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Comparing Sleep Quality, Duration, and Efficiency Among Low-Income Community-Dwelling Older Adults With and Without Physical Disabilities

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Abstract

PURPOSE: Physical disabilities may exacerbate the natural decline in sleep quality that occurs with aging. In the current study, we assessed sleep quality and medicinal sleep aid use among 87 community-dwelling older adults with (n = 24) and without (n = 63) physical disabilities.

METHOD: Sleep quality, duration, and efficiency were assessed subjectively with the Pittsburgh Sleep Quality Index. Sleep duration and efficiency were objectively measured with actigraphy. Participants self-reported medicinal sleep aid use.

RESULTS: Significant group differences were observed in sleep duration measured objectively (p = 0.01) and subjectively (p = 0.04). No other group differences were observed for sleep factors (p > 0.05) or medicinal sleep aid use (p = 0.41).

CONCLUSION: Findings show that physical disability may be a factor in sleep duration; however, physical disability was not found to be associated with worsened sleep perception or greater reliance on medicinal sleep aids. Future research should consider longer objective actigraphy assessment windows and explore potential subgroup differences in sex and race/ethnicity.

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Seventy million Americans experience chronic sleep disorders (Soares de Almeida Ciquinato et al., 2023) and older adults are more likely than younger adults to have problems sleeping (Chen, 2019). Sleep quality changes as a function of normal aging (Borges et al., 2019; Landry et al., 2015); however, the experience of aging and difficulty sleeping is multifactorial (Li et al., 2022). Income and disability status can also impact sleep quality among older adults (Campanini et al., 2019; Li et al., 2022). Sleep is a critical part of the circadian rhythm of older adults, and the prevalence of dysregulated sleep may lead to increased use of over-the-counter or prescribed medicinal sleep aids to attempt to alleviate the issue (Landry et al., 2015; St George et al., 2009). Chronic use of sleep aids, however, may not be beneficial for alleviating sleep complaints (Schroeck et al., 2016).

Dysregulated sleep encompasses several factors, such as decreased sleep duration, efficiency, and overall quality (St George et al., 2009; Stone et al., 2008). An increase in fall risk, as well as a decrease in physical function and overall quality of life, have been linked to sleep dysregulation (St George et al., 2009). Moreover, cellular repair occurs during sleep, and this cellular repair aids in combatting age-related disorders, such as sarcopenia (Choi et al., 2020). *Sarcopenia* is a progressive and generalized skeletal muscle disorder that is associated with an increased likelihood of adverse outcomes, including falls, fractures, physical disability, and mortality (Cruz-Jentoft et al., 2010). Although sleep quality is important for all older adults to combat age-related disorders, individuals with low income and a physical disability may be at a disadvantage. Income status is considered a social determinant of health, with individuals at a lower income level experiencing a greater prevalence of chronic poor sleep (Jean-Louis et al., 2022). Physical disabilities are characterized by difficulties in performing activities of daily living and diminished physical function (Chien & Chen, 2015). Previous research has also shown a connection in older adults between dysregulated sleep and physical disability (Campanini et al., 2019; Chien & Chen, 2015). However, those researchers recommend further largescale, well-controlled studies to verify the connection.

Historically, sleep quality has been assessed either subjectively, with assessments such as the Pittsburgh Sleep Quality Index (PSQI), or objectively, with assessments such as polysomnography or with an ActiGraph (Landry et al., 2015). Researchers recommend that sleep quality in older adults be measured subjectively and objectively. Subjective assessments rely on an individual’s memory of sleep and sleeping habits, whereas the combination of objective and subjective assessments may provide unique insights into sleep quality that only one measure cannot provide.

Despite recommendations, previous research that established a connection between disability and sleep has done so largely with subjective measurements alone (Campanini et al., 2019; Chien & Chen, 2015). Considering that older adults are at high risk for developing a disability (Chien & Chen, 2015), understanding how living with a physical disability might impact older adults’ sleep quality is important. The current investigation aimed to compare objectively and subjectively assessed sleep quality, efficiency, and duration among older adults living with and without physical disabilities. In addition, we sought to compare medicinal sleep aid use between those living with and without physical disabilities. We hypothesized that low-income community-dwelling older adults with a physical disability

would exhibit poorer sleep quality, efficiency, and duration, as well as greater medicinal sleep aid use, compared to those without a physical disability.

METHOD

Design

The current study was a cross-sectional study with primary data analysis and part of a federally funded study (NIH Grant #R01MD018025) of which protocols were pre-registered on ClinicalTrials.gov (NCT05778604) and published elsewhere (Thiamwong et al., 2023). All study protocols were approved by the University of Central Florida Institutional Review Board (STUDY00003206) and conducted in accordance with the Declaration of Helsinki. All participants gave written informed consent prior to participation.

Participants

We recruited 121 older adults, comprising 13 men and 108 women, using flyer distribution, word-of-mouth, and community partners that facilitated introductions to potential participants. Participants all resided in older adult living communities within the greater Orlando, Florida metropolitan region, which has a diverse population. Participants were screened for inclusion and exclusion criteria prior to participation. Participants were included in the study if they were aged ≥60 years, lived independently in their own homes or apartments, had low-income status based on the 2019 poverty thresholds relative to family size (U.S. Census Bureau, 2020), and if their ActiGraph registered data for at least five nights during the week-long data collection period. Participants were excluded from the study if they were actively receiving treatment from a rehabilitation facility or were cognitively impaired, determined by a score ≤4 on the Memory Impairment Screening test or a score ≤22 on the Rowland Universal Dementia Assessment Scale (Buschke et al., 1999; Nielsen et al., 2019), two assessments used as part of a larger research study.

Measures

Physical Disability and Medicinal Sleep Aid.—Physical disability and medicinal sleep aid use were classified using a self-report checklist from the Centers for Disease Control and Prevention (CDC; 2019) Stopping Elderly Accidents and Deaths Initiative (STEADI) algorithm. Participants completed the STEADI checklist in person. The checklist includes *yes* or *no* questions about physical ability and sleep aid use. Participants were classified as having a physical disability if they answered *yes* to the statement, “I use or have been advised to use a cane or walker to get around safely” (CDC, 2019). Participants were classified as using medicinal sleep aids if they answered *yes* to the statement, “I take medicine to help me sleep or improve my mood” (CDC, 2019).

Subjective Sleep Assessment.—On the same day, after self-reporting physical disability status and medicinal sleep aid use, participants completed the PSQI in person. The PSQI (Buysse et al., 1989) was originally developed to categorize individuals as either “good” or “poor” sleepers. This 19-item questionnaire assesses sleep quality using subjective ratings for seven different components: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction.

Some items are open ended, whereas others are scored on a Likert-type scale ranging from 0 to 3, with higher scores indicating a greater degree of sleep disturbances. Respondents are asked to answer the questionnaire retrospectively, surveying sleep components spanning the previous month. The PSQI is quick and easy to administer and score, making it an effective tool for sleep quality assessments. It has also been validated as a measure of sleep quality and sleep efficiency in various populations, with an internal consistency of $\alpha = 0.72$ in older women (Beaudreau et al., 2012) and $\alpha = 0.69$ in older men (Spira et al., 2012).

Objective Sleep Assessment.—Immediately after completing the PSQI, participants were instructed to wear the ActiGraph GT9X Link on their non-dominant wrist for 7 consecutive days. Participants were considered noncompliant and excluded if <5 days of ActiGraph data were recorded. The GT9X Link uses a tri-axial accelerometer and photoplethysmography sensor to collect data regarding sleep duration and efficiency. ActiGraph data were extracted using ActiLife software (version 6.13.5) and processed using R statistical software (version 4.3.1) using pre-existing built-in raw accelerometer data analysis functions and code (Migueles et al., 2019; van Hees et al., 2015; van Hees et al., 2018). Wrist-worn actigraphy has demonstrated good concurrent validity with polysomnography, which is considered a gold standard for sleep assessments (Weiss et al., 2010). The GT9X does not provide a global sleep quality score like the PSQI; therefore, no direct comparison could be made for that variable.

Data Analysis

All statistical analyses were conducted using jamovi version 2.4.1. Levene's test (used to assess the assumption of equal variances between dependent variables) revealed non-heteroscedastic sleep data (ActiGraph sleep efficiency and PSQI sleep duration), and a Kolmogorov-Smirnov test (used to assess the assumption of a normal distribution pattern for each dependent variable) revealed that sleep efficiency data from the PSQI and ActiGraph were not normally distributed. However, results did not differ between nonparametric and parametric assessments, so parametric assessments adjusting for unequal variances are reported within. A one-way Welch's analysis of variance (ANOVA) was used to compare sleep duration and efficiency between groups using Games-Howell adjustments for post-hoc analyses. Welch's ANOVA and Games-Howell post-hoc assessments account for unequal variances. A chi-square test of association was used to compare pharmaceutical sleep/mood aid use between groups. Data are presented as mean (standard deviation) unless otherwise noted. The threshold for statistical significance was set to $p < 0.05$.

RESULTS

Participants

Of 121 participants recruited for this study, only 87 participants completed all required assessments. Therefore, 87 participants were included in the analysis. Table 1 details participant characteristics.

Sleep Quality, Duration, and Efficiency

Table 2 details results of between-group comparisons of sleep quality and medicinal sleep aid use. A significant between-group difference was identified in the category of objective ActiGraph sleep duration ($p = 0.01$), with respondents without physical disability reporting longer sleep duration (mean = 7 hours, $SD = 1.7$ hours) compared to those with physical disability (mean = 6 hours, $SD = 1.9$ hours). A similar significant difference was observed between groups for subjective sleep duration ($p = 0.04$). Global sleep quality score (measured subjectively) identified lower sleep quality scores in participants with physical disability (mean = 8.3, $SD = 3.9$) compared to those without physical disability (mean = 6.9, $SD = 4.3$), although findings were not statistically significant ($p = 0.21$). Likewise, objective measurement of sleep efficiency via actigraphy revealed non-statistically significant differences between groups of 78.3% ($SD = 15.5\%$) and 83.1% ($SD = 11.8\%$) in respondents without and with physical disability, respectively. No statistically significant differences in subjective sleep efficiency ($p = 0.09$) were observed either.

Medicinal Sleep Aid Use

No significant difference in sleep aid use was identified between participants with or without physical disabilities ($\chi^2 = 1.14$, $p = 0.29$). Of 63 participants without a physical disability, 14 (22%) reported using a pharmaceutical sleep/mood aid. Of 24 participants with a physical disability, eight (33%) reported using a pharmaceutical sleep/mood aid.

DISCUSSION

In the current study, using subjective and objective sleep assessments, we analyzed sleep quality and medicinal sleep aid use among community-dwelling low-income older adults with and without physical disabilities. We hypothesized that those living with a physical disability would exhibit poorer sleep quality, efficiency, and duration, as well as greater medicinal sleep aid use compared to those without a physical disability and these results partially support our hypothesis.

Many differences were not significant; however, we were able to identify a statistically significant difference of longer sleep duration in participants without disability when measured objectively via actigraphy and subjectively via the PSQI. There were no significant differences identified in subjective sleep quality or efficiency, objective efficiency, or medicinal sleep aid use.

One plausible explanation may be found in understanding the different temporal foci of the PSQI and actigraphy. Whereas the PSQI measures quality and habits for the previous 30 days of sleep, actigraphy measures present sleep duration and efficiency. Landry et al. (2015) demonstrated that global PSQI scores did not correlate significantly with ActiGraph data in younger or older adults but correlated with Consensus Sleep Diary (CSD) entries. This finding suggests that subjective measures may be influenced by a Hawthorne effect, where sleep is rated differently retrospectively compared to when it is rated presently. Although our results did not indicate subjective differences in sleep quality between those with and without a physical disability, future research should seek to validate our

results using actigraphy and a different concurrent subjective assessment, such as the CSD. Furthermore, a longer assessment window of ≥14 days may help account for potential sleep variances by increasing the number of observations with enough data collection to capture trends (Landry et al., 2015).

Using subjective and objective assessments, those with a physical disability demonstrated significantly lower sleep duration than those without a physical disability. Furthermore, accounting for standard deviations, both groups are on the cusp of the recommended amount of sleep for older adults (Hirshkowitz et al., 2015). Previous research is equivocal on the impact of sleep duration, with some studies indicating negative consequences to prolonged sleep duration and others indicating negative consequences to short sleep duration (Devore et al., 2016; Fu et al., 2017; Goldman et al., 2007). It is likely that prolonged and short sleep duration are maladaptive for older adults; however, it is not clear if the statistically significant difference in sleep duration observed in the current study represents a clinically significant difference. Actigraphy is limited in its ability to produce a measure of overall sleep quality like the PSQI, so future research may benefit from using a prospective study design to assess consequences to short and prolonged sleep duration over time in individuals with a physical disability.

Other studies have examined sleep quality with similar instruments in the subpopulations of race/ethnicity and sex. Carnethon et al. (2016) identified that Black participants were more likely to have shorter sleep duration and poorer subjective and objective sleep quality compared to their White counterparts. Hispanic participants were also identified to display poorer sleep quality patterns (Chen et al., 2015; Patel et al., 2010), although research shows conflicting results on participants of Hispanic origin (George et al., 2020). Multiple meta-analyses have corroborated sleep disparities among impoverished racial/ethnic minoritized individuals (Ruiter et al., 2011; Sosso et al., 2021; Sosso et al., 2023). Likewise, sex and gender play a role in sleep quality and duration, which may be explained by hormonal differences, gender differences in reporting, and environmental, social, and cultural influences (Mallampalli & Carter, 2014). Evidence for sex/gender sleep differences include women reporting better sleep quality, efficiency, and duration, but higher sleep-related complaints (Dietch et al., 2017; Kocevska et al., 2020; Krishnan & Collop, 2006) and others observing poorer overall sleep quality in female participants (Zeng et al., 2020). When further explored by race/ethnicity, Black/African American and Hispanic/Latino women report poorer sleep quality due to a complexity of factors, including greater prevalence of obstructive sleep apnea (Chen et al., 2016; Jackson et al., 2020; Meetze et al., 2002), life stressors, increased body mass index, and financial hardships (Matthews et al., 2019).

One indication of poor sleep quality may be medicinal sleep aid use, as those pharmaceuticals are designed to improve sleep. No significant difference in medicinal sleep aid use was observed between individuals with and without a physical disability. This finding supports the assertion that there may not be a meaningful difference in sleep quality between individuals with and without a physical disability. However, we did not assess specific details of sleep aid use, such as frequencies, dosages, and drug classes. These are important details that should be investigated further, as older adults often turn to medicinal

sleep aids (Albert et al., 2017). Furthermore, there is the potential for medications targeting symptoms of a disability to also influence sleep (Pagel & Parnes, 2001), so consideration is needed in categorizing all medications used.

LIMITATIONS

The current study has some limitations. Factors that were not assessed included whether participants had a preexisting medical or mental health condition, and their living arrangements inside their home. Moreover, disability status typically results in function loss or functional impairment, and each disability is unique and affects individuals differently. Variations in physical function among individuals with a physical disability can largely be attributed to how physical disability is defined and categorized. The current study relied on the use or recommended use of a mobility aid for defining physical disability and self-report for categorizing individuals. It is possible that observed results might have changed if a different definition of physical disability were adopted. Similarly, our study relied on self-report to account for medicinal sleep aid use. When self-identifying, it is possible that participants may have overlooked medications used for other issues that simultaneously impact sleep. However, although use of self-report can be limiting, this study used validated and common instruments, such as the PSQI and STEADI checklist, which aided in consistently guiding participants in their self-report.

Due to the limited numbers of male and racial and ethnically diverse participants, we did not stratify results by sex or race/ethnicity. Future research may benefit from investigating potential differences in how physical disability impacts sleep quality, as both sex (Kocevska et al., 2021; Krishnan & Collop, 2006; Wang & Boros, 2021) and race/ethnicity (Chen et al., 2015; Dietch et al., 2017; George et al., 2020; Ruiter et al., 2011) differences have been observed in sleep quality retrospectively via the PSQI and presently via the CSD, while still concurrently measuring sleep objectively. In addition, there are countless other factors that could potentially influence sleep and cannot reasonably be controlled for in a single study, so current results should be interpreted within the context of variables that were accounted for. Results of this study can reasonably be generalized to low-income, community-dwelling, older adult men and women with and without physical disabilities.

CONCLUSION

Despite no difference in perceived sleep quality and sleep efficiency, sleep duration is lower in those with a physical disability than those without a physical disability. Moreover, medicinal sleep aid use does not differ in individuals with and without a physical disability. Health care professionals should be cognizant of the reduced sleep duration that individuals with physical disabilities experience and not disregard their subjective reporting. Individuals with physical disabilities may benefit from targeted interventions to increase sleep duration. Further research is needed to validate these results, particularly using subjective and objective sleep assessments, a larger male sample, and more detailed reporting in medication use.

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TABLE 1

Participant Characteristics ($N = 87$)

Characteristic	*n* (%)	
	Without Physical Disability (*n* = 63)	**With Physical Disability (*n* = 24)**
Age (years), mean (*SD*) (range)	72.8 (6.36) (61.1 to 87.9)	75.1 (7) (62.3 to 87.3)
Sex		
Female	55 (87)	21 (88)
Male	8 (13)	3 (12)
Race/ethnicity		
African American	32 (51)	16 (67)
Asian	2 (3)	0 (0)
Hispanic	22 (35)	3 (12)
Non-Hispanic White	7 (11)	5 (21)
Educational level		
Lower than high school	5 (8)	2 (8)
High school	32 (51)	12 (50)
College or higher	26 (41)	10 (42)

TABLE 2

Comparison of Sleep Quality, Duration, and Efficiency Using Subjective and Objective Sleep Assessments (*N* = 87)

Variable	Mean (*SD*) (Range)		*F*	*p*
	Without Physical Disability (*n* = 63)	**With Physical Disability (*n* = 24)**		
PSQI[a] sleep quality	7.2 (4.3) (0 to 16)	8.5 (4.1) (2 to 16)	1.6	0.21
PSQI sleep duration (hours)	8.5 (1.6) (4 to 12)	7.3 (2.5) (2 to 10.5)	4.5	0.04
ActiGraph sleep duration (hours)	7.2 (1.7) (3.19 to 12.3)	5.9 (2) (2.78 to 9.57)	7.2	0.01
PSQI sleep efficiency (%)	82.8 (24.4) (45.5 to 225)	88.8 (32) (50 to 200)	0.7	0.41
ActiGraph sleep efficiency (%)	77.7 (16.1) (20.7 to 94.8)	83.4 (12.9) (28.2 to 95.7)	3	0.09

Note. PSQI = Pittsburgh Sleep Quality Index.

[a]Comprises 19 items that generate seven component scores. Some items are open-ended and others are scored on a Likert-type scale ranging from 0 to 3, with higher scores indicating a higher degree of sleep disturbances.