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Prevalence of sleep disorders in geriatrics: an exploratory study using sleep questionnaires

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ABSTRACT

Objectives: This study aimed to investigate the prevalence of sleep problems in older subjects, considering sex and age differences.
Methods: Subjects admitted to a geriatrics clinic underwent a medical visit and completed a battery of questionnaires assessing sleep quality, insomnia, sleep apnea risk, excessive daytime sleepiness (EDS), restless legs syndrome (RLS), chronotype, depression and global cognition.
Results: Fifty-eight subjects (58.6 % women, mean age 77.36±6.07) were included. The most predominant sleep-related complaint was poor sleep quality (36.2 %), followed by sleep apnea risk (34.5 %), insomnia symptoms (25.9 %), EDS (15.5 %) and RLS (12.1 %). Older women reported more insomnia, poorer sleep quality and depressive symptoms than males. Patients aged ≥ 75 years old had more comorbidities and higher sleep apnea risk compared to those under 75 years old.
Conclusions: Sleep problems are frequent in older adults, requiring their screening and treatment for possibly improving well-being and reduce the burden of neuropsychiatric and medical comorbidities.

Introduction

Sleep disorders are increasingly prevalent in aging, likely due to more widespread screening programs and a growing awareness of the importance of sleep throughout the lifespan, particularly in older adults.[1] Current evidence suggests that, in healthy older adults, sleep remains relatively constant from age 60 to mid-90s, with the exception of sleep efficiency, which declines with age.[2] This reduction in sleep efficiency is more pronounced in women than men, who may instead experience a greater number of sleep-related issues.[2] Additionally, polysomnographic studies have shown that deep sleep, including both slow-wave sleep and REM sleep, diminishes with age.[3] These sleep-related issues can be further exacerbated by the health problems commonly associated with aging, resulting in frequently reported sleep problems among the elderly.[4]

Sleep impairment can pose also significant risks to both brain and body health. For example, poor subjective sleep quality, as measured by the Pittsburgh Sleep Quality Index (PSQI), was associated with a double-fold increase in the risk of depressive symptoms and more than threefold increase in the risk of depression.[5] Regarding sex differences, low sleep efficiency (less than 80 %) and being awake more than 90 minutes during the night are associated with a 1.5-fold increased risk of poor physical function in older men.[6] Conversely, in older women, a total sleep time of less than 7 hours per night or a low sleep efficiency index (≤ 65 %) is associated with a higher risk of falls.[7] Furthermore, there is an elevated mortality risk when total sleep time is less than 5 hours per night and sleep efficiency is poor (≤ 65 %).[8]

While previous studies reported a high prevalence of sleep problems in the older population (50 % in the study by Foley, et al.[9]), some of these studies may be relatively outdated,[10–13] as the mean age of the current older population increased and is expected to continue rising in the coming years. Furthermore, some of these studies utilized single questionnaires or a limited number of questionnaires, primarily focusing on insomnia and excessive daytime sleepiness (EDS).[10,14] Considering these premises, the present study aimed to investigate the prevalence of sleep problems in older subjects using a comprehensive set of validated questionnaires to screen sleep

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disorders, global cognition, and depressive symptoms. The study also explored the prevalence of sleep problems based on sex, age, depression and chronotype considering the importance of developing appropriate clinical strategies that can help recognizing sleep disorders in this frail population of subjects by setting a strategy involving the role of specialized nurses managing sleep problems for increasing the patients' well-being.

Methods

Participants and study design

The present observational study included subjects admitted to the geriatrics clinic of the University Hospital of Rome "Tor Vergata" between October 2022 and September 2023 for the BioGerT (Geriatric Biobank of "Tor Vergata") project. All subjects underwent a standard medical visit, which included a comprehensive medical history, and completed a battery of validated questionnaires to assess sleep and depressive symptoms administered by a nurse expert in sleep medicine (M.A.). Given the age of the participants, the questionnaires were administered in a comfortable setting, with assistance provided as needed. Moreover, validated questionnaires were utilized, and data collection was conducted by trained personnel to minimize potential sources of bias.

Inclusion criteria for this study were: 1) age 65 years and older; 2) male and female patients of any ethnic origin; 2) absence of dementia, as evaluated by a Mini-Mental State Examination (MMSE) [15] score, which should be of 24 or above; 3) willingness to complete the battery of questionnaires. Exclusion criteria included: 1) progressive medical disorders, including tumors; 2) recent prescription (within the last 6 months) of drugs acting on the central nervous system; 3) unstable or acute medical disorders (e.g., cardiac, respiratory, gastrointestinal, renal disease), or significant neurologic or psychiatric diseases; and 4) substance abuse or dependence.

The study was approved by the local Ethics Committees of the University Hospital of Rome "Tor Vergata" and written informed consent was obtained by the participants to this study (R.S. #190.22).

Measures

The following questionnaires were administered to all the participants:

- The Italian version of the PSQI,[16,17] which assesses sleep quality and disturbances over a 1-month period. It contains 19 items yielding seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. Each component is scored from 0 to 3, with the global PSQI score ranging from 0 to 21. A global PSQI score above 5 indicate poor sleep quality.
- The Italian version of Insomnia Severity Index (ISI), consisting of 7 items that assess the severity of nighttime and daytime symptoms of insomnia.[18,19] Each item is rated on a 5-point Likert scale (0-4), with total scores ranging from 0 to 28. Scores are categorized as follows: 0-7 (no clinically significant insomnia), 8-14 (subthreshold insomnia), 15-21 (moderate-severe insomnia), and 22-28 (severe insomnia).
- The International Restless Legs Syndrome Study Group Rating Scale (IRLS), used to assess the presence and severity of the restless legs syndrome (RLS) symptoms.[20] The IRLS comprises 10 items rated on a scale ranging from 0 to 4, providing an overall severity of symptoms in the past 7 days.[20] IRLS scores can be categorized into no symptoms (score of 0), mild (score 1–10), moderate (score 11–20), severe (score 21–30) and very severe (score 31–40).[20]
- The Berlin questionnaire (BQ), used to assess the risk for sleep apnoea.[21] It consists of 10 questions across three categories: snoring and cessation of breathing (category 1; five questions); symptoms of EDS (category 2; four questions); and body mass index (BMI) and hypertension (category 3; one question and height and weight information). A positive score in two or more categories suggest a high risk for sleep apnoea.
- The Epworth Sleepiness Scale (ESS), which measures EDS.[22,23] Patients rated on a 4-point scale (0-3) their typical chance of dozing off or falling asleep while engaged in eight different activities. ESS final score ranges from 0 to 24. Scores of 10 or higher indicate EDS.
- The Italian version of the Morningness-Eveningness questionnaire (MEQ), a 19 self-report scale evaluating chronotype preference.[24,25] Chronotype refers to an individual's natural preference for activities and alertness at different times of the day (morningness-eveningness), reflecting the individual's circadian rhythm, which plays a crucial role in regulating various physiological and psychological processes. Scores range from 16 to 86, with higher scores indicating a stronger morning preference. Categories include definite evening type (16-30), moderate evening type (31-41), neither type (42-58), moderate morning type (59-69), and definite morning type (70-86).
- The Italian version of the 15-item Geriatric Depression Scale (GDS),[26–28] which assesses depressive symptoms in the older adults. Responses are given on a yes/no scale, with total scores ranging from 0 to 15. Scores of 0-4 are considered normal; 5-8 indicate mild depression; 9-11 indicate moderate depression; and 12-15 indicate severe depression.

Statistical analysis

Data analysis was conducted with the statistical program SPSS for Windows, version 25.0 (IBM Corp, Armonk, New York, USA).[29] Categorical variables were summarized with counts and percentages with 95 % confidence intervals, while numerical variables were presented as means and standard deviations or medians and interquartile ranges, depending on the data distribution. Differences between groups based on sex (males vs. females), age ($<$75 years old vs. $\geq$ 75 years old) and sleep problems (absence vs. presence) were analyzed using the Mann-Whitney test for continuous variables and the chi-square test for categorical variables.

Correlations between the sleep questionnaires, MMSE and depressive symptoms were performed using Spearman's correlation test. For all the analyses, *p*-values below 0.05 were considered statistically significant.

Results

Participants' description

Two hundred and forty subjects were evaluated at the geriatrics clinic during the study period. Of these, fifty-nine (24.58 %) met the inclusion and exclusion criteria and were enrolled in the study. One subject was excluded after completing scales and questionnaires due to loss of compliance, resulting in a final sample of fifty-eight subjects (41.4 % men and 58.6 % women), with a mean age of 77.36 (SD=6.07). The mean MMSE was 26.83 (SD=2.34). Data are reported in Table 1.

Questionnaires and scales

Approximately 62 % (n = 36) of participants reported at least one sleep problem. Specifically, 27.6 % (n = 16) reported one sleep problem, 17.2 % (n = 10) reported two sleep problems, and the remaining 17.2 % (n = 10) reported at least three different sleep problems. The

Table 1
Participants' demographic and clinical data.

	N=58
Sex, n. (%)	
Males	24 (41.4 %)
Females	34 (58.6 %)
Mean age (years)	77.36 ± 6.07
Body Mass Index	26.54 ± 3.98
Mean Number of Medical Comorbidities	3.68 ± 1.84
Medical Comorbidities, n. (%)	
Diabetes	11 (19.0 %)
Hypertension	44 (75.9 %)
Cardiovascular	32 (55.2 %)
Dyslipidaemia	28 (48.3 %)
Urological	17 (29.3 %)
Pneumological	4 (6.9 %)
Endocrinological	23 (39.7 %)
Haematological	4 (6.9 %)
Gastrointestinal	12 (20.7 %)
Neuropsychiatric	13 (22.4 %)
Hypoacusia	3 (5.2 %)
Mini-Mental State Examination (MMSE), global score	26.83 ± 2.34
Geriatric Depression Scale (GDS), global score	4.16 ± 3.21

most common sleep complaint was poor sleep quality, as measured by the PSQI (36.2 %; n = 21), followed by sleep apnea risk (34.5 %, n = 20), insomnia symptoms (25.9 %, n = 15), EDS (15.5 %, n = 9), and RLS (12.1 %, n = 7) (Fig. 1). Results for each questionnaire administered are summarized in Table 2.

In terms of depressive symptoms, the majority of patients (63.8 %, n=37) reported no symptoms, while 24.1 % (n=14) exhibited mild symptoms, 10.3 % (n=6) reported moderate symptoms, and 1.7 % (n=1) reported severe symptoms.

Subgroup analysis

Comparing the 24 men and 34 women included in the study (Table 3), no significant differences were found for age (p = 0.239), BMI (p = 0.090), number of comorbidities (p = 0.422) and MMSE (p = 0.415). Regarding sleep problems, women reported higher ISI scores (p = 0.002), indicating more severe insomnia symptoms compared to males. Women also reported worse subjective sleep quality than men ($p < 0.001$), particularly in the PSQI components related to sleep latency (p = 0.001), sleep disturbances (p = 0.013), overall sleep quality (p = 0.026) and daytime dysfunction (p = 0.003), respectively. There were no significant differences between men and women in the PSQI components of sleep duration (p = 0.828), sleep efficiency (p = 0.084) and sleep medication use (p = 0.087). Additionally, no significant differences were observed between sexes in the measures of RLS (p = 0.512), sleep apnea risk (p = 0.877), EDS (p = 0.781) and chronotype (p = 0.596). Women also reported higher scores on the GDS, indicating more severe depressive symptoms than men (p = 0.023), with 9 women (15.3 %) showing mild depression and 6 women (10.2 %) moderate or severe depression, compared to 5 men (8.5 %) with mild depression and 1 man (1.7 %) with moderate depression.

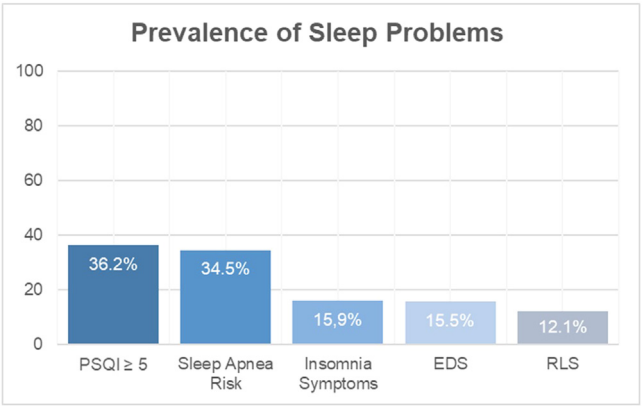

Fig. 1. Prevalence of sleep problems in older adults.

Considering age, participants were divided into two groups: those under 75 years old (n = 24; 41.4 %) and those 75 years and older (n = 34; 58.6 %). The two groups did not differ significantly in terms of sex (p = 0.396) and BMI (p = 0.120). Patients aged 75 and older had higher MMSE scores (p = 0.025) and a greater number of medical comorbidities (p = 0.022) compared to the younger group (<75 years old). Additionally, the older had a higher risk of sleep apnea than the younger group. No significant differences were found for other sleep-related problems or depressive symptoms (Table 4).

Finally, comparing participants without sleep problems to those with at least one sleep problem (Table 5), no significant differences were found between the two groups in age (p = 0.602), sex (p = 0.443), BMI (p = 0.695), number of medical comorbidities (p = 0.630), MMSE scores (p = 0.315) and depressive symptoms (p = 0.686). However, participants without sleep problems had a higher mean MEQ score, indicating a definitely morning chronotype, compared to those with at least one sleep problem (p = 0.007).

Correlations

The GDS score, which measures depressive symptoms, shows a positive correlation with age, and various components of the PSQI, including Subjective Sleep Quality, Sleep Latency, Sleep Efficiency, Sleep Medication use, as well as the PSQI Global Score. Additionally, significant positive correlations were found between the GDS score and the ESS and ISI scores. These findings indicate that individuals with higher GDS scores, reflecting more depressive symptoms, also report poorer subjective sleep quality, longer sleep latency, lower sleep efficiency, increased use of sleep medication, greater EDS, and more pronounced insomnia symptoms.

MEQ scores were negatively correlated with two components of the PSQI—Subjective Sleep Quality and Sleep Medication use—as well as the PSQI Global Score. This suggests that individuals with a morning-type preference report better sleep quality and less use of sleep medication. Additionally, a significant negative correlation was found between MEQ scores and IRLS scores. Correlations between the study variables are presented in Table 6.

Discussion

The study assessed the prevalence of sleep problems using validated questionnaires in older adults, while also evaluating global cognition and depressive symptoms. A previous study documented that in a large cohort of elderly individuals (n= 9282), 57 % reported at least one sleep problem, assessed through clinical interview.[9] Notably, subjects reporting sleep problems were those with indicators of poor health (depressed mood, respiratory problems, and physical disability). In the present study, 36.2 % of subjects reported poor sleep quality when considering the PSQI global score (≥5). This percentage increases and reaches 62 % when taking into consideration the presence of at least one sleep problem measured through the self-report questionnaires. This finding reinforces that sleep problems are prevalent among older adults, and using appropriate questionnaires for investigating these issues may provide better screening than general sleep quality assessments or a brief sleep medicine interview. Specifically, the PSQI, ISI and ESS represent effective tools for screening sleep disorders and related symptoms in older

Table 2
Questionnaire data in the whole group of subjects.

	N	%
Pittsburgh Sleep Quality Index		
Good Subjective Sleep Quality (<5)	37	63.8
Low Subjective Sleep Quality (≥5)	21	36.2
Berlin Questionnaire*		
Low Risk for sleep apnea	35	65.5
High Risk for sleep apnea	20	34.5
Epworth Sleepiness Scale (ESS)		
Normal Daytime Sleepiness (<9)	49	84.5
Excessive Daytime Sleepiness (>10)	9	15.5
Risk for Sleep apnea coupled with ESS >10	5	8.62
Insomnia Severity Index		
Absence of insomnia symptoms	43	74.1
Mild and Moderate insomnia symptoms	15	15.5
International Restless Legs Syndrome (RLS) Study Group Scale		
Absence of RLS symptoms	51	87.9
Mild RLS symptoms	2	3.4
Moderate RLS symptoms	4	6.9
Severe RLS symptoms	1	1.7
Morningness-Eveningness Questionnaire		
Definitely morning type	14	24.1
Moderately morning type	28	48.3
Neither type	14	24.1
Moderately evening type	2	3.4

* 3 subjects did not complete the Berlin Questionnaire since did not have a bed partner and reported difficulty in answering on their own some questions.

adults. These instruments were key in identifying prevalent issues and can be easily integrated into routine clinical practice to guide treatment planning.

Considering each sleep disorder separately, the most frequent sleep problem in the group of subjects included in the current study was the risk of sleep apnea, reported by 34.5 % of participants. One of the earliest studies examining the prevalence of obstructive sleep apnea using nocturnal polysomnography found a prevalence of 62 % at respiratory desaturation index (RDI) >10/h in 427 older adults.[30] Another study with a considerably larger sample (n=2911) found that 26.4 % of older adults had RDI>15/h and 60 % had RDI>5/h, with prevalence increasing with age.[31] Further, a recent study of community-recruited adults documented that among those aged 60-85 years, 48.7 % had an RDI>15/h (64.7 % in men, 35.2 % in women), a significantly higher percentage than that observed in younger adults.[32] In the present study, the risk of sleep apnea was evaluated only through a validated screening questionnaire, which may explain the lower prevalence of this sleep disorder in our sample. Participants with asymptomatic sleep apnea may not be identified through a questionnaire and need polysomnography or home sleep apnea test to document sleep apneas. Consistently, older adults present fewer symptoms related to sleep apnea than younger adults,[33,34] which may explain the lower percentage obtained by using questionnaires compared to polysomnography. Additionally, the present study found a similar prevalence of sleep apnea between men and women (37.5 % vs 35.5 %). This unexpected result may reflect the high prevalence of sleep apnea in older women.[35] The high prevalence of sleep apnea identified in older women through a brief screening questionnaire highlights the need to investigate this sleep disorder further, as women with sleep apnea are at a higher risk for cognitive decline, neuropsychiatric symptoms, and decreased quality of life.[33] Conversely, the lower percentage of men at risk for sleep apnea detected by the BQ possibly reflects the under-recognition of sleep apnea symptoms in men.

In the present study, a prevalence of insomnia was estimated in 27.1 % of the recruited subjects and is in line with previous findings, which hypothesized a prevalence between 23 % and 34 % of elderly participants.[36] However, when a subgroup was re-evaluated during follow-up, 50% reported no symptoms without a clear clinical motivation, suggesting that improved self-perceived health might be linked to the resolution of insomnia symptoms in older adults.[36] Further, the current results suggest that the use of ISI may help in recognizing sleep problems in older adults. Insomnia was one of the most frequent sleep problems among older adults, with a higher prevalence in women than men, and no significant age-related differences among participants.

Table 3
Sex differences in demographic, clinical, cognition, depression, and sleep problems.

	Sex						Test Differences	
	Males (n=24)			Females (n=31)				
	Median	Percentile 25	Percentile 75	N (%)	Median	Percentile 25	Percentile 75	N (%)	Mann-Whitney U / χ2	*p*-values
Age (years)	76.00	72.50	81.00		78.50	73.00	83.00		482.5	0.239
Body Mass Index (BMI)	26.45	25.28	28.21		25.48	23.71	27.82		300.5	0.09
Mini-Mental State Examination (MMSE), global score	26.70	24.85	28.05		26.95	25.70	28.40		459.5	0.415
Number of Medical Comorbidities	3.50	2.00	5.00		4.00	2.00	5.00		445.0	0.422
Geriatric Depression Scale (GDS), global score	2.00	1.00	4.50		4.00	2.00	7.00		550.5	0.023
Pittsburgh Sleep Quality Index (PSQI), global score	3.00	2.00	4.00		6.00	4.00	9.00		643.0	<0.001
Component 1, Subjective Sleep Quality	1.00	0.00	1.00		1.00	1.00	1.00		529.0	0.026
Component 2, Sleep Latency	1.00	0.00	1.00		2.00	1.00	3.00		610.5	0.001
Component 3, Sleep Duration	0.00	0.00	1.00		0.00	0.00	1.00		420.0	0.828
Component 4, Sleep Efficiency	0.00	0.00	0.00		0.00	0.00	0.00		456.0	0.084
Component 5, Sleep Disturbances	1.00	1.00	1.00		2.00	1.00	2.00		541.5	0.013
Component 6, Sleeping Medications	0.00	0.00	0.00		0.00	0.00	2.00		489.0	0.087
Component 7, Daytime Dysfunction	0.00	0.00	0.00		0.00	0.00	1.00		556.0	0.003
Insomnia Severity Index (ISI), total score	3.00	1.00	4.50		6.50	3.00	12.00		604.5	0.002
International Restless Legs Syndrome Study Group Rating Scale (IRLS), total score	0.00	0.00	0.00		0.00	0.00	0.00		431.5	0.512
Epworth Sleepiness Scale (ESS), total score	6.00	2.50	7.50		6.00	4.00	8.00		425.5	0.781
Morningness-Eveningness questionnaire (MEQ), total score	63.00	57.50	68.00		64.50	58.00	70.00		441.5	0.596
Berlin Questionnaire	Low Sleep Apnea Risk				15 (62.5 %)			20 (64.5 %)	0.024	0.877
	High Sleep Apnea Risk				9 (37.5 %)			11 (35.5 %)		

Table 4
Age differences in demographic, clinical, cognition, depression, and sleep problems.

	Age Groups								Test Differences	
	< 75 years old (n=24)				≥ 75 years old (n=34)					
	Median	Percentile 25	Percentile 75	N (%)	Median	Percentile 25	Percentile 75	N (%)	Mann-Whitney U / χ2	*p*-values
Males				12 (50 %)				12 (35.3 %)	0.721	0.396
Body Mass Index	26.63	25.32	28.73		25.46	23.83	27.68		428.5	0.695
Mini-Mental State Examination (MMSE), global score	27.35	26.10	30.00		26.45	24.70	27.80		458.5	0.315
Number of Medical Comorbidities	3.00	1.00	4.50		4.00	3.00	5.00		414.0	0.63
Geriatric Depression Scale (GDS), global score	3.00	2.00	5.00		4.00	2.00	7.00		421.0	0.686
Pittsburgh Sleep Quality Index (PSQI), global score	3.50	3.00	6.00		4.50	3.00	8.00		656.0	<0.001
Component 1, Subjective Sleep Quality	1.00	0.00	1.00		1.00	0.00	1.00		476.0	0.135
Component 2, Sleep Latency	1.00	0.00	2.00		1.00	1.00	2.00		542.5	0.015
Component 3, Sleep Duration	0.50	0.00	1.00		0.00	0.00	1.00		574.0	0.001
Component 4, Sleep Efficiency	0.00	0.00	0.00		0.00	0.00	0.00		440.0	0.108
Component 5, Sleep Disturbances	1.00	1.00	2.00		1.00	1.00	2.00		535.0	0.009
Component 6, Sleeping Medications	0.00	0.00	0.00		0.00	0.00	1.00		527.0	0.005
Component 7, Daytime Dysfunction	0.00	0.00	0.50		0.00	0.00	1.00		499.0	0.038
Insomnia Severity Index (ISI), total score	3.50	1.50	7.00		6.00	3.00	10.00		564.0	0.007
International Restless Legs Syndrome Study Group Rating Scale (IRLS), total score	0.00	0.00	0.00		0.00	0.00	0.00		473.0	0.029
Epworth Sleepiness Scale (ESS), total score	5.50	3.00	7.00		7.00	4.00	9.00		432.0	0.562
Morningness-Eveningness questionnaire (MEQ), total score	62.00	58.50	68.50		64.00	58.00	70.00		227.0	0.007
Berlin Questionnaire	Low Sleep Apnea Risk			16 (66.7 %)				19(61.3 %)	0.017	0.898
	High Sleep Apnea Risk			8 (33.3 %)				12 (38.7 %)		

RLS and EDS were other sleep problems investigated in this study, with prevalences of 12.1 % and 15.5 %, respectively. These two sleep disorders did not show differences by sex or age groups. Regarding the prevalence of RLS, the present findings concord with those proposed by the previous literature, which reported a range between 7.4 % and 22 %.[37] When coupling the subjective report of sleep apnea and EDS, the prevalence was 8.62 %. The combination of sleep apnea and EDS increases mortality in older adults, especially in cases of OSA with AHI ≥20 and EDS, which is associated with an increased all-cause mortality risk, even after adjusting for other significant factors, such as prolonged sleep duration.[38] Therefore, it appears clinically significant the identification of sleep apnea and EDS in the older adults, and the use of questionnaires can help in identifying these sleep disorders. Consistently, sleep apnea can be treated by positive airway pressure treatment, which can not only prevent apnea and hypopnea events, but can also improve sleep architecture, daytime sleepiness, self-reported symptoms (snoring and gasping), motor speed and nonverbal learning and memory, vascular resistance, platelet coagulability and other factors affecting cardiac function, and nocturia.[37,39–41]

Considering chronotype, which refers to individuals' natural preference for activities and alertness at different times of the day, as measured by the MEQ, most subjects in the study exhibited a morning chronotype (72.4 %) whereas only a few participants showed an evening chronotype (3.4 %). No significant differences in the prevalence of the morning chronotype were observed in the subgroup analysis based on sex and age. Our findings also suggest that individuals with a morning-type preference report better sleep quality and less use of sleep medication. These findings align with the understanding that aging is associated with changes in circadian sleep-wake rhythm, such as decreased amplitude, advanced phase, internal desynchronization, and an increase in variability of the sleep-wake cycle.[42–44] Additionally, alterations in the expression of clock genes, neurochemical changes in the suprachiasmatic nucleus (SCN), decreased ability of SCN to drive peripheral oscillators, reduced light input, and age-related loss in photoreception, along with less exposure to light, contribute to these modifications in the circadian sleep-wake rhythm in the elderly.[42–48] A further contribution factor is the reduction in melatonin levels with age.[49] These circadian rhythm

Table 5
Differences in demographic, clinical, cognition, and depression between older adults with and without sleep problems.

	Sleep Problems								Test Differences	
	No (n=22)				Yes (n=36)					
	Median	Percentile 25	Percentile 75	N (%)	Median	Percentile 25	Percentile 75	N (%)	Mann-Whitney U / χ2	*p*-values
Males				11 (41.8 %)				11 (32.4 %)	0.589	0.443
Age (years)	76.50	73.00	81.00		78.00	72.50	82.50		428.5	0.602
Body Mass Index (BMI)	26.38	24.22	28.89		25.83	24.38	27.75		371.5	0.695
Mini-Mental State Examination (MMSE), global score	26.55	24.70	27.70		26.95	25.40	28.40		458.5	0.315
Number of Mecical Comorbidities	4.00	2.00	5.00		4.00	2.00	5.00		414.0	0.630
Geriatric Depression Scale (GDS), global score	2.50	2.00	7.00		4.00	2.00	5.50		421.0	0.686
Morningness-Eveningness questionnaire (MEQ), total score	66.00	61.00	70.00		60.00	57.00	67.50		227.0	0.007

Table 6
Correlations between sleep-related questionnaires, depressive symptoms and global cognition in older adults.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age	1															
2. MMSE	-.187	1														
3. GDS	.262*	.051	1													
4. C1. Sleep Quality	.153	.186	.274*	1												
5. C2. Sleep Latency	.152	-.165	.337**	.295*	1											
6. C3. Sleep Duration	-.039	.078	.038	.127	.144	1										
7. C4. Sleep Efficiency	.208	-.104	.325*	.209	.405**	.277*	1									
8. C5. Sleep Disturbances	-.061	.088	.150	.158	.176	.129	.048	1								
9. C6. Sleeping Medication	.241	.107	.265*	.264*	.389**	.151	.114	.073	1							
10. C7. Daytime Dysfunction	.139	.113	.209	.476**	.293*	.080	.291*	.293*	.186	1						
11. Global PSQI	.167	.008	.375**	.576**	.767**	.425**	.395**	.371**	.647**	.533**	1					
12. ESS	.212	.060	.271*	.133	.085	.040	.109	.162	.165	.302*	.206	1				
13. MEQ	.059	-.004	.087	-.302*	-.248	-.092	-.040	-.066	-.337**	-.237	-.373**	.122	1			
14. IRLS	-.105	.043	.175	.314*	.207	.171	.103	.165	.158	.034	.285*	.050	-.304*	1		
15. ISI	.244	.136	.390**	.615**	.496**	.285*	.313*	.278*	.465**	.550**	.747**	.241	-.242	.186	1	
16. Berlin Risk (0=No 1=Yes)	.043	.055	.060	.041	.131	.015	-.018	.396**	.183	.274*	.181	.146	-.239	.068	.236	1

Abbreviations: MMSE, Mini-Mental State Examination; GDS, Geriatric Depression Scale; PSQI, Pittsburgh Sleep Quality Index; ESS, Epworth Sleepiness Scale; MEQ, Morningness-Eveningness questionnaire; IRLS, International Restless Legs Syndrome Study Group Rating Scale; ISI, Insomnia Severity Index; C, component of the PSQI.
*$p<0.05$ **$p<0.01$

alterations in older adults has been associated with depressive symptoms, dementia and increased mortality risk, particularly among women, while they have been associated with cardiovascular risk and mortality in men.[50–53]

Another significant observation from the present study was the correlation between depressive symptoms and various aspects of sleep quality in the elderly. The data suggests that interventions aimed at improving sleep quality should also consider the mental health status of older adults to be fully effective. Depression in older adults often coexists with sleep disturbances, creating a cycle that can exacerbate both conditions.[54,55] Poor sleep quality can worsen depressive symptoms, while depression can contribute to difficulties in having restful sleep.[54,55] Therefore, addressing both sleep and mental health issues is crucial in the clinical interview and it can be assessed by trained nurses expert in sleep medicine, such as in the present research. Additionally, acknowledging findings from previous studies[4] that demonstrate a correlation between sleep disturbances and other comorbidities can assist in developing personalized care plans and guiding appropriate referrals to sleep specialists. This integrated approach is essential for effectively managing these prevalent issues in the geriatrics population, improving overall health outcomes and quality of life.

Limitations and strenghts

Although these findings are valuable by showing the contribution of validated sleep questionaries in older adults in line with previous research, several limitations of the present study need to be discussed. An important limitation is the relatively small number of participants, although the group of individuals included in this analysis was selected following several inclusion and exclusion criteria from a higher group of subjects admitted at the geriatrics clinic of a University Hospital. A further limitation is that the enrolment of the patients was carried out in a single healthcare center in Italy and thus the findings cannot be generalized to the whole Italian population. Longitudinal studies may be useful to provide more data and a better understanding of the prevalence of sleep problems over time. In fact, symptoms severity may change during the course of life and may be related to health status. On the other hand, a major strength of this study is the use of a comprehensive set of validated questionnaires for participants aged 65 and older, providing a detailed analysis of sleep characteristics in this age group, crucial given the increasing life expectancy.

Conclusions

This study underscores the significant prevalence of various sleep disorders among older adults, with particular emphasis on worse sleep quality, insomnia, and sleep apnea risk, especially among women and those aged 75 and older. For nurses and healthcare providers working in geriatrics settings, these findings suggest a crucial role in routinely assessing sleep health as part of comprehensive care. Using validated questionnaires to screen for sleep disorders can facilitate early identification and intervention, thereby improving the overall quality of life in the elderly. Hence, clinicians should be vigilant and screen for possible sleep problems, possibly by asking to specialized nurses to administer validated questionnaires when evaluating older patients as part of preventive medicine, considering the high prevalence of sleep disorders in the older population, as also demonstrated in the current study.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Mariana Fernandes: Writing – original draft, Investigation, Formal analysis, Data curation. **Matteo Antonucci:** Writing – review & editing, Investigation, Data curation. **Francesca Capecci:** Investigation. **Nicola Biagio Mercuri:** Supervision. **David Della-Morte:** Writing – review & editing, Conceptualization. **Claudio Liguori:** Writing – review & editing, Formal analysis, Conceptualization.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.gerinurse.2024.08.032.

References

1. Gulia KK, Kumar VM. Sleep disorders in the elderly: a growing challenge. *Psychogeriatrics*. 2018;18(3):155–165.
2. Ohayon MM, Carskadon MA, Guilleminault C, Vitiello MV. Meta-Analysis of Quantitative Sleep Parameters From Childhood to Old Age in Healthy Individuals: Developing Normative Sleep Values Across the Human Lifespan. *Sleep*. 2004;27(7):1255–1273.
3. Van Cauter E, Leproult R, Plat L. Age-related changes in slow wave sleep and REM sleep and relationship with growth hormone and cortisol levels in healthy men. *Jama*. 2000;284(7):861–868.
4. Ancoli-Israel S, Ayalon L, Salzman C. Sleep in the elderly: normal variations and common sleep disorders. *Harv Rev Psychiatry*. 2008;16(5):279–286.
5. Paudel ML, Taylor BC, Diem SJ, et al. Association between depressive symptoms and sleep disturbances in community-dwelling older men. *J Am Geriatr Soc*. 2008;56(7):1228–1235.
6. Dam TL, Ewing S, Ancoli-Israel S, et al. Association between sleep and physical function in older men: the osteoporotic fractures in men sleep study. *J Am Geriatr Soc*. 2008;56(9):1665–1673.
7. Stone KL, Ewing SK, Lui L, et al. Self-reported sleep and nap habits and risk of falls and fractures in older women: the study of osteoporotic fractures. *J Am Geriatr Soc*. 2006;54(8):1177–1183.
8. 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(16):1768–1775.
9. Foley DJ, Monjan AA, Brown SL, Simonsick EM, Wallace RB, Blazer DG. Sleep complaints among elderly persons: an epidemiologic study of three communities. *Sleep*. 1995;18(6):425–432.
10. Maggi S, Langlois JA, Minicuci N, et al. Sleep Complaints in Community-Dwelling Older Persons: Prevalence, Associated Factors, and Reported Causes. *J Am Geriatr Soc*. 1998;46(2):161–168.
11. Babar SI, Enright PL, Boyle P, et al. Sleep disturbances and their correlates in elderly Japanese American men residing in Hawaii. *Journals Gerontol Ser A Biol Sci Med Sci*. 2000;55(7):M406–M411.
12. Schubert CR, Cruickshanks KJ, Dalton DS, Klein BEK, Klein R, Nondahl DM. Prevalence of sleep problems and quality of life in an older population. *Sleep*. 2002;25(8):48–52.
13. Chiu HFK, Leung T, Lam LCW, et al. Sleep problems in Chinese elderly in Hong Kong. *Sleep*. 1999;22(6):717–726.
14. Bonanni E, Tognoni G, Maestri M, et al. Sleep disturbances in elderly subjects: an epidemiological survey in an Italian district. *Acta Neurol Scand*. 2010;122(6):389–397.
15. Folstein MF, Folstein SE, McHugh PR. Mini-mental state (MMSE). *Journal of Psychiatric Research*. 1975;12. Published online.
16. Curcio G, Tempesta D, Scarlata S, Marzano C, Moroni F, Maria P. Validity of the Italian Version of the Pittsburgh Sleep Quality Index (PSQI). Published online 2013:511-519.
17. Buysse DJ, Reynolds III CF, TH Monk, SR Berman, DJ Kupfer. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28(2):193–213.
18. Bastien CH, Vallières A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med*. 2001;2(4):297–307.
19. Castronovo V, Galbiati A, Marelli S, et al. Validation study of the Italian version of the Insomnia Severity Index (ISI). *Neurol Sci Off J Ital Neurol Soc Ital Soc Clin Neurophysiol*. 2016;37(9):1517–1524.
20. The International Restless Legs Syndrome Study Group. Validation of the International Restless Legs Syndrome Study Group rating scale for restless legs syndrome. *Sleep Med*. 2003;4(2):121–132.
21. Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. *Ann Intern Med*. 1999;131(7):485–491.
22. Johns MW. A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*. 1991;14(6):540–545.
23. Vignatelli L, Plazzi G, Barbato A, et al. Italian version of the Epworth sleepiness scale: External validity. *Neurol Sci*. 2003;23(6):295–300.
24. Horne JA, Ostberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *Int J Chronobiol*. 1976;4(2):97–110.
25. Natale V. Validazione di una scala ridotta di Mattutinità (rMEQ). *Giunti Organ Spec*. 1999. Published online.
26. Galeoto G, Sansoni J, Scuccimarri M, et al. A psychometric properties evaluation of the Italian version of the geriatric depression scale. *Depress Res Treat*. 2018;2018.
27. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of a geriatric depression screening scale: a preliminary report. *J Psychiatr Res*. 1982;17(1):37–49.
28. Sheikh JI, Yesavage JA. Geriatric Depression Scale (GDS): recent evidence and development of a shorter version. *Clinical Gerontology*. Routledge; 2014:165–173.
29. *SPSS - Statistical Package for Social Sciences*. IBM; 2020. Published online.
30. Ancoli-Israel S, Ancoli-Israel S, Kripke DF, et al. Sleep-disordered breathing in community-dwelling elderly. *Sleep*. 1991;14(6):486–495.
31. Mehra R, Stone KL, Blackwell T, et al. Prevalence and correlates of sleep-disordered breathing in older men: osteoporotic fractures in men sleep study. *J Am Geriatr Soc*. 2007;55(9):1356–1364.
32. Heinzer R, Vat S, Marques-Vidal P, et al. Prevalence of sleep-disordered breathing in the general population: THE HypnoLaus study. *Lancet Respir Med*. 2015;3(4):310–318.
33. Launois SH, Pépin J-L, Lévy P. Sleep apnea in the elderly: a specific entity? *Sleep Med Rev*. 2007;11(2):87–97.
34. Martínez-García MA, Soler-Cataluña JJ, Román-Sánchez P, González V, Amorós C, Montserrat JM. Obstructive sleep apnea has little impact on quality of life in the elderly. *Sleep Med*. 2009;10(1):104–111.
35. Ye L, Pien GW, Weaver TE. Gender differences in the clinical manifestation of obstructive sleep apnea. *Sleep Med*. 2009;10(10):1075–1084.
36. Foley DJ, Monjan A, Simonsick EM, Wallace RB, Blazer DG. Incidence and remission of insomnia among elderly adults: an epidemiologic study of 6,800 persons over three years. *Sleep*. 1999;22:S366–S372.
37. Weaver TE, Chasens ER. Continuous positive airway pressure treatment for sleep apnea in older adults. *Sleep Med Rev*. 2007;11(2):99–111.
38. Gooneratne NS, Richards KC, Joffe M, et al. Sleep disordered breathing with excessive daytime sleepiness is a risk factor for mortality in older adults. *Sleep*. 2011;34(4):435–442.
39. Liguori C, Cremascoli R, Maestri M, et al. Obstructive sleep apnea syndrome and Alzheimer's disease pathology: may continuous positive airway pressure treatment delay cognitive deterioration? *Sleep Breath*. 2021;22. Published online February.
40. Fernandes M, Mari L, Chiaravalloti A, et al. 18F-FDG PET, cognitive functioning, and CSF biomarkers in patients with obstructive sleep apnoea before and after continuous positive airway pressure treatment. *J Neurol*. 2022;269(10):5356–5367.
41. Carpi M, Cordella A, Placidi F, et al. Continuous positive airway pressure treatment improves bone mineral density in men affected by severe obstructive sleep apnea syndrome. *J Clin Sleep Med*. 2024;20(1):67–73.
42. Naylor E, Zee PC. Circadian rhythm alterations with aging. *Sleep Med Clin*. 2006;1(2):187–196.
43. Hofman MA, Swaab DF. Living by the clock: the circadian pacemaker in older people. *Ageing Res Rev*. 2006;5(1):33–51.
44. Gibson EM, Williams III WP, LJ Kriegsfeld. Aging in the circadian system: considerations for health, disease prevention and longevity. *Exp Gerontol*. 2009;44(1-2):51–56.
45. Hofman MA, Swaab DF. Alterations in circadian rhythmicity of the vasopressin-producing neurons of the human suprachiasmatic nucleus (SCN) with aging. *Brain Res*. 1994;651(1-2):134–142.
46. Yamazaki S, Straume M, Tei H, Sakaki Y, Menaker M, Block GD. Effects of aging on central and peripheral mammalian clocks. *Proc Natl Acad Sci*. 2002;99(16):10801–10806.
47. Turner PL, Mainster MA. Circadian photoreception: ageing and the eye's important role in systemic health. *Br J Ophthalmol*. 2008;92(11):1439–1444.
48. Campbell SS, Kripke DF, Gillin JC, Hrubovcak JC. Exposure to light in healthy elderly subjects and alzheimer's patients. *Physiol Behav*. 1988;42(2):141–144.
49. Benloucif S, Green K, L'Hermite-Balériaux M, Weintraub S, Wolfe LF, Zee PC. Responsiveness of the aging circadian clock to light. *Neurobiol Aging*. 2006;27(12):1870–1879.
50. Maglione JE, Ancoli-Israel S, Peters KW, et al. Study of Osteoporotic Fractures Research Group Depressive symptoms and circadian activity rhythm disturbances in community-dwelling older women. *Am J Geriatr Psychiatry*. 2014;22(4):349–361.
51. Tranah GJ, Blackwell T, Ancoli-Israel S, et al. Circadian activity rhythms and mortality: the study of osteoporotic fractures. *J Am Geriatr Soc*. 2010;58(2):282–291.
52. Paudel ML, Taylor BC, Ancoli-Israel S, et al. Rest/activity rhythms and mortality rates in older men: MrOS Sleep Study. *Chronobiol Int*. 2010;27(2):363–377.
53. Tranah GJ, Blackwell T, Stone KL, et al. Circadian activity rhythms and risk of incident dementia and mild cognitive impairment in older women. *Ann Neurol*. 2011;70(5):722–732.
54. Fang H, Tu S, Sheng J, Shao A. Depression in sleep disturbance: a review on a bidirectional relationship, mechanisms and treatment. *J Cell Mol Med*. 2019;23(4):2324–2332.
55. Yao Y, Guo D, Liu F-L, Han Y. An overview of mechanisms underlying the comorbidity of sleep and depression disorders in the elderly. *Stress Brain*. 2024;4(1).