-131.

Neikrug, Ariel B, and Sonia Ancoli-Israel. 2010. “Sleep Disorders in the Older Adult—A Mini-Review.” *Gerontology* 56: 181-189.

Pace-Schott, Edward F, and Rebecca M. C. Spencer. 2011. “Age-Related Changes in the Cognitive Function of Sleep.” *Progress in Brain Research* 191: 75-89.

Pearlin, Leonard I, and Joyce S. Johnson. 1977. “Marital Status, Life-Strains and Depression.” *American Sociological Review* 42(5): 704-715.

Phillips, Barbara and David M. Mannino. 2007. “Do Insomnia Complaints Cause Hypertension or Cardiovascular Disease?” *Journal of Clinical Sleep Medicine” JCSM: Official Publication of the American Academy of Sleep Medicine* 3: 489-493.

Population Reference Bureau. 2011. “America’s Aging Population.” *Population Bulletin* 66(1).

Robles, F. Theodore, and Janice K. Kiecolt-Glaser. 2003. “The Physiology of Marriage: Pathways to Health.” *Physiology & Behavior* 79(3): 409-416.

Espiritu, Joseph Roland D. 2008. “Aging-Related Sleep Changes.” *Clinics in Geriatric Medicine* 24: 1-14.

Schnittker, Jason. 2007. “Look (Closely) at All the Lonely People: Age and the Social Psychology of Social Support.” *Journal of Aging and Health* 19: 659-682.

Schwartz, Skai W., Joan Cornoni-Huntley, Stephen R. Cole, Judith C. Hays, Dan G. Blazer, and Douglas D. Schocken. 1998. “Are Sleep Complaints and Independent Risk Factor for Myocardial Infarction?” *Annals of Epidemiology* 8:384-392.

Sarwari, AR, L. Fredman, P. Langenberg, J. Magaziner. 1998. “Prospectives Study on the Relation between Living Arrangement and Change in Functional Health Status of Elderly Women.” *American Journal of Epidemiology* 147(4): 370-378.

Schone, Barbara Steinberg and Robin M. Weinick. 1998. “Health-Related Behaviors and the Benefits of Marriage for Elderly Persons.” *The Gerontologist* 38(5): 618-627.

Seeman, Teresa E. 2000. “Health Promoting Effects of Friends and Family on Health Outcomes in Older Adults.” *American Journal of Health Promotion* 14(3): 362-370.

Seeman, Teresa E, Eileen Crimmins, Mei-Hua Huang, Burton Singer, Alexander Bucur, Tara Gruenewald, Lisa F. Berkman, and David B. Reuben. 2004. “Cumulative Biological Risk and Socioeconomic Differences in Mortality: MacArthur Studies of Successful Aging. *Social Science and Medicine* 58: 1985-1997.

Smith, Kirsten P, Nicholas A. Christakis. 2008. “Social Networks and Health.” *Annual Review of Sociology* 34:405-429.

Song Y, Ancoli-Israel S, Lewis CE, et al. The association of race/ethnicity with objectively measured sleep characteristics in older men. *Behav Sleep Med* 2011;10:54-69

StataCorp. 2011. Statistical Software (Release 12). College Station, TX: StataCorp LP.

Stone KL, Ancoli-Israel S, Blackwell T, et al. Actigraphy-measured sleep characteristics and risk of falls in older women. *Arch Intern Med* 2008;168:1768-75

Umberson, Debra. 1987. "Family Status and Health Behaviors: Social Control as a Dimension of Social Integration." *Journal of Health and Social Behavior* 28: 306-319.

Umberson, Debra, Robert Crosnoe, and Corinne Reczek. 2010. "Social Relationships and Health Behavior across the Life Course." *Annual Review of Sociology* 36: 139-157.

Umberson, Debra and Kristi Williams. 2005. "Marital Quality, Health, and Aging: Gender Equity?" *Journal of Gerontology Series B Psychological Sciences*: 60B: 109-112.

Umberson, Debra, Kristi Williams, Daniel A. Powers, Hui Liu, and Belinda Needham. 2006. "You Make Me Sick: Marital Quality and Health over the Life Course. *Journal of Health and Social Behavior* 47(1): 1-16.

Vitiello, Michael V. 2006. "Sleep in Normal Aging." *Sleep Medicine Clinics* 1: 17-176.

Van Den Berg JF, Van Rooij FJ, Vos H, et al. Disagreement between subjective and actigraphic measures of sleep duration in a population-based study of elderly persons. *J Sleep Res* 2008;17:295-302.

Waite, Linda. 1995. "Does Marriage Matter?" *Demography* 32(4): 483-507.

Williams, Kristi and Debra Umberson. 2004. "Marital Status, Marital Transitions, and Health: A Gendered Life Course Perspective." *Journal of Health and Social Behavior* 45: 81-98.

Table 1: Weighted Descriptive Statistics, National Social Life, Health, and Aging Project 2010-2011

	Total sample	By Gender	
		Male	Female
Social and demographic characteristics			
Female (proportion)	0.54	Na	1.00
Age	71.79	72.49	71.18
Education			
Less than high school (proportion)	0.14	0.14	0.14
High school of equivalent (proportion)	0.30	0.24	0.34
Some college (proportion)	0.34	0.32	0.36
College or higher (proportion)	0.22	0.29	0.16
Race and ethnicity			
White (proportion)	0.83	0.83	0.83
African American (proportion)	0.07	0.06	0.08
Hispanic (proportion)	0.06	0.08	0.05
Others (proportion)	0.04	0.03	0.04
Household Income (thousand dollars)	58	67	50
Household Assets (thousand dollars)	576	636	524
Retired (proportion)	0.74	0.78	0.70
Self-rated physical health			
Poor (proportion)	0.04	0.04	0.04
Fair (proportion)	0.16	0.17	0.15
Good (proportion)	0.31	0.35	0.28
Very good (proportion)	0.34	0.31	0.36
Excellent (proportion)	0.15	0.13	0.17
Self-rated mental health			
Poor (proportion)	0.01	0.01	0.01
Fair (proportion)	0.08	0.09	0.08
Good (proportion)	0.32	0.32	0.31
Very good (proportion)	0.39	0.38	0.39
Excellent (proportion)	0.21	0.20	0.21
Relationship characteristics			
Married or lived with a partner (proportion)	0.67	0.76	0.59
Mean supportive relationship scale (0-10)	8.08	8.24	7.90
Mean strain relationship scale (0-6)	1.54	1.65	1.42
Self-report sleep characteristics			
Total sleep time	493	487	498
Troubled sleep scale (0-12)	5.85	5.69	6.00
Actigraph-estimated sleep characteristics			
Total sleep time (minutes)	435	426	443
Percent sleep	82.09	81.84	82.31
Sleep fragmentation	14.36	15.17	13.67
WASO (minutes)	39.07	39.82	38.42
Sample size	727	343	384

Table 2: Results of OLS Regressions Regressing Self-Report and Actigraph-Estimated Sleep Characteristics on Partnership Status, Adjusted for Social and Demographic Characteristics (N=727)

	Self-report sleep characteristics		Actigraph-estimated sleep characteristics			
	Total sleep time (minutes)	Troubled sleep scale	Total sleep time (minutes)	Percent sleep	Sleep fragmentation	WASO (minutes)
Married or lived with a partner	13.33 (9.22)	-0.04 (0.10)	**16.26**$^{+}$ **(8.15)**	**4.01*** **(1.55)**	**-1.53*** **(0.72)**	**-6.84*** **(2.55)**
Female	12.50 (6.90)	**0.20*** **(0.09)**	**22.52**** **(7.45)**	0.60 (1.42)	**-1.80**** **(0.50)**	-2.72 (2.10)
Age	0.62 (0.50)	-0.00 (0.01)	**1.28*** **(0.51)**	-0.29 (0.81)	0.06 (0.04)	0.18 (0.13)
Education	**-11.92**** **(4.19)**	-0.02 (0.51)	-2.33 (3.54)	1.01 (0.63)	-0.15 (0.33)	**-2.03+** **(1.12)**
Race (Ref = White)						
African American	-20.95 (11.63)	-0.08 (0.12)	-8.31 (12.77)	-1.55 (1.66)	**2.32**** **(0.68)**	**8.75**** **(3.07)**
Hispanic	**-29.18+** **(14.89)**	-0.27 (0.19)	-3.29 (9.48)	1.89 (2.46)	-0.33 (0.76)	0.26 (3.93)
Other	-0.06 (16.32)	0.14 (0.31)	**-58.41*** **(24.80)**	2.90 (2.92)	0.86 (1.83)	-6.23 (3.52)
Log household income	-9.74 (6.19)	-0.03 (0.09)	-6.59 (6.72)	0.58 (1.24)	-0.52 (0.45)	-1.64 (1.69)
Log household assets	1.52 (1.38)	0.03 (0.06)	3.23 (3.20)	0.17 (0.56)	-0.09 (0.28)	-0.22 (0.91)
Retired	**14.85*** **(6.97)**	0.01 (0.13)	12.06 (9.47)	-2.23 (1.35)	-0.59 (0.66)	-0.25 (2.28)
Self-Rated Physical Heath	0.29 (4.26)	**-0.09+** **(0.05)**	2.90 (2.66)	0.66 (0.68)	**-0.54**$^{+}$ **(0.31)**	-0.94 (1.08)
Self-Rated Mental Health	**-8.92*** **(4.20)**	**-0.17**** **(0.06)**	-1.58 (3.72)	0.79 (0.61)	-0.04 (0.31)	-1.17 (1.08)
Constant	**558.73***** **(79.51)**	1.89 (1.02)	**433.41***** **(82.70)**	**96.64***** **(10.31)**	**19.25**** **(5.26)**	**58.66*** **(22.81)**

Note: Figures shown are coefficients with standard errors in parentheses. All regressions were weighted. *** $p < .001$, ** $p < .01$, * $p < .05$, $p < .1$

Table 3: Results of OLS Regressions Regressing Self-Report and Actigraph-Estimated Sleep Characteristics on Relationship Quality Scales among Married/Partnered Older Adults, Adjusted for Social and Demographic Characteristics (N=506)

	Self-report sleep characteristics		Actigraph-estimated sleep characteristics			
	Total sleep time (minutes)	Troubled sleep scale	Total sleep time (minutes)	Percent sleep	Sleep fragmentation	WASO (minutes)
Spousal Strain Scale	2.01	0.04	-0.69	0.40	0.01	-0.08
	(3.00)	(0.05)	(4.00)	(0.44)	(0.29)	(0.91)
Spousal Support Scale	0.54	-0.01	-0.10	**1.03***	-0.31	**-1.78***
	(3.40)	(0.05)	(2.89)	**(0.45)**	(0.22)	**(0.73)**

Note: Figures shown are coefficients with standard errors in parentheses. All regressions were weighted and adjusted for gender, age, education, race and ethnicity, household income, household assets, retirement status, self-rated physical health, self-rated mental health. Coefficients for covariates were not included in the table for brevity.

*** $p < .001$, ** $p < .01$, * $p < .05$, $p < .1$