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Sleep Disorders and Symptoms in Blacks with Metabolic Syndrome: The Metabolic Syndrome Outcome Study (MetSO)

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Introduction: Sleep disturbance is a major public health issue and is comorbid with the cluster of conditions associated with metabolic syndrome (MetS). Our study explored the presence of sleep disturbance, including daytime sleepiness, the risk for obstructive sleep apnea (OSA), and insomnia symptoms, in a cohort of adult Black men and women with MetS.

Methods: Patients (n=1,013) from the Metabolic Syndrome Outcome Study (MetSO), 2009-2012, met criteria for MetS based on guidelines from the National Cholesterol Education Program's Adult Treatment Panel and provided sociodemographic data and the Apnea Risk Evaluation System (ARES) questionnaire to assess OSA risk, sleep characteristics, and physician-reported diagnosis of a sleep disorder.

Results: Prevalence of the components of MetS included: diabetes (60%); obesity (67%); hypertension (94%); and dyslipidemia (74%). Based on the ARES, 49% were at risk for OSA. Of all study patients, slightly more than half (53%) reported feeling sleepy during the day, and 10% reported an insomnia diagnosis. The most common sleep disturbance reported by 46% of the patients was early morning awakenings (EMA). This was closely followed by 42% who reported difficulty staying asleep (DSA) and 38% reporting difficulty falling asleep (DFA). Seventy percent reported short sleep (≤ 6 hours), whereas a minority (19%) reported long sleep (≥ 9 hours). Only 12% used sleep aids. Women, compared with men, reported greater daytime sleepiness, greater DFA, and greater DSA (57% vs 45%; 41% vs 32.4%; 45% vs 37%), respectively.

Conclusion: Blacks with MetS reported insomnia symptoms and insomnia disorder, use of sleep aids, feeling sleepy during the day, and inadequate sleep durations. The presence of these sleep characteristics suggests that patients with MetS should be referred for further sleep assessment. *Ethn Dis*. 2018;28(3):193-200; doi:10.18865/ed.28.3.193

Keywords: Inadequate Sleep; African American; Black; Obstructive Sleep Apnea; Insomnia; Metabolic Syndrome; Daytime Sleepiness

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Introduction

Nearly one-fifth of adults in the United States meet criteria for metabolic syndrome (MetS)[1]; and, individuals with MetS are at greater risk than individuals without MetS for cardiovascular disease (CVD) morbidity and early mortality.[2] When examining the individual components of MetS — obesity, hypertension, diabetes, and dyslipidemia — a significant burden exists among racial/ethnic groups. Unfortunately, evidence-based interventions to address these lifestyle-related risk factors have not adequately impacted minority populations, leading to continued, and even widened, disparities.

Sleep disturbance, including obstructive sleep apnea (OSA), is highly prevalent in the United States.[3] Additionally, OSA is an independent risk factor for MetS and one study reported that MetS was 9.1 times more likely to be reported in patients with OSA.[4] A few cross-sectional and prospective studies indicate that inadequate sleep duration is an independent risk factor for the individual components of MetS, including obesity,[5] dyslipidemia,[6,7] hypertension,[8] and diabetes.[9] The Quebec Family Study conducted on 293 individuals found that short sleepers (≤ 6 hours) had a relative risk of 1.74 of developing MetS compared with healthy sleepers.[10] In addition, self-reported poor sleep quality and insomnia symptoms (ie, difficulty falling asleep) are associated with poor metabolic health.[11,12] Blacks have poor sleep practices including inadequate sleep durations.[13] Black

men and women have consistently reported shorter and longer sleep duration than White men and women.[14] Additionally, available evidence from cohort studies suggests that younger Blacks (aged < 26 years) and older Blacks (aged >65 years) are at greater risk for developing OSA than Whites.[15] Given the available evidence and the prevalence of inadequate sleep duration and greater risk for OSA among Blacks, a top priority in sleep medicine should be to develop a comprehensive public health agenda that includes the examination of non-traditional risk factors for MetS (eg, inadequate sleep duration and sleep disorders). Such an agenda is important in achieving health equity for all Americans.

Given the available evidence and the prevalence of inadequate sleep duration and greater risk for OSA among Blacks, a top priority in sleep medicine should be to develop a comprehensive public health agenda that includes the examination of non-traditional risk factors for MetS

In our cross-sectional study of a well-characterized sample of Blacks with MetS, we examined the presence of several self-reported sleep characteristics. Several investigations have reported sex differences in sleep parameters including daytime sleepiness[16] and sleep duration.[17] Therefore, the sleep characteristics reported by patients were additionally stratified by sex to examine the association between sex and sleep characteristics.

Methods

Patients from the Metabolic Syndrome Outcome study (MetSO) (n=1,013) provided sociodemographic data including age, sex, income, education, place of birth, and marital status. Patient characteristics and the MetSO methods have been published elsewhere.[18] Briefly, patients were recruited from four outpatient clinics in Brooklyn, NY during 2009–2012. All patients provided written informed consent. The Institutional Review Boards of NYU School of Medicine and SUNY Downstate Medical Centers approved the study.

Measures

Based on the National Cholesterol Education Program's (NCEP) Adult Treatment Panel (ATP III) guidelines for the clinical identification of MetS,[19] patients met criteria for the syndrome based on the presence of three or more of the following five risk factors: 1) waist circumference >102 cm (>40 in) in men and ≥88 cm (>35 in) in women; 2) blood pressure ≥130 mm Hg systolic, or ≥85 mm Hg diastolic, or receiving drug therapy; 3) serum triglycerides ≥150 mg/dL; 4) high-density lipoprotein (HDL) cholesterol <40 mg/dL in men or <50 mg/dL in women, or receiving drug therapy; and 5) fasting serum glucose ≥110 mg/dL. These clinical data were collected during patient visits at the outpatient clinics.

To ascertain risk for OSA, we used the Apnea Risk Evaluation System (ARES) questionnaire. This screening tool includes questions on sleep patterns, daytime functioning, excessive daytime sleepiness, snoring and gasping, height, weight, neck size, sex, and diseases associated with risk for OSA (ie, hypertension, heart disease). In a large study with 608 patients, the ARES correctly identified patients with OSA compared with polysomnography, the gold standard for assessing OSA. Scoring is assessed by adding 1 point for diseases associated with risk for OSA; 0-3 points for 8 sleepiness items; and 0-4 points for 3 OSA symptoms. Total points range from low risk (4-5), high risk (6-10) and very high risk (11 or greater). Body Mass Index (BMI), neck size, mean sleepiness score, mean snoring, sex, and total number of co-morbidities were the variables most predictive of assessing OSA risk.[20] These variables were included in the OSA risk algorithm. The OSA risk algorithm created for assessing risk yielded a sensitivity of .94, specificity of .79, and a positive predictive value of .91 (based on a clinical cut-off of AHI > 5).[20] In a study comparing the ARES questionnaire to the Berlin ques-

tionnaire,[21] the ARES performed better than the Berlin questionnaire in identifying patients with OSA.[22]

Patients were asked if they had ever received an insomnia diagnosis by a health care professional. In addition, patients were asked to report on three commonly used insomnia symptoms: 1) "do you have difficulty falling asleep" (DFA); 2) "do you have difficulty staying asleep" (DSA); and 3) "do you wake up earlier than you would like to" (EMA). Self-reported sleep duration was characterized as short sleep (≤ 6 hours) and long sleep (≥ 9 hours) referenced to normal sleep (7-8 hours).

Patients also provided a physical and mental health risk profile, including self-reported medical history, smoking and alcohol use, anxiety and symptoms of depression, medications, and quality of life indicators. BMI was based on height and weight measurements gathered at the four outpatient clinics in Brooklyn, NY.

Statistics

Univariate statistics were computed to describe the study patients. For categorical variables, we describe study patient characteristics with percentage distributions. For continuous variables, values are reported as means ± standard deviation (SD). In addition, chi-square test was used to determine differences in characteristics of sleep and sociodemographic and lifestyle characteristics. A small number of items (ie, income) were not collected from patients. For all analyses, P≤.05 was defined as statistically significant. Analyses were performed using SPSS version 22 (Chicago, IL).

Table 1. Patient characteristics

Variable	
Age, N=1013 [a]	62 ± 14
Sex, female [b], N=971	69
Marital status, married, N=969	33
Employment status, employed, N=956	30
Education, <HS, N=946	35
Income, <$10K, N=858	43
Tobacco use, N=887	30
Alcohol use, N=807	23
Obesity, N=945	67
Diabetes, N=1013	60
Dyslipidemia, N=992	74
Hypertension, N=1006	94
Depression, N=1012	17.2 ± 7.1
Heart disease, N=1013	31

a. Mean and standard deviation is presented for continuous variables
b. Percentage is presented for categorical variables

Results

The mean age of the study population was 62 ± 14 years; 69% female and 43% reported an annual income <$10,000. The frequency of the components of metabolic syndrome included diabetes (60%), obesity (67%), hypertension (94%), and dyslipidemia (74%). Additional

Table 2. Sociodemographic and lifestyle factors summarized for average hours of sleep

Variable	≤6 hrs	7-8 hrs	≥9 hrs	P
Age, N=1013	60.5 ± 12.7	63.0 ± 13.7	66.1 ± 13.0	.001
Sex, N=971				.882
Male	38.2 (118/309)	55.3 (171/309)	6.5 (20/309)	
Female	39.7 (263/662)	53.6 (355/662)	6.6 (44/662)	
Education, N=917				.026
<High school	36.9 (120/325)	53.5 (174/325)	9.5 (31/325)	
≥High school	41.2 (244/592)	34.7 (318/592)	5.1 (30/592)	
Marital Status, N=928				.714
Not married	40.9 (256/626)	52.4 (328/626)	6.7 (42/626)	
Married	38.1 (115/302)	55.0 (166/302)	7.0 (21/302)	
Income, N=833				.077
<$10,000	38.6 (136/352)	52.6 (185/352)	8.8 (31/352)	
≥$10,000	42.2 (203/481)	52.8 (254/481)	5.0 (24/481)	
BMI, N=914	34.6 ± 9.6	33.7 ± 7.9	31.6 ± 7.4	.056
Smoking, N=857[a]				.244
No	37.9 (226/597)	54.9 (328/597)	7.2 (43/597)	
Yes	43.5 (113/260)	51.2 (133/260)	5.4 (14/260)	
Drinking, N=777[b]				.017
No	38.1 (227/596)	54.0 (322/596)	7.9 (47/596)	
Yes	46.4 (84/181)	50.8 (92/181)	2.8 (5/181)	

Mean ± SD is presented for continuous variables. Percentage and ratio is presented for categorical variables.
a. "Yes" includes history of smoking and current smoking vs never smoked.
b. "Yes" includes history of drinking and current drinking vs never drank.

Table 3. Sociodemographic and lifestyle factors summarized for sleep symptoms

	Feeling sleepy, yes %	P	DFA, yes %	P	DSA, yes %	P	EMA, yes %	P
Age [a]	61.27 ± 13.9 (2.2)	.010	61.0 ± 13.2 (1.9)	.029	61.3 ± 13.1 (1.6)	.066	60.3 ± 13.8 (3.5)	<.001
Sex		<.001		.008		.014		.096
Male	44.9 (140/312)		32.4 (102/315)		36.6 (115/314)		42.0 (132/314)	
Female	57.1 (388/679)		41.1 (281/683)		44.9 (306/681)		47.7 (322/675)	
Education		.661		.579		.927		
<High school	54.8 (182/332)		39.9 (132/331)		43.1 (143/332)		44.6 (148/332)	
≥High school	53.3 (321/602)		38.0 (232/610)		42.8 (260/608)		46.6 (281/603)	
Marital status		.013		.822		.122		.870
Not married	56.5 (362/641)		39.1 (252/645)		44.8 (288/643)		46.6 (299/641)	
Married	47.9 (148/309)		38.3 (118/308)		39.5 (122/209)		46.1 (141/306)	
Income		.228		.081		.447		.209
<$10,000	57.1 (204/357)		42.3 (153/362)		45.7 (165/361)		49.2 (176/358)	
≥$10,000	53.0 (259/489)		36.4 (179/492)		43.1 (212/492)		44.8 (220/491)	
BMI	34.2+8.5 (0.9)	.105	34.3+9.0 (-0.8)	.177	34.2+8.7 (0.7)	.247	34.9 + 9.3 (-2.0)	<.001
Smoking [b]		.049		.145		<.001		.120
No	52.2 (319/611)		36.7 (226/616)		39.2 (242/617)		44.8 (274/611)	
Yes	59.4 (158/266)		41.9 (111/265)		54.0 (142/263)		50.6 (133/263)	
Drinking [c]		.347		.942		.900		.741
No	56.4 (346/614)		38.3 (237/619)		43.5 (269/619)		46.7 (287/614)	
Yes	52.4 (97/185)		38.6 (71/184)		42.9 (79/184)		45.4 (83/183)	

a. For continuous variables, the mean ± SD (mean difference) is presented. The mean difference is the mean of "no"- the mean of "yes".
b. "Yes" includes history of smoking and current smoking vs. never smoked.
c. "Yes" includes history of drinking and current drinking vs. never drank.
DFA, Difficulty Falling Asleep; DSA, Difficulty Staying Asleep; EMA, Early Morning Awakenings.

characteristics of patients are reported in Table 1 and Table 2 provides sociodemographic and lifestyle factors by hours of sleep duration.

Based on the ARES questionnaire, 49% were at risk for OSA. Fifty-three percent reported feeling sleepy during the day, and 10% reported an insomnia diagnosis by a health care professional. Prevalence of insomnia symptoms, DFA, DSA, and EMA, were 38%, 42%, and 46%, respectively (Table 3). Napping was experienced by 53% of study patients (data not shown). Twelve percent used sleep medication. Prevalence of short sleepers (≤6 hrs) and long sleepers (≥9 hrs) referenced to average sleepers (7–8 hours) was 70% and 19%, respectively. In the chi-square analysis, there were significant sex differences with women reporting greater sleepiness (57.1% vs 44.9%, P<.01), greater DFA (41% vs 32%, P<.01), greater DSA (44.9% vs 36.6%, P<.01), and greater EMA (47.7% vs 42%, P<.01). (Table 3).

In Table 3, we also summarize sociodemographic and lifestyle factors associated with sleep symptoms. Unmarried individuals were more likely to report feeling sleepy (56.5% vs 47.9%, P<.05). No other significant differences were found for sociodemographic factors. A high BMI (34.9 ± 9.3 P<.001) was associated with EMA and current smoking or a history of smoking was associated with DSA (54.0% vs 39.2% P<.001).

Discussion

Previous studies have explored the relationship between MetS and sleep, but these studies were conducted among specific subgroups and primarily non-Hispanic Whites.[12,23] The main finding of our study was a high prevalence of insomnia symptoms and OSA that may be undiagnosed among Blacks with MetS. Further, these insomnia symptoms are comorbid with components of MetS, including hypertension, diabetes, and obesity. Our cohort had a high proportion of Blacks who were obese, hypertensive, and reported a history of heart disease. In 2012, the prevalence of obesity in the United States was 37.1% among Black men and 56.6% among Black women.[24] Similarly, our findings are consistent with this prevalence rate and other large-scale studies.[25]

National trends suggest that the prevalence of obesity in Blacks will

remain high, especially for abdominal obesity.[26] Given the significant number of obese patients in this study, we observed a high percentage of sleepiness and inadequate sleep duration. Daytime sleepiness is often associated with obesity, and the presence of sleepiness may be a symptom of undiagnosed OSA.[27] Yet, some studies have found that sleepiness is not always related to OSA. Our finding raises the question as to whether treating sleep disturbance more broadly could affect Blacks who are obese and overweight.

Though our data could not be corroborated with the gold standard method, polysomnography,[28] for diagnosing OSA, we demonstrated a high risk for OSA among middle-aged-to-older adults. This finding highlights the need to ascertain the true prevalence of OSA in this population. Moreover, if the high risk among Blacks is largely related to obesity, as suggested by others,[15] then steps should be taken to counsel Blacks on ways to reduce risk factors of OSA, including weight-reduction programs. Referrals for OSA screening should be made for high-risk individuals, particularly those who are obese. However, providers often neglect to communicate about sleep with their patients,[29] and referrals for OSA screening and evaluation remains relatively inadequate.[30]

Among study patients, several poor sleep practices were observed, including both short and long sleep duration. In a cross-sectional study of 228 Blacks, Kazman et al[31] reported the average sleep duration was 6.5 hours, 54% were considered short sleepers (<7 hours) and 8% were considered long sleepers (>8 hours). Our results are higher than those reported by Kazman, although the categorization of short sleepers and long sleepers was the same. The larger sample size in our study could explain the discrepant findings. Our previous focus group findings suggest that Blacks are largely unaware of the national recommendations for 7–8 hours of sleep and believe that sleeping <7 hours in a 24-hour period is sufficient.[32] If these discrepant beliefs about sleep are not addressed, then Blacks could fail to achieve optimal sleep duration. Since inadequate sleep and poor-quality sleep are implicated in CVD morbidity,[33] Blacks would remain at risk for CVD.

The main finding of our study was a high prevalence of insomnia symptoms and obstructive sleep apnea that may be undiagnosed among Blacks with MetS.

Consistent with previous studies, we observed sex differences in reports of insomnia symptoms with women reporting more insomnia symptoms and daytime consequences than men.[34] We also observed an association between lifestyle factors including BMI and smoking. The relationship between these variables and sleep are complex and problematic. For example, cross-sectional studies indicate smoking is positively associated with sleepiness and insomnia symptoms,[35] but one study found that smoking and sleep disturbance only occurred among females.[34] Short sleep duration is typically associated with BMI;[36] we noted a relationship between insomnia symptoms and obesity. A similar finding was noted among adults in The Penn State Sleep Cohort study.[37] Focusing on Blacks and addressing these modifiable risk factors (ie, BMI, smoking) may be important for improving sleep health and comorbidity.

A high number of Blacks reported an insomnia diagnosis by a health professional and an even higher number of adults reported symptoms of insomnia. Troxel and colleagues[11] reported insomnia symptoms in a cohort of patients with MetS at these rates: DFA (25%), DMS (32%), and frequent awakenings (16%). Plausibly, the higher rate in our study group may be due to methodological differences in categorizing insomnia. Unfortunately, Troxel and colleagues did not provide the insomnia results according to race/ethnicity, which would have allowed for further race/ethnic comparisons.

Interestingly, one study found that older Blacks may be at greater risk for insomnia than older Whites;[38] yet racial/ethnic differences of insomnia are inconclusive. For example, in the Sleep Heart Health Study, there were no racial/ethnic differences in reports of insomnia symptoms.[39] Others have suggested that Blacks are less likely to report insomnia symptoms compared with Whites. The subjective nature of insomnia could make it difficult to

establish the prevalence of Blacks who might have the disorder, and Blacks with insomnia may underreport symptoms.[40] For example, several studies have documented that Blacks are less likely to engage in the health care system.[41] This is particularly evident among young adults, and certain insomnia subtypes are more common among this population.[42] In addition, diagnosis of insomnia entails the patient consulting with a mental health provider.[43] Blacks tend to rely on religious leaders for mental health problems[28] and experience disparities in access to mental health services,[44] both of which may contribute to the possible under-diagnosis of insomnia in this population. Future studies that examine patient-level, provider-level, and health care system-level barriers would be useful to disentangle these differences. Nonetheless, Blacks with components of MetS reported insomnia symptoms and insomnia disorder. If, indeed, Blacks with insomnia symptoms are under-diagnosed, then they may well face serious health complications.[45]

Study Limitations

A few limitations of our study are worth noting. We relied on patient self-report for sleep duration, which may be underestimated. In addition, we used a screening questionnaire to ascertain risk for OSA and could not verify an OSA diagnosis. Also, generalizing our results to other populations may be difficult, and the study design does not allow us to ascertain causality. Despite these limitations, our findings have important clinical and public health implications. Future studies should examine the exact mechanisms of MetS and sleep characteristics among this vulnerable population and whether adequate treatment of sleep disorders could improve MetS.

Conclusion

Sleep in the context of MetS among Blacks is understudied. This study furthers our understanding of the complex interplay between sleep and MetS in this vulnerable population that is disproportionately burdened by MetS and inadequate sleep duration. Most importantly, it is crucial to confirm the high proportion of individuals at risk for OSA and its associated CVD outcomes. Well-designed longitudinal studies would be extremely valuable in documenting possible racial/ethnic disparities in sleep disorders and CVD morbidity and mortality. Our findings suggest that the presence of these sleep symptoms co-occurring with MetS should be adequately addressed by sleep specialists for further evaluation.

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Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Williams, Jean-Louis; Acquisition of data: Jean-Louis; Data analysis and interpretation: Williams, Jean-Louis; Manuscript draft: Williams, Castor, Seixas, Ravenell, Jean-Louis; Statistical expertise: Williams, Jean-Louis; Acquisition of funding: Jean-Louis; Administrative: Williams; Supervision: Jean-Louis

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