Short sleep duration increases the risk of diseases in older adults exercise practitioners

Felipe Fank (felipee.fank@gmail.com)
State University of Santa Catarina. Health and Sport Sciences Center
Matheus Godinho Werlich
State University of Santa Catarina. Health and Sport Sciences Center
Franciele Silva Pereira
State University of Santa Catarina. Health and Sport Sciences Center
Giovana Zarpellon Mazo
State University of Santa Catarina. Health and Sport Sciences Center

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Abstract

Background: Aging causes changes in sleep and thus can increase the risk of developing diverse diseases. However, little is still known about the impact of sleep duration in some conditions of older adults who exercise regularly.

Aim: To evaluate the association between diseases and short sleep duration in older adults who are practitioners of physical exercise.

Methods: This is a cross-sectional observational study. Two hundred and sixteen older adults (70.2±6.81 years) were investigated. Sociodemographic and health characteristics were collected by interview using questionnaires. The Pittsburgh Sleep Quality Index (PSQI) was applied to assess sleep quality and sleep duration. Sleep duration was classified as short when the older adults slept less than seven hours per night. A Poisson regression model was used, adopting a 5% significance level.

Results: The prevalence of poor sleep quality in the sample was 47.7% (95%CI: 44.4-50.9). In addition, 43.1% (95%CI: 36.5-49.6) of the older adults had short sleep duration. Older adults with arthrosis ($p=0.008$), depression ($p=0.043$), diabetes ($p=0.005$), heart disease ($p=0.008$), fibromyalgia ($p<0.001$), and urinary incontinence ($p=0.004$) had a higher PSQI score than those without these diseases. In regression analysis, hypothyroidism (PR=1.63; 95%CI: 1.19-2.23) and fibromyalgia (PR=1.68; 95%CI: 1.07-2.62) were associated with short sleep duration.

Conclusions: Older adults with hypothyroidism and fibromyalgia are more likely to sleep less than seven hours per night compared to those without these diseases. Multidisciplinary interventions are important to improve sleep and the quality of life of older adults.

1 Introduction

Aging causes changes in sleep characteristics [1, 2]. Factors associated with age such as clinical or psychiatric diseases, medication use, and altered circadian rhythm can induce sleep disorders [3]. However, sleep-related problems are associated with several comorbidities and not exclusively with age [4], suggesting that chronological age is not an independent factor of future sleep disorders [5].

Sleep complaints can increase the risk of developing depression [6], diabetes [7], cardiovascular diseases [8], obesity, and metabolic syndrome [9]. Within this context, sleep plays an important role in homeostasis and a homeostatic imbalance favors the onset of mental disorders, compromises physical performance, and decreases immunological competence, consequently increasing the vulnerability of older adults [10].

Current recommendations indicate that people aged 65 and over need seven to eight hours of sleep per night [11]. In this respect, both a short sleep duration (< 7 hours) and a long sleep duration (> 8 hours) are risk factors for all-cause mortality in older adults [7, 12, 13]. Furthermore, sleep duration is also associated with an increased risk of stroke [14], myocardial infarction [15], falls [16] and cognitive decline [17], in addition to chronic diseases such as hypertension [18, 19], diabetes, [7, 18] and obesity [7, 18].

According to the literature, one factor that contributes to improving the quality and duration of sleep is physical exercise [20, 21]. Thus, it is expected that physically active older adults have fewer sleep complaints than their sedentary counterparts [22]. However, even exercising older people can have sleep problems and chronic diseases [23] since sleep disorders have multifactorial causes [24].

Exploring the impact of sleep duration and its consequences on health represents an important step in public health [13]. Although there is consensus that aging causes changes in sleep and affects sleep quality and duration, it is necessary to investigate the association between diseases and short sleep duration in elderly exercise practitioners. This will permit to identify to which extent this relationship between sleep and disease is mediated by exercise in older adults. Therefore, the objective of the present study was to evaluate the association between diseases and sleep duration in older adults who are practitioners of physical exercise.

2 Materials And Methods

2.1 Participants

This cross-sectional study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement and was approved by the Ethics Committee on Research Involving Humans of the Santa Catarina State University (UDESC) (CAAE 4588115.1.000.0118). All participants signed the free and informed consent form according to Resolution 510/2016 of the National Health Council.

Older adults from the Grupo de Estudos da Terceira Idade (GETI) university extension program, Center for Health Sciences and Sport (CEFID), linked to UDESC, participated in this study. GETI develops health promotion actions that involve different types of physical exercise such as walking, gymnastics, water aerobics, swimming, weight training, dancing, and Pilates. The modalities have a weekly frequency of two to three times and each session lasts 50 minutes [25]. Criteria for inclusion in the study were age of 60 years or older, both sex, and participation for at least six months in one of the exercise modalities offered by GETI. Older adults who missed the scheduled data collection due to illness or travel and those who did not answer any of the questionnaires were excluded from the study. For this study, 216 elderly exercise practitioners met the inclusion criteria.

2.2 Instruments

A diagnostic form was used to investigate sociodemographic (age, marital status, and education) and health (health perception, diseases, and medications) characteristics. Sleep quality of the participants was assessed using the Pittsburgh Sleep Quality Index (PSQI) [26]. The PSQI is a questionnaire consisting of 19 questions that assess various sleep-related problems in the last month. The questions are categorized into seven components and rated from 0 to 3. The components are sleep quality, sleep duration, sleep latency, habitual sleep efficiency, sleep disorders, use of sleep medication, and daytime dysfunction. The sum of scores for each component generates a global score that ranges from 0 to 21, with a higher score indicating poor quality of sleep. The PSQI was validated for Brazil by Bertolazi et al. [27], demonstrating high internal consistency (Cronbach's $\alpha = 0.82$).

Three PSQI questions were used to evaluate the sleep duration (in hours) of older adults: "What time of day have you gone to bed?"; "What time have you woken up in the morning?" and "How long has it taken you to fall asleep after lying in bed?". The difference between going to bed and waking up in the morning, considering the sleep latency (third question), was considered to be the total sleep duration. Sleeping less than seven hours per night was defined as short sleep duration following the cutoff used in most studies [12].

2.3 Data collection

Previously trained researchers collected the data. First, contact was made with the older adults participating in the GETI exercise modalities. The research objectives were explained, highlighting the confidentiality of the information, and the older adults were invited to participate. Upon acceptance, the participants signed the free informed consent form. A date, place, and time were then scheduled for application of the instruments. The diagnostic form and the PSIQ were applied by individual interview.

2.4 Data analysis

Data were tabulated in Excel® and analyzed using the IBM SPSS 20.0 software. Sociodemographic, health, and sleep characteristics were analyzed using descriptive statistics. Data normality was verified using the Kolmogorov-Smirnov test. The independent t-test was applied to identify differences in the mean scores of the PSQI components and their total score according to the presence or absence of diseases. The chi-square test was used to evaluate possible associations between short sleep duration and disease. All associations with $p < 0.20$ were included in a Poisson Regression model with a robust estimator to determine the prevalence ratio (PR) and confidence interval (CI). The final model was adjusted for all variables (diseases) included in the model, in addition to gender and education. A level of significance of 5% was adopted.

3 Results

This study consisted of 216 elderly exercise practitioners with a mean age of 70.2 ± 6.81 years. Regarding the sociodemographic and health characteristics of the sample, 60.6% were married; 49.7% had one to eight years of schooling; 64.4% had a good health perception; 87.0% hade one or more diseases, and 85.2% used medications (Table 1). The prevalence of poor sleep quality in the sample was 47.7% (95%CI: 44.4–50.9). In addition, 43.1% (95%CI: 36.5–49.6) of the older adults had short sleep duration.

Table 1
Sociodemographic, health and sleep characteristics of the older adults (n = 216).

Variable	Total sample
Age, years (mean, SD)	70.2 (6.81)
Gender	
Male	18 (8.3)
Female	198 (91.7)
Marital status (n, %)	
Married	131 (60.6)
Separate	23 (10.6)
Single	23 (10.6)
Widowed	39 (18.2)
Education (n, %)	
No education	1 (0.5)
1 to 8 years of schooling	107 (49.5)
9 to 11 years of schooling	59 (27.3)
Higher education	49 (22.7)
Health perception (n, %)	
Excellent	23 (10.6)
Good	139 (64.4)
Poor	51 (23.6)
Very poor	3 (1.4)
Diseases (n, %)	
No disease	28 (13.0)
One or more diseases	188 (87.0)
Medication use (n, %)	
Yes	184 (85.2)
No	32 (14.8)

Note: n = number; SD = standard deviation.

Variable	Total sample
Sleep quality (n, %)	
Good quality	113 (52.3)
Poor quality	103 (47.7)
Sleep duration (n, %)	
Normal duration	123 (56.9)
Short duration	93 (43.1)
Note: n = number; SD = standard deviation.	

Comparison of the global PSQI score according to the presence or absence of diseases showed that older adults with arthrosis ($p = 0.008$), depression ($p = 0.043$), diabetes ($p = 0.005$), heart disease ($p = 0.008$), fibromyalgia ($p < 0.001$), and urinary incontinence ($p = 0.004$) had a higher score than those without these diseases, indicating poor sleep quality (Table 2).

Table 2
Comparison of the global PSQI score according to the presence or absence of diseases in elderly exercise practitioners (n = 216).

Disease	Global PSQI score Mean (SD)	t test	p value
Arthrosis			
Yes	6.27 (4.20)	2.690	**0.008**
No	4.91 (3.22)		
Depression			
Yes	7.15 (3.75)	2.143	**0.043**
No	5.27 (3.65)		
Diabetes			
Yes	7.22 (4.04)	2.950	**0.005**
No	5.09 (3.52)		
Heart disease			
Yes	7.27 (4.17)	2.799	**0.008**
No	5.11 (3.51)		
Fibromyalgia			
Yes	9.67 (4.73)	4.828	**< 0.001**
No	5.13 (3.41)		
Hypertension			
Yes	5.91 (3.93)	1.810	0.072
No	5.01 (3.41)		
Hypothyroidism			
Yes	6.20 (4.29)	0.294	0.770
No	5.92 (3.98)		
Urinary incontinence			
Yes	7.29 (4.56)	2.878	**0.004**
No	5.14 (3.43)		

Note: PSQI = Pittsburgh Sleep Quality Index; SD = standard deviation.

Disease	Global PSQI score Mean (SD)	t test	p value
Osteoporosis			
Yes	6.42 (4.45)	1.741	0.083
No	5.25 (3.50)		
Note: PSQI = Pittsburgh Sleep Quality Index; SD = standard deviation.			

Table 3 shows the association between short sleep duration and the presence of diseases in older adults. In the crude analysis, hypothyroidism and fibromyalgia were associated with sleep duration. After adjusting for all variables included in the model, in addition to gender and education, the same diseases continued to be significantly associated. The result showed that older adults with hypothyroidism were 1.63 times (95%CI: 1.19–2.23) more likely to have short sleep duration. Furthermore, older adults with fibromyalgia were more likely (PR = 1.68; 95%CI: 1.07–2.62) to sleep less than seven hours per night. The presence of urinary incontinence, heart disease, or diabetes was not associated with short sleep duration in this study.

Table 3
Association between short sleep duration and diseases in elderly exercise practitioners (n = 216).

Disease	Sleep duration		PR* (95%CI)	PR** (95%CI)
	Normal	Short		
Urinary incontinence				
Yes	15 (12.2)	19 (20.4)	1.37 (0.97–1.94)	0.96 (0.62–1.48)
No	108 (87.8)	74 (79.6)	1	1
Heart disease				
Yes	15 (12.2)	18 (19.4)	1.33 (0.93–1.90)	0.85 (0.55–1.31)
No	108 (87.8)	75 (80.6)	1	1
Hypothyroidism (n = 128)				
Yes	7 (11.1)	18 (27.7)	1.58 (1.14–2.18)	**1.63 (1.19–2.23)**
No	56 (88.9)	47 (72.3)	1	1
Diabetes				
Yes	17 (13.8)	19 (20.4)	1.28 (0.90–1.83)	1.28 (0.90–1.82)
No	106 (86.2)	74 (79.6)	1	1
Fibromyalgia				
Yes	4 (3.3)	11 (11.8)	1.80 (1.27–2.55)	**1.68 (1.07–2.62)**
No	119 (96.7)	82 (88.2)	1	1

Note: PR = prevalence ratio; 95%CI = 95% confidence interval. * Crude analysis. ** Analysis adjusted for all model variables, in addition to gender and education.

4 Discussion

The main objective of this study was to evaluate the association between diseases and sleep duration in older adults who exercise regularly. The results showed that older adults with hypothyroidism and fibromyalgia were more likely to have short sleep duration, i.e., to sleep less than seven hours per night. As a secondary result, we also found that participants with osteoarthritis, depression, diabetes, heart disease, fibromyalgia, and urinary incontinence had a higher global PSQI score, indicating poor sleep quality.

The scientific community has made efforts to understand the relationship between sleep duration and health outcomes, and there is a particular need to analyze this association in the elderly population [12]. Sleep physiology undergoes significant changes throughout life and sleep duration distribution varies with age [28]. Within this context, both short and long sleep durations appear as “villains” of health in older adults [12, 13] and are associated with different diseases and adverse conditions [14–17].

We found that older adults with hypothyroidism are more likely to sleep less than seven hours per night. Hypothyroidism is a condition caused by dysregulation of thyroid hormone production. Its symptoms include drowsiness, fatigue, lethargy, and intolerance to cold, which vary according to age and gender [29]. Our result is in line with a population-based study in which adults with subclinical hypothyroidism were more likely to have short sleep duration (OR=1.15) regardless of sex or age [30]; the conditions was also associated with increased sleep latency and a higher frequency of sleep disturbances. However, another study involving 4,945 adults showed that only long sleep duration was associated with a risk of hypothyroidism [31].

The mechanisms underlying this association have not been well established. However, some hypotheses can be raised. Studies have shown an interaction between sleep and the immune system [32, 33]; the latter is also associated with hypothyroidism since the disease is more prevalent in patients with autoimmune conditions such as type I diabetes [29]. In this respect, the relationship between sleep duration and hypothyroidism occurs indirectly, mediated by the immune system. Another hypothesis is based on the inhibitory effect of sleep on the secretion of thyroid-stimulating hormone (TSH) [34] in which poor sleep, including short sleep duration, can affect the hypothalamic-pituitary-thyroid axis, increasing TSH levels [35].

Another finding is the higher probability of short sleep duration in older adults with fibromyalgia when compared to those without the disease, regardless of gender and education. Fibromyalgia affects approximately 2.7% of the world population [36] and is characterized by a group of symptoms that include fatigue, pain, memory problems, and sleep disturbances [37]. Sleep problems are common among people with fibromyalgia, with nocturnal restlessness, involuntary leg movements, frequent awakenings, and the perception that sleep is light and not restorative being common complaints [38].

The presence of fibromyalgia actually affects sleep. In a meta-analysis, Wu et al. [39] found that individuals with fibromyalgia have a shorter sleep duration, in addition to poor sleep quality. A classic study also identified a relationship of poor sleep quality and short sleep duration with fibromyalgia [40]. This association seems to be bidirectional since the authors concluded that a night of nonrestorative sleep results in significantly more pain on the following day [40], which is the main complaint of patients with fibromyalgia [37].

Fibromyalgia disrupts sleep in a vicious cycle that primarily involves the autonomic nervous system; pain caused by the disease increases cardiovascular sympathetic activation and reduces sleep efficiency, resulting in lighter sleep and more awakenings during the night, events that lead to abnormal cardiovascular neural control and heightened sensitivity to pain [41]. In addition, slow-wave sleep (SWS) – one of the sleep phases – is reduced in fibromyalgia patients compared to healthy individuals [42]. The duration of SWS is regulated homeostatically in such a way that it is directly related to the duration of wakefulness [38], which increases SWS when prolonged and decreases it when reduced [43]. Thus, the decrease of SWS in fibromyalgia has been suggested to be an indication of the impairment of the homeostasis, directly affecting sleep duration [38].

It is important to remember that the older adults studied here are exercise practitioners. Exercise has been reported as an important non-pharmacological intervention in the treatment and prevention of numerous diseases [44, 45]. In patients with hypothyroidism, exercise can improve endothelial function, VO_2max, lipid profile [46], serum TSH levels [47], and quality of life [48]. For patients with fibromyalgia, exercise has positive effects on fatigue [49, 50], pain [50, 51], sleep quality [49, 52], quality of life [50, 51], and physical function [49].

Exercise is also independently associated with sleep in older adults [53], improving sleep quality, latency, and duration [54–56]. Although the literature shows that physically active older adults have a lower prevalence of sleep problems than their sedentary counterparts [22, 57], the participants in this study exhibited a significant prevalence of poor sleep quality (47.7%) and short sleep duration (43.1%). This result reinforces the multifactorial origin of sleep complaints, involving not only behavioral factors such as physical exercise but also psychological, environmental and pharmacological factors [24].

This study has some limitations such as the self-reported diagnosis of the diseases by the older adults and the use of indirect measures to assess the quality and duration of sleep. However, the applied questionnaire (PSQI) is widely used in the literature and is a validated and reliable instrument. In addition, it was not possible to indicate a causal relationship between the variables since cross-sectional studies do not allow to establish causality. Thus, longitudinal studies are necessary to better monitor changes in sleep duration and quality during the health-disease process. On the other hand, the study involved a significant sample and is part of a university extension program, portraying more reliably the reality of older adults. Furthermore, this is the first study to link sleep duration to the presence of disease in older adults who exercise regularly.

Conclusions

We found that older adults with hypothyroidism and fibromyalgia are more likely to sleep less than seven hours per night compared those without these diseases. Second, we showed that older adults with arthrosis, depression, diabetes, heart disease, fibromyalgia, and urinary incontinence have a higher global PSQI score, indicating poor quality of sleep. These findings are extremely relevant, especially for professionals who work directly with this population, and demonstrate the importance of close monitoring of this population and their possible sleep-related complaints.

Furthermore, it should be noted that physical exercise itself may not be sufficient to solve all problems associated with the health-disease process; thus, multidisciplinary interventions are important to improve the quality of life of older adults. Follow-up of this population is also necessary for future evaluations. This study will serve as a basis for further research in the area, focusing particularly on different sleep durations and their implications for the health of older adults.

Declarations

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Authors' contribution

Conceptualization: FF, MGW, FSP, GZM. Methodology: FF, MGW, FSP. Investigation: FF, GSM. Formal analysis: FF. Writing - original draft: FF, MGW, FSP, GZM. Writing - review & editing: FF, MGW, FSP, GZM. Supervision: GZM.

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Conflict of interest

The authors have no relevant financial or non-financial interests to disclose.

Ethical approval

The study was approved by the Ethics Committee on Research Involving Humans of the Santa Catarina State University (UDESC) (CAAE 4588115.1.000.0118). All participants signed the free and informed consent form according to Resolution 510/2016 of the National Health Council and the Declaration of Helsinki and later amendments.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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