Original Article

SOUTHERN GERONTOLOGICAL SOCIETY

Journal of Applied Gerontology
2014, Vol. 33(7) 791–807

DOI: 10.1177/0733464812455097
jag.sagepub.com
SAGE

A Longitudinal Examination of Sleep Quality and Physical Activity in Older Adults

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IRB protocol numbers: IRB-200801-183, IRB-200904-317

Abstract

The relationship between sleep quality and physical activity is bidirectional, yet prior research on older adults has mainly focused on investigating whether increasing levels of physical activity leads to improvements in sleep quality. The current longitudinal study examined both directional relationships by assessing sleep quality and physical activity twice over a two-year period among 426 community-dwelling older adults (ages 61-100). A cross-lagged panel analysis that included age, gender, perceived stress, functional ability, and severity of chronic health conditions as covariates, revealed that better initial sleep quality predicted higher levels of later physical activity beyond the effects of prior physical activity; whereas initial physical activity did not predict later sleep quality after accounting for prior sleep quality. These findings highlight sleep quality as an important contributor to a physically active lifestyle among older adults.

Keywords

sleep quality, physical activity, older adults, longitudinal

Manuscript received: January 13, 2012; **final revision received:** May 4, 2012; **accepted:** June 22, 2012.

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Among older adults, regular physical activity such as walking or swimming can reduce the risk of chronic diseases (e.g., coronary heart disease, cancer, diabetes), improve mental and physical health, increase energy levels, help maintain a healthy body weight, and enhance physical functioning (Benedetti et al., 2008; Benloucif et al., 2004; Chasens, Sereika, Weaver & Umlauf, 2007; Chodzko-Zajko et al., 2009; Dye & Wilcox, 2006; Reid et al., 2010; Singh, Clements & Fiatarone, 1997). Other benefits include improved strength, flexibility, balance, and coordination, which are particularly important for older adults who commonly face declines in mobility and functional ability with advanced age (Dye & Wilcox, 2006; Parsons, Foster, Harman, Dickinson & Westerlind, 1992; U.S. Department of Health and Human Services, 2000, 2008). Thus, engaging in regular physical activity is a critical component of healthy aging, yet many older adults live a sedentary lifestyle (Pate et al., 1995; Reid et al., 2010; Rowe & Khan, 1997). In fact, 50% of men and 75% of women above the age of 75 do not engage in regular physical activity (U.S. Department of Health and Human Services, 2000). Moreover, many of these individuals do not engage in regular physical activity despite their knowledge of its benefits (Goggin & Morrow, 2001).

Like physical activity, good quality sleep is also important in later life yet approximately 50% of older adults report sleep disturbances (Foley et al., 1995; Reid et al., 2010). These sleep disturbances may include difficulty falling asleep or waking up multiple times per night and can lead to problems in cognitive functioning (e.g., reduced memory and alertness) and a greater risk of depression (Dotto, 1996).

Physical Activity and Sleep Quality

Given their importance to healthy aging, it is not surprising that ample research has examined associations between sleep quality and physical activity among older adults. In particular, research examining physical activity as a predictor of sleep quality has demonstrated that as physical activity levels increase, both subjective and objective sleep quality tends to improve (Benloucif et al., 2004; Driver & Taylor, 2000; Freburger, Callahan, Shreffler & Mielenz, 2010; King, Oman, Brassington, Bilwise, & Haskell, 1997; King et al., 2008; Reid et al., 2010; Singh et al., 1997; Tworoger et al., 2003).

The majority of studies to examine the impact of physical activity on sleep quality in older adults have used experimental paradigms involving structured exercise interventions. For example, Reid et al. (2010) investigated whether an aerobic physical activity program combined with sleep hygiene education was effective in improving sleep quality in a small sample of community-dwelling adults' aged above 55 who suffered from chronic insomnia. These researchers determined that the exercise intervention was successful in improving sleep quality among participants in the treatment group when compared with a nonphysical activity control group. Similarly, Tworoger et al. (2003) found that a yearlong moderate-intensity exercise or stretching intervention enhanced sleep quality and improved fitness in sedentary women between the ages of 50 to 75.

In additional research, King and colleagues have reported improvements in sleep quality using exercise programs that have varied in duration. For example, a 16 week moderate-intensity exercise training paradigm was effective in improving subjective sleep quality in 43 healthy, sedentary older adults aged 50 to 76 years (King et al., 1997). More recently, King and colleagues (2008) found modest improvements in both objective and subjective measures of sleep quality with a 12 month moderate-intensity exercise program among community-dwelling older adults who were experiencing mild to moderate sleep problems.

Other studies have shown improvements in sleep quality among depressed older adults using a weight training intervention (Singh et al., 1997) and with a physical activity regimen among older adults residing in a continued care retirement facility (Naylor et al., 2000).

Overall, much of the research examining the association between sleep quality and physical activity has focused on whether increasing levels of physical activity leads to improvements in sleep quality. However, it is important to note that the relationship between physical activity and sleep quality is bidirectional. Thus, improved or diminished sleep quality may also contribute to higher or lower levels of physical activity.

Although this alternate directional relationship between sleep quality and physical activity has been largely disregarded in the literature, it is important to consider for two main reasons. First, poor sleep quality is often associated with a decreased desire to engage in physical activity (Chasens et al., 2007; Gooneratne et al., 2003; Stewart et al., 2006). Thus, better sleep quality should presumably lead to greater motivation to engage in regular physical activity, likely as a result of increased energy levels commonly associated with good quality sleep. Second, like physical activity, sleep quality is malleable and striving to improve one's quality of sleep may contribute to increasing levels of physical activity. Because regular physical activity is associated with sleep quality and has been linked to healthy aging (Pate et al., 1995; Rowe & Khan, 1997), it is likely that better sleep quality also contributes to the healthy aging process.

Few studies have investigated the impact of sleep quality on physical activity among older adults. Driscoll et al. (2008) found an association between sleep quality and measures of physical health among 64 healthy older adults aged 75 or older. These researchers asserted that improvements in sleep quality may lead to greater physical health as a result of increased physical activity. In another study, Chasens et al. (2007) examined the relationship between daytime sleepiness, exercise and physical functioning among a large sample of community-dwelling older adults aged above 55. The researchers found that daytime sleepiness predicted low exercise frequency and poor physical functioning after controlling for age and body mass index (BMI). Although sleep quality was not examined as a direct predictor in these analyses, it is likely that daytime sleepiness was partially the result of poor sleep quality. A limitation of this past research on sleep quality as a predictor of physical activity is that it often employed a cross-sectional design, thus eliminating the ability to make causal inferences. This limitation is addressed in the current study as subsequently described.

The Current Study

Our study built upon past research in four significant ways. First, it consisted of a large sample of community-dwelling older adults. This differs from previous studies that used small samples (i.e., less than 67 participants; Benloucif et al., 2004; Dye & Wilcox, 2006; King et al., 2008; Naylor et al., 2000; Reid et al., 2010; Singh et al., 1997), or strictly clinical samples (Naylor et al., 2000; Singh et al., 1997). Second, the current study used a two-year longitudinal design which improves upon past cross-sectional designs (Chasens et al., 2007; Driscoll et al., 2008) by enabling the examination of causal relationships. Third, we examined both causal directions in the association between sleep quality and physical activity. Past studies have examined only one causal direction in this association, primarily focusing on examining whether physical activity predicts sleep quality (Benloucif et al., 2004; King et al., 2008; Reid et al., 2010). In contrast, our study examined this predictive relationship as well as the rarely considered role of sleep quality predicting physical activity. Fourth, unlike prior research (Chasens et al., 2007), our study used a cross-lagged panel design to account for prior levels of sleep quality and physical activity (see Figure 1). This design enabled us to examine the associations of sleep quality and physical activity beyond the effects of earlier sleep quality or physical activity. Furthermore, the analyses controlled for other factors known to predict sleep quality and/or physical activity in older adults, including perceived stress (Aldana, Sutton, Jacobson, & Quirk, 1996), functional ability (Chasens et al., 2007; Hanson & Ruthig, in press), and severity of chronic health conditions (Graham & Streitel, 2010; Stewart et al., 1994). This allowed us to examine the reciprocal relationship between physical activity and sleep quality beyond the effects of these other physical and psychological health factors.

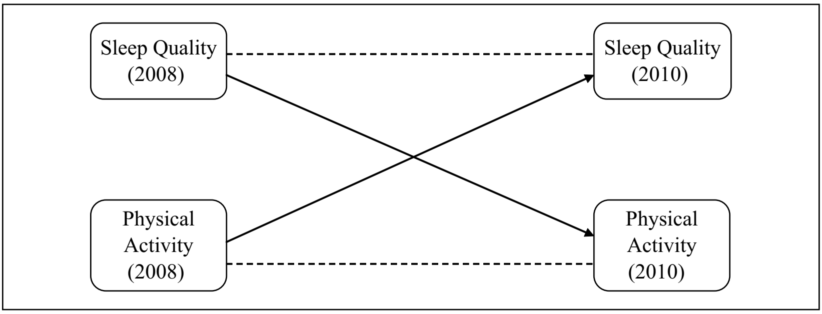

Figure 1. Cross-lagged panel design of association between sleep quality and physical activity.

Method

Participants & Procedure

In 2008, 1,106 individuals (age 60 or older) who were living independently in a Midwestern community were contacted via telephone and invited to participate in a study on healthy aging. Of these potential participants, 489 agreed to partake in the study. Most participants completed an in person interview either on-campus (n = 370 or 76%) or in their own home (n = 30 or 6%). The remaining participants completed an equivalent mailed out interview (n = 89 or 18%).

In 2010, 426 (or 87%) of the original participants completed a second interview. Of the original 489 participants from 2008, four participants could not be reached, 11 were deceased, and 48 declined to participate as a result of being too busy, having no interest, or having health issues that prevented them from partaking in the study (e.g., dementia or hospitalization). The 426 participants who agreed to be reinterviewed ranged in age from 61 to 100 (M = 72.00, SD = 7.50). The majority (242 or 57%) were women and 184 were men. All analyses were based on these 426 participants. Most of these 2010 participants completed a one-hour in person interview either on-campus (n = 315 or 74%) or in their own home (n = 19 or 5%). These interviews were conducted by trained graduate student researchers and consisted of reading each question aloud and recording the participant's response. The remaining participants completed an equivalent mailed out interview (n = 92 or 21%). All participants received monetary compensation after completing each of the two phases of the study.

Measures

The following measures of physical activity and sleep quality were assessed in both 2008 and two years later in 2010.

Physical activity. Consistent with other health and aging research (Ruthig, Chipperfield, Newall, Perry, & Hall, 2007), participants' level of physical activity was assessed using the following measure: "Thinking about the past few months, how would you rate your physical activity?" (Response range: 1 = *extremely inactive* through 7 = *extremely active*). The test–retest reliability was 0.58.

Sleep quality. Participants' overall quality of sleep was assessed using five items. As in past research (Hanson & Ruthig, in press) one item asked participants to report their overall quality of sleep in the past year (1 = *fair or poor*; 2 = *good*; 3 = *very good*; 4 = *excellent*). The remaining items measured specific aspects of quality of sleep: "Do you have difficulty falling asleep?," "do you awake a lot during the night?," "do you wake up too early without being able to get back to sleep?," or "do you wake up feeling unrefreshed?" Participants' responses to each item ranged from 1 (*every night to almost every night*) to 4 (*never*). Internal consistency in 2008: $\alpha = .79$ and in 2010: $\alpha = .74$. The test–retest reliability was 0.76.

Covariates

Each of the following measures was assessed in 2008: age, gender, perceived stress, functional ability, and severity of chronic health conditions.

Perceived stress. As in past health and aging research (Hanson & Ruthig, in press), participants' perceived stress was measured using a 7-item scale adopted from Cohen, Kamarck, and Mermelstein (1983). Participants were asked to rate each item on a scale from 1 (*never*) to 5 (*very often*) in terms of how stressful particular experiences were in the past month (e.g., "How often have you found yourself thinking about all the things that you would have to accomplish?"). An overall perceived level of stress was created by summing up the responses for each item so that higher scores reflected higher levels of perceived stress ($\alpha = .79$).

Functional ability. The functional ability of each participant was assessed using a 20-item scale of basic and instrumental activities adopted from Lawton and Brody's (1969) Instrumental Activities of Daily Living (IADL). Participants indicated whether they were able to complete various daily activities (e.g., preparing a hot meal, using the toilet, going up and down the stairs etc . . .) without help from anyone (0 = *No*; 1 = *Yes*). "Yes" responses were summed to create an overall level of functional ability for each participant in which higher scores reflected greater functional ability.

Severity of chronic health conditions. Participants' were asked to report the presence or absence of 21 chronic health problems including: Heart and circulation problems, hypertension, heart attack, stroke, anemia, arthritis or rheumatism, palsy or Parkinson's disease, Alzheimer's disease, eye trouble not relieved by glasses, hearing loss, dental problems, chest problems, stomach trouble, incontinence, bowel trouble, kidney trouble, diabetes, foot trouble, skin problems, nerve trouble including mental illness, and/or any type of cancer. The severity rankings listed in the Revised Seriousness of Illness Rating Scale (SIRS-R; Rosenberg, Hayes, & Peterson, 1987) were used to weight the severity of each of 19 chronic conditions. As detailed elsewhere (Chipperfield, Perry, Bailis, Ruthig, & Chuchmach, 2007), for two conditions, incontinence and Alzheimer's disease, that were not listed in the SIRS-R, weights were assigned by medical experts in the same fashion as done in the SIRS-R. Each participant was assigned a total severity score by summing the weights of each of the conditions reported to be present. Higher scores reflected an increased severity of chronic health conditions.

Data Analysis

All analyses were conducted using SPSS version 19.0. Descriptive statistics and bivariate correlations were computed to examine the relationships among all study variables. Cross-lagged panel analyses were computed to examine the causal relationship between sleep quality and physical activity. The first hierarchical regression model examined whether initial sleep quality (2008) predicted later physical activity (2010) beyond the predictive effects of initial physical activity level (2008) and the covariates of age, gender, perceived stress, functional ability and severity of chronic health conditions. A second hierarchical regression model was computed to examine whether initial physical activity (2008) predicted later sleep quality (2010) while controlling for initial sleep quality (2008) and the same covariates as the first model.

Results

Table 1 presents descriptive statistics and bivariate correlations for all study variables. Participants' reported physical activity levels were fairly consistent across the two-year period, with average levels of 4.72 in 2008 and 4.43 two years later in 2010 and a moderate correlation between the two measures ($r = .58$, $p < .001$). Likewise, participants' two sleep quality assessments were quite consistent, with an average sleep quality of 13.96 in 2008 and 13.78 in 2010. The two sleep quality assessments were strongly correlated ($r = .76$, $p < .001$).

Table 1. Descriptive Statistics and Bivariate Correlations.

Variable	*M* (*n*)	*SD* (%)	2	3	4	5	6	7	8	9
1. Age	72.05	7.58	−.06	.04	−.39**	.31**	.14**	−.23**	−.06	−.09
2. Gender				.08	−.31**	.05	.12*	−.06	−.09	−.05
Male	(182)	(43%)								
Female	(243)	(57%)								
3. Perceived stress	15.59	3.91			−.18**	.22**	−.27**	−.16**	−.30**	−.26**
4. Functional ability	18.91	1.43				−.43**	.43**	−.39**	.15**	.15**
5. SCHC	230.07	170.26					.30**	−.31**	−.17**	.12*
6. Physical activity (2008)	4.72	1.31						.58**	.19**	.16**
7. Physical activity (2010)	4.43	1.30							.22**	.24**
8. Sleep quality (2008)	13.96	3.52								.76**
9. Sleep quality (2010)	13.78	3.29								

Note: SCHC = severity of chronic health conditions.
*p < .05. **p < .01.

Table 2. Predicting 2010 Physical Activity Level.

	Step 1			Step 2		
2008 predictors	*B*	*SE*	β	*B*	*SE*	β
Age	−.01	.01	−.08*	−.01	.01	−.08*
Gender	.08	.11	.03	.10	.11	.04
Perceived stress	.00	.01	.01	.01	.01	.04
Functional ability	.11	.05	.11**	.10	.05	.11**
SCHC	.00	.00	−.06	.00	.00	−.06
Physical activity	.51	.05	.51***	.50	.05	.50***
Sleep quality				.04	.02	.10**
R^2	.37***			.38**		

Note: SCHC = severity of chronic health conditions.
*p < .10. **p < .05. ***p < .001.

Predicting physical activity level. In Step 1 of the regression model predicting later physical activity, participants' age, gender, perceived stress, functional ability, severity of chronic health conditions and physical activity level were entered as predictors. Participants' sleep quality was added in Step 2 of the regression model (see Table 2).

Table 3. Predicting 2010 Sleep Quality.

	Step 1			Step 2		
2008 predictors	*B*	*SE*	β	*B*	*SE*	β
Age	−.01	.02	−.02	−.01	.02	−.02
Gender	.38	.23	.06	.38	.23	.06
Perceived stress	−.05	.03	−.05	−.04	.03	−.05
Functional ability	.14	.10	.06	.14	.10	.06
SCHC	.00	.00	.05	.00	.00	.05
Sleep quality	.69	.03	.75***	.69	.03	.75***
Physical activity				.02	.09	.01
R^2	.58***			.58		

Note: SCHC = severity of chronic health conditions.
****p* < .001.

Step 1 of the model was significant, F (6,396) = 38.67, $p < .001$ and predicted 37% of the variance in physical activity. Greater initial functional ability (β = .11, $p = .03$) and physical activity (β = .51, $p < .001$) predicted greater subsequent physical activity whereas age marginally predicted lower levels of subsequent physical activity (β = –.08, $p = .07$). Adding prior sleep quality in Step 2 of the model resulted in both a significant increase to R^2: F_{inc} (1,395) = 6.00, $p = .02$, and a significant overall model, F (7,395) = 34.41, $p < .001$. Prior sleep quality significantly predicted higher levels of subsequent physical activity (β = .10, $p = .02$) beyond the effects of prior physical activity level, age, gender, perceived stress, functional ability, and severity of chronic health conditions.

Predicting sleep quality. In Step 1 of the regression model predicting later sleep quality, participants' age, gender, perceived stress, functional ability, severity of chronic health conditions and sleep quality were entered as predictors. Step 2 of the model included participants' physical activity level.

In Step 1 of the regression model (Table 3), initial sleep quality significantly predicted current sleep quality (β = .75, $p < .001$) resulting in a significant model, F (6,396) = 92.00, $p < .001$. Adding physical activity level to Step 2 of the model did not result in a significant change to the model R^2: F_{inc} (1,395) = .06, $p = .81$ nor did initial physical activity level predict subsequent sleep quality.

Discussion

Previous research examining the association between sleep quality and physical activity in older adults has primarily focused on only one directional relationship:

physical activity level predicting sleep quality (Benloucif et al., 2004; King et al., 2008; Naylor et al., 2000; Reid et al., 2010; Singh et al., 1997; Tworoger et al., 2003). The other possible directional relationship of sleep quality predicting physical activity level has been largely overlooked in the literature. The current longitudinal study adopted a cross-lagged panel approach to examine both causal directions in the association between sleep quality and physical activity level among community-dwelling older adults.

Predicting physical activity level. Initial sleep quality predicted later physical activity level even after accounting for prior physical activity level and participants' age, gender, perceived stress, functional ability and severity of chronic health conditions. This suggests that sleep quality is an important contributor to older adults' level of physical activity in terms of better sleep quality promoting more physical activity and poorer sleep quality predicting less physical activity. This finding is consistent with past research showing sleepiness was negatively related to physical activity among community-dwelling older adults (Chasens et al., 2007). Although it was not directly examined in the current study, it is likely that physical energy played a mediating role in the positive association between sleep quality and subsequent physical activity. That is, individuals who experience good quality sleep, with few or no sleep disturbances, are likely to subsequently have more physical energy than those who have poorer sleep quality. In turn, older adults with more physical energy to draw upon are more likely to engage in physical activity (Dye & Wilcox, 2006). Further research is needed to directly examine potential mediating factors, such as physical energy and alertness associated with sleep quality that increase the likelihood of older adults engaging in physical activity. Likewise, it would be useful to account for additional predictors of physical activity such as depression and anxiety, psychological well-being indices that have been found to disrupt physical activity levels.

In addition to considering potential mediators and additional predictors to further clarify the linkages between sleep quality and subsequent physical activity, future research should also examine whether changes in (i.e., improved or diminished) sleep quality predict later physical activity level. This would require an extended time period beyond the two-year duration of the current study, given the high stability of sleep quality indicated in the current findings.

Predicting sleep quality. Unlike previous studies that reported improvements in sleep quality using a variety of exercise interventions among older adults (King et al., 1997; King et al., 2008; Reid et al., 2010; Singh et al., 1997; Tworoger et al., 2003), our findings indicate that physical activity level did not predict later sleep quality. A possible explanation for this departure from prior research findings is that unlike prior studies, participants in the current study were only asked to indicate their level of physical activity at two points of time (two years apart) whereas in other studies (Reid et al., 2010; Singh et al., 1997; Tworoger et al., 2003), participants' level of physical activity was manipulated through exercise interventions lasting one year or less. Thus, the present study used a more naturalistic approach to examine physical activity levels among older adults over a longer duration. Also, unlike prior studies (King et al., 2008; Reid et al., 2010; Singh et al., 1997; Tworoger et al., 2003), we did not focus solely on older individuals with low levels of physical activity or prior sleep complaints. Therefore, the effects of physical activity on sleep quality may be more pronounced in previous studies that examined older adults with sedentary lifestyles and/or sleep problems. In comparison, the current results suggest that physical activity level may not be as significant of a contributor to sleep quality in a more general sample of nonsedentary, nonsleep disordered community-dwelling older adults. Further research comparing the bidirectional relationship between sleep quality and physical activity among groups of sedentary, nonsedentary, sleep disordered, and nonsleep disordered older adults would clarify the extent to which these associations vary as a function of the sample characteristics.

Implications

The current findings underscore the importance of sleep quality in the relationship between sleep quality and physical activity in community-dwelling older adults. In particular, sleep quality predicts greater levels of subsequent physical activity. Sleep quality is malleable, much like physical activity, thus, developing practices and interventions to improve sleep quality may be particularly useful in reducing sedentary lifestyles. In turn, more active lifestyles are associated with a reduced risk of chronic diseases (Chard & Stuart, 2012; Chodzko-Zajko et al., 2009; Reid et al., 2010; Rowe & Khan, 1997) and can contribute to greater overall functional ability by improving strength, flexibility and mobility (Dye & Wilcox, 2006). Taken together, improvements in sleep quality in older adults may be particularly useful in promoting other aspects of life such as overall physical functioning and health.

Currently, there are a number of both pharmacological and nonpharmacological sleep practices/interventions available to nonclinical older populations. Nonpharmacological behavioral practices/interventions are generally the recommended method as they have fewer side effects and pose little risk of addiction (Irwin, Cole, & Nicassio, 2006). Some behavioral practices such as sleep hygiene education and stimulus control therapy have been shown to impact sleep quality in positive ways (Jefferson et al., 2005). Often, sleep hygiene education is used as a first step in attempting to alleviate sleep problems (Lichstein & Riedel, 1994). Sleep hygiene as introduced by Hauri (1977), refers to the behavioral (e.g., diet, exercise, eating habits, alcohol consumption) and environmental factors (e.g., lighting, noise, mattress, temperature) that can affect sleep quality (Brown, Buboltz, & Soper, 2002). Many of the common sleep hygiene guidelines delineate the importance of limiting or avoiding particular foods or behaviors just before bedtime. For example, avoid eating a large meal or exercising as well as limiting caffeine, nicotine or alcohol consumption (Bootzin & Perlis, 1992; Morin, Mimeault & Gagne, 1999). Sleeping environments should also be arranged to reduce any excessive noise (e.g., from the television, radio, or neighbor) and to limit the amount of light coming into the bedroom (Morin et al., 1999).

A good understanding of sleep hygiene practices is a critical element in improving sleep quality but one must engage in effective sleep habits and practices to achieve better quality sleep (Brown et al., 2002). For example, engaging in poor sleep hygiene practices is associated with poorer sleep quality whereas engaging in good sleep hygiene practices is related to better quality sleep (Brown et al., 2002; Jefferson et al., 2005).

Another sleep technique, stimulus control therapy (Bootzin, Epstein, & Wood, 1991), has often been used in conjunction with sleep hygiene education. Stimulus control therapy uses a set of instructions that are designed to promote better sleep quality practices. For example, individuals are told to: only go to bed when they are sleepy, limit or avoid daytime naps, leave the room if you cannot fall asleep and return in 15 min or when sleepiness begins to set in, use the bedroom only for sleeping and/or sexual activity and wake up at the same time every morning (Morin et al., 1999).

Other types of sleep techniques such as relaxation techniques have also been effective in improving sleep quality among adults over time (Lichstein, Riedel, Wilson, Lester, & Aguillard, 2001; Morin et al., 1999). One particular technique, a form of Tai Chi, has been particularly effective for older adults with moderate sleep complaints (Irwin, Olmstead, & Motivala, 2008). Taken together, better sleep practices may be effective to improve sleep quality and can contribute to increasing levels of physical activity among older adults.

Numerous benefits of engaging in regular physical activity include: a reduced risk of chronic diseases (e.g., coronary heart disease, cancer, and diabetes), an increase in energy levels, can help maintain a healthy body weight and enhanced physical functioning (e.g., flexibility, mobility; Chasens et al., 2007; Dye & Wilcox, 2006; Pate et al., 1995; Reid et al., 2010; Singh et al., 1997; U.S. Department of Health and Human Services, 2008). Given that our findings indicated that sleep quality is strongly linked to physical activity, it is reasonable to infer that improvements in sleep quality would also be a significant contributor to the healthy aging process. Therefore, it is prudent for researchers and health care practitioners to make older adults aware of the importance of sleep quality, in addition to physical activity.

Furthermore, health care providers need to be aware that patients complaining of poor quality sleep may also become less physically active or even sedentary. As a result, these patients may not only suffer the negative effects associated with sleep disturbances (e.g., depressed mood, reduced quality of life; Lee & Ward, 2005) but may also experience the negative risks of a sedentary lifestyle such as a greater vulnerability to chronic diseases (e.g., coronary heart disease).

Limitations & Conclusion

This study is not without some limitations. First, because a longitudinal design was used, some participant attrition occurred (e.g., could not be reached, did not want to participate, were too busy, had no interest, or had major health issues) from the original study. However, 87% of the original participants completed both phases of the study and were found to be representative of the original larger sample. That is, returning versus nonreturning participants did not significantly differ on any of the 2008 measures (e.g., sleep quality, physical activity level, perceived stress, functional ability, severity of chronic health conditions).

A second limitation is that only subjective indices of sleep quality were used. Although subjective measures of sleep quality are considered to be reliable (Phelan, Love, Ryff, Brown, & Heidrich, 2010), more objective measures of sleep quality (e.g., actigraph data) would provide further support for the findings in the current study. Third, our sample was restricted to older adults aged 60 or older living independently in their community. It is unclear if these findings would generalize across other samples of older adults such as those living in retirement care facilities or personal care homes as well as nonclinical samples (e.g., sleep disorders). As earlier suggested, further research is needed to determine whether better sleep quality is associated with improvements in physical activity among these older populations.

Despite these limitations, the present study contributes to the research examining the link between sleep quality and physical activity among community-dwelling older adults. Sleep quality predicted greater levels of physical activity but physical activity did not predict later sleep quality. These results were found beyond the effects of physical activity or sleep quality respectively, as well as age, gender, perceived stress, functional ability, and severity of chronic health conditions. These findings have important implications for researchers and health care practitioners interested in understanding factors associated with healthy aging.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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