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Short sleep is associated with more depressive symptoms in a multi-ethnic cohort of older adults

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Abstract

Objectives—To evaluate cross-sectional and prospective associations between short and long sleep duration and depressive symptoms in older adults (aged >65 years).

Methods—The data from a subsample of the racially/ethnically diverse Northern Manhattan Study were analyzed. Depressive symptoms were assessed twice with the Center for Epidemiologic Studies Depression Scale (CES-D), approximately 5 years apart. The presence of depressive symptoms was defined as a CES-D score ≥16 or use of antidepressants. Self-reports of short (<6 hours), intermediate (6–8 hours) and long (≥9 hours) sleep were assessed prior to the initial CES-D. Logistic regression was used to evaluate the cross-sectional associations between

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short and long sleep durations with depressive symptoms, using intermediate sleep as the reference. The prospective association between sleep duration and depression in a sample of participants without depressive symptoms at first CES-D was also analyzed. All models were adjusted for demographic, behavioral, and vascular risk factors.

Results—The initial sample consisted of 1110 participants: 62% women, 69% Hispanic, 17% black, 14% white. Short sleep was reported by 25%, intermediate sleep by 65%, and long sleep by 9%. Depressive symptoms were described in 25% of the initial sample. Short sleep, but not long sleep, was associated with depressive symptoms at baseline (adjusted OR 1.8, 95% CI 1.3–2.6), and at follow-up (adjusted OR 1.9, 95% CI 1.1–3.5; median follow-up = 5.1 years).

Conclusion—Short sleep duration had a cross-sectional and prospective association with depressive symptoms in an urban multi-ethnic cohort of older adults.

Keywords

Depression; Sleep; Sleep duration; Short sleep; Race; Ethnic

Introduction

The global prevalence of major depression is 5–10% [1]. Depression is predicted to be the second leading cause of disability by 2020, after cardiovascular diseases [2]. Interestingly, 90% of people who experience depression also complain of sleep disturbances, including decreased sleep time [1]. Many studies have shown an association between sleep duration and medical conditions, such as cardiovascular events and mental disorders, and increased mortality [2, 3]. The prevalence of sleep-wake disturbances increases with age. Specifically, there are changes in sleep-wake patterns, increasing sleep fragmentation, and worsening sleep quality throughout a lifetime. Of interest: up to one third of older adults report either short (<6–7 hours) or long sleep duration (>8–9 hours) [4]. There are also race/ethnic differences in sleep disturbances and depressive symptoms, with Hispanic and non-Hispanic blacks having an increased burden of symptoms [5–7]. However, there is a paucity of studies evaluating sleep duration and depressive symptoms in racially/ethnically diverse cohorts, particularly in older adults.

Therefore, the current study aimed to determine the cross-sectional and prospective associations between sleep duration and depressive symptoms in the Northern Manhattan Study (NOMAS). It was hypothesized that short and long sleep durations would be associated with depressive symptoms.

Methods

Population

The initial cohort of the Northern Manhattan Study (NOMAS) consisted of 3298 stroke-free community-dwelling participants randomly sampled from northern Manhattan in New York City, and enrolled from 1993 to 2001, as previously described [7].

The analytical sample was obtained from the NOMAS magnetic resonance imaging (MRI) Sub-Study, which began in 2003 and recruited 1290 participants, completing enrollment in

2008, with the following eligibility criteria: a) remaining clinically stroke-free, b) aged >50 years, and c) no contraindications to MRI. To reach target enrollment, the study recruited 199 community-dwelling household members who met eligibility criteria. The study was approved by the Columbia University Medical Center and University of Miami, Miller School of Medicine Institutional Review Boards. All participants gave written informed consent [8].

Outcome: Depressive symptoms

Depressive symptoms were estimated with the Center for Epidemiological Studies Depression scale (CES-D), a 20-item scale assessing depressive affect, somatic complaints, positive affect, and interpersonal relations [9]. The CES-D scale scores range from 0–60, with greater scores indicating symptoms of depression. Specifically, depressive symptoms were considered present if the sum of the CES-D scores was ≥16 [10] or if the participant self-reported use of antidepressants at the time of the first CES-D evaluation. The 20-item CES-D has a sensitivity of 80% and specificity of 69.8% to detect depressive symptoms [11]. Test-retest reliability is excellent for the CES-D-20 (ICC = 0.87) [12]. The CES-D has been validated in individuals aged >64 years and non-Hispanic blacks; the coefficient alpha remained high (>0.85) in both groups [13]. Depressive symptoms were also defined as the use of antidepressant medication.

Main exposure: Sleep duration

The Northern Manhattan Study obtained self-reported questionnaires on sleep symptoms [7]. Self-reported sleep duration was an estimate of hours of nightly sleep in the 4 weeks prior to follow-up with the following question: “During the past 4 weeks, how many hours, on average, did you sleep each night?” Respondents reported hours in 60-minute or 30-minute increments. This information was collected with the first CES-D. The current study categorized sleep duration into short sleep (<6 hours), intermediate sleep (6–8 hours), and long sleep duration (≥9 hours), which were intervals chosen based on the distribution of the sleep hours in the NOMAS sample and prior studies [14–18].

Covariates

Race and ethnicity were defined by self-identification based on questions modeled after the United States census, and categorized into mutually exclusive groups as non-Hispanic black, non-Hispanic white, and Hispanic [14]. Educational level was classified by whether or not individuals had completed high school [8]. Insurance status was defined as having Medicaid/no insurance, or other insurance. Moderate consumption of alcohol was defined as more than one drink per month, up to two drinks per day. Smoking was categorized as never, past, or current smoker, and included cigarettes, cigars, and pipes [10]. Physical activity was assessed by a questionnaire adapted from the National Health Interview Survey that recorded the frequency and duration of 14 activities during the prior 2 weeks. Physical activity was categorized as moderate to vigorous physical activity versus none to light [8,19]. Body mass index (BMI) was calculated in kg/m^2 [20] and obesity was defined as ≥30 kg/m^2. Cardiac disease included a history of angina, myocardial infarction, coronary artery disease, atrial fibrillation, congestive heart failure or valvular heart disease. Diabetes mellitus was defined as fasting blood glucose ≥126 mg/dL, or the patient’s self-report of

diabetes, use of insulin or hypoglycemic medications. Hypertension was defined as a systolic blood pressure of ≥140 mmHg, or a diastolic blood pressure of ≥90 mmHg, or a patient's self-report of a history of hypertension or use of antihypertensive medications [8]. Social isolation was assessed using the question, "How many people do you know well enough to visit within their homes?" Categories were then defined as: 1 = none, 2 = one or two, 3 = three or four, or 4 = five or more people. Social isolation was used as a dichotomous variable and defined as knowing fewer than three people well enough to visit the participant's home. This assessment was adapted from the Berkman Social Network Index [21].

Statistical analyses

Chi-squared and ANOVA tests were used to evaluate proportions and means across the sleep duration groups and covariates of interest. Logistic regression was used to examine the cross-sectional and prospective association between short (<6 hours) and long sleep duration (≥9 hours) with depressive symptoms. Sleep duration of 6–8 hours was the reference group. The unadjusted associations between sleep duration and depressive symptoms (Model 1) was first evaluated, with subsequent adjustments for age, sex, race-ethnicity, education, insurance status, physical activity and time from sleep questionnaire to CES-D (Model 2). Further adjustments were made for alcohol, smoking, BMI, cardiac disease, diabetes and social isolation, systolic blood pressure, diastolic blood pressure, and antihypertensive medication use [22] (Model 3).

A second set of analyses using logistic regression was completed for participants without depressive symptoms at baseline (CES-D <16, not on medication), to evaluate the association between sleep duration and symptoms of depression at 5-year follow-up. The unadjusted associations between sleep duration and depressive symptoms (Model 1) was first evaluated, with subsequent adjustments for age, sex, race-ethnicity, education, insurance status, physical activity, time from sleep questionnaire to CES-D, and time between the first and second CES-D (Model 2). Further adjustment was made for alcohol, smoking, BMI, cardiac disease, diabetes, social isolation, systolic blood pressure, diastolic blood pressure, and antihypertensive medication use [22] (Model 3).

The CES-D was also analyzed as a continuous outcome using linear regression. Short and long sleep durations were evaluated with the CES-D scores, adjusting for age, sex, race, education level, insurance status, and physical activity, time between the sleep survey and CES-D, and antidepressant use. Self-reports of daytime sleepiness were also added into the final models to further evaluate for the effect of sleep confounders.

Results

The demographic, lifestyle, vascular risk factors, and sleep duration, stratified by depressive symptoms are presented in Table 1. A total of 60% of the sample were women, with 69% of Hispanic/Latino background; 65% reported 6–8 hours of sleep. Depressive symptoms were present in 25% of the sample at baseline. A total of 123 participants reported use of antidepressants. Forty-one percent were on antihypertensive medications and 13% reported social isolation. Participants with depressive symptoms were more likely to be women

(p<0.001), have Medicaid or no insurance (p=0.012), report heavy or no alcohol consumption (p=0.020), have cardiac disease (p=0.020), and report sleep duration of <6 hours (p=0.0002).

Participants who reported short sleep duration had worse depressive symptoms, adjusting for age, sex, race-ethnicity, education status, insurance status, physical activity, alcohol, tobacco, BMI, cardiac disease, diabetes, time from sleep reports to CES-D, social isolation, systolic blood pressure, diastolic blood pressure, and antihypertensive medications (Table 2).

In a sample of 480 participants without depression at baseline, 77 new cases of depressive symptoms after 5 years of follow-up were observed. In the current sample, short sleep duration also had a prospective association with depressive symptoms adjusting for age, sex, race-ethnicity, education status, insurance status, physical activity, alcohol, tobacco, BMI, cardiac disease, diabetes, social isolation, systolic blood pressure, diastolic blood pressure, antihypertensive mediations, time from sleep reports to CES-D, time between CES-D 1 and CES-D 2 (Table 3). There was no cross-sectional or prospective association between long sleep duration (≥9 hours) and depressive symptoms when compared to the reference.

In the sensitivity analysis, short sleep duration (<6 hours) was associated with higher CES-D scores at baseline (β=1.83, p=0.03). Among participants without depressive symptoms at baseline, follow-up analyses showed that short sleep was associated with higher CES-D scores (β=1.73, p=0.03) compared to the reference. The sensitivity analysis adjusted for age, sex, race, education level, insurance status, physical activity, time between the sleep survey and CES-D, and antidepressant use. Long sleep was not associated with CES-D scores. Upon adding daytime sleepiness to the models, the effect estimates for short sleep duration were attenuated, but still significant at the cross-sectional (OR 1.55, 95% CI 1.06–2.27) and prospective analysis (OR 1.88, 95% CI 1.01–3.50). The effect estimates for long sleep duration were not significant (data not shown).

Discussion

In this multi-ethnic sample of older participants, short sleep (<6 hours), but not long sleep (>9 hours), was associated with more depressive symptoms compared to participants reporting intermediate sleep durations (6–8 hours). More importantly, short sleepers without depressive symptoms at baseline had increased depressive symptoms at 5 years of follow-up. These results remained significant after adjusting for demographic, behavioral, and vascular risk factors.

A meta-analysis of seven prospective studies showed that both short and long sleep durations were associated with depression in adults [2]. This meta-analysis compiled prospective studies with participants from different age groups, using various methodologies to define sleep duration (actigraphy, self-reports) and depression (ie, CESD, Geriatric Depression Scale). Of interest, four studies from this meta-analysis evaluated participants aged >60 years, with no observed associations between short sleep (pooled OR 1.15; CI = 0.84–1.58) or long sleep (pooled OR 1.40; CI = 0.97–2.01) with depression. In addition, one study from

a sample of young males evaluated participants without baseline depression, as did the current study.

Importantly, it was observed that short sleep and depressive symptoms did not differ across race-ethnic groups. Most studies have examined non-Hispanic white populations, with a paucity of data from racially/ethnically diverse communities. However, in a recent analysis from a racially/ethnically diverse cohort with actigraphy-defined sleep duration, short sleepers (<6 hours), but not long sleepers (>9 hours), had more depressive symptoms (CES-D ≥16) when compared to the reference (6–9 hours of sleep). In contrast to the current study, participants with depressive symptoms were more likely to be younger and from a Hispanic background [23].

Compared to studies evaluating older cohorts, the current finding may be partly explained by the methodological differences when defining short and long sleep duration (actigraphy, questionnaires) and depressive symptoms (CES-D) [24–26]. The current sample also had few participants with long sleep (>9 hours), which may have limited the power to detect an association with depressive symptoms.

The mechanisms underlying the association between sleep duration and depression are not fully understood [2]. Chronic sleep deprivation alters the hypothalamic-pituitary-adrenal axis, which is strongly implicated in the development of depressive symptoms. Others posit an increase in pro-inflammatory cytokines (CRP, TNFa, and IL6), which are found in both short sleep duration and depression [27–30].

There were several strengths of the current study. It evaluated a relatively large sample of older participants from racially/ethnically diverse backgrounds with systematic measures and statistical adjustments for demographic, lifestyle and vascular risk factors. However, several limitations should be noted. For one, sleep duration was self-reported; however, multiple studies have used self-reported sleep as the main exposure. Sleep duration was collected at one time point, with the initial CES-D; therefore, sleep changes over time were not assessed. Although the study adjusted for daytime sleepiness in the statistical models, it did not obtain information about daytime sleep (ie, daytime napping), which may have modulated the association between sleep duration and depressive symptoms. Also, it did not account for other sleep confounders such as sleep apnea [31] and insomnia, which commonly manifest with short sleep duration and depressive symptoms [8]. For these reasons, short sleep may be associated with depression through these unmeasured confounders.

Additionally, it must be considered that participants on antidepressants may be taking them for reasons other than depression, such as pain or anxiety. The study had no information on type of antidepressants, which could potentially affect sleep duration; however, 123 participants from the sample reported use of antidepressants. Of importance, the findings were mostly unchanged in the sensitivity analysis using the CES-D scores as continuous outcomes and further adjusting for use of antidepressants.

In conclusion, short sleep duration was associated with prevalent and new cases of depressive symptoms in a diverse community-based older cohort. Short sleep is a potentially

modifiable risk factor for depressive symptoms, which requires further assessment in future treatment studies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

1. There is a paucity of information on sleep duration and depressive symptoms in multi-ethnic cohorts of older adults.
2. In this study, short sleep, but not long sleep duration, was associated with depression at baseline and 5-year follow-up.
3. Short sleep may be a modifiable factor for depressive symptoms in older adults.

Table 1

Demographic, vascular risk factors, and sleep duration across categories of depressive symptoms.

Variable	Depressive symptoms	No depressive symptoms
***N* = 1110**	***n* (%)**	***n* (%)**
	272 (25)	838 (75)
Female***	207 (76)	480 (57)
Age, years		
<60	31 (12)	91 (11)
60–69	105 (39)	312 (38)
70–79	89 (33)	273 (33)
80 +	45 (17)	144 (18)
Ethnic group		
Non-Hispanic black	35 (13)	156 (19)
Hispanic	199 (73)	563 (67)
Non-Hispanic white	38 (14)	119 (14)
< high school education	160 (59)	468 (56)
Medicaid or no insurance*	151 (56)	392 (47)
Moderate alcohol consumption*	96 (35)	361 (43)
Current tobacco	54 (20)	126 (15)
Moderate to heavy physical activity	22 (8)	80 (9)
BMI (kg/m^2)		
normal	62 (23)	228 (27)
overweight	113 (42)	369 (44)
obese	96 (35)	240 (29)
Cardiac disease*	53 (20)	115 (14)
Diabetes mellitus	59 (22)	164 (20)
Hypertension	182 (67)	578 (69)
Sleep duration***		
<6 hours	94 (35)	185 (22)
6–8 hours	153 (56)	573 (68)
≥9 hours	25 (9)	80 (10)

* $p<0.05$

** $p<0.01$

*** $p<0.001$

Table 2

Cross-sectional association between sleep symptoms and depressive symptoms (CES-D ≥ 16 or antidepressant use) at baseline evaluation (MRI).

	Model 1		Model 2		Model 3	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
<6 hours	1.8	1.3–2.5	1.8	1.3–2.5	1.8	1.3–2.6
≥9 hours	1.2	0.7–1.9	1.2	0.7–2.0	1.1	0.7–1.9

Reference. Intermediate sleep of 6–8 hours

Model 1. unadjusted

Model 2. Age, sex, race-ethnicity, education, insurance status, physical activity, time from sleep to CES-D

Model 3. Model 2 and alcohol, smoking, BMI, cardiac disease, diabetes, social isolation, systolic blood pressure, diastolic blood pressure, antihypertensive mediations

Table 3

Association between sleep duration and incident depressive symptoms at follow-up.

	Model 1		Model 2		Model 3	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
<6 hours	1.5	0.9–2.6	1.6	0.9–2.8	1.9	1.1–3.5
≥9 hours	0.8	0.3–2.1	0.9	0.4–2.4	0.8	0.3–2.1

Reference. Intermediate sleep of 6–8 hours

Model 1. unadjusted

Model 2. Age, sex, race-ethnicity, education, insurance, physical activity, time from sleep to CES-D, time between CES-D 1 and CES-D 2.

Model 3. Model 2 and alcohol, smoking, BMI, cardiac disease, diabetes, social isolation, systolic blood pressure, diastolic blood pressure, and antihypertensive medications.