Published in final edited form as:

Ann Med. 2015 December ; 47(8): 687–693. doi:10.3109/07853890.2015.1107186.

Obstructive Sleep Apnea Risk and Psychological Health among Non-Hispanic Blacks in the Metabolic Syndrome Outcome (MetSO) Cohort Study

Mirnova E. Ceïde¹, Natasha J. Williams², Azizi Seixas², Samantha K. Longman-Mills³, and Girardin Jean-Louis²

¹Montefiore Medical Center, Department of Psychiatry and Behavioral Science' Bronx, NY 10467, USA

²Center for Healthful Behavior Change (CHBC), Division of Health and Behavior, Department of Population Health, New York University Medical Center, New York, NY 10016, USA

³The University of the West Indies, Mona, Jamaica

Abstract

Introduction—This study assessed associations of depression and anxiety with risk of OSA among Non-Hispanic Blacks in the Metabolic Syndrome Outcome (MetSO) study.

Method—1,035 patients provided data for the analysis. *AREST*^{TM} score ≥ 6 defined high OSA risk. Moderate depression was defined by a *CES-D* score ≥ 16 . Moderate anxiety was measured by a *BAI* score ≥ 16 .

Results—The mean age was 62 ± 14 years; 70% were female. 93% were diagnosed with hypertension; 61%, diabetes; and 72%, dyslipidemia; 90% were overweight/obese; 33% had a history of heart disease and 10% had a stroke. Logistic regression analysis, adjusting for age and gender, showed that patients with depression had nearly a two-fold increased odds of being at risk for OSA (OR = 1.75, 95% CI = 1.02–2.98, $p < .05$). Patients with anxiety had a three-fold increased odds of being at risk for OSA (OR = 3.30, 95% CI = 2.11–5.15, $p < .01$). After adjusting for marital status and income, patients with anxiety had a 6% increase in OSA risk (OR=1.06, 95% CI= 1.04–1.09, $p < .05$) but depression was no longer significant.

Conclusion—Our results suggest that Non-Hispanic Blacks with metabolic syndrome who experience anxiety and/or depression should be screened for OSA.

Keywords

obstructive sleep apnea; metabolic syndrome; psychological health; Non-Hispanic Blacks

Address Correspondence to: Mirnova Ceïde, MD, Montefiore Medical Center, 111 East 210 Street, Bronx, NY 10467, USA, Phone: +1 (347) 920-0112, Fax: +1 (718) 920- 6538, mirnova@gmail.com.

Disclosure of Interest:

The authors report no conflicts of interest.

Introduction

Obstructive sleep apnea (OSA) is a highly prevalent sleep-related breathing disorder caused by repeated episodes of airflow cessation (apneas) leading to arterial hypoxemia and sleep fragmentation. OSA is characterized by intermittent hypoxia, which can lead to oxidative stress,¹ systemic inflammation,² vascular endothelial dysfunction³ and an increase in sympathetic nervous system (SNS) activity,⁴ thereby putting patients with OSA at risk for cardiovascular and cardiometabolic diseases.⁵ The physiological effects of OSA are severe including hypoxia, hypercapnia, increased left ventricular afterload and acute arterial hypertension.⁵ OSA is also associated with abnormalities in glucose metabolism as shown in one recent cross sectional study of obese adults with short sleep duration. More severe OSA was associated with higher glucose concentration, higher fasting insulin levels and higher plasma ACTH levels.⁶ Additionally several lines of evidence suggest that OSA is an independent risk factor for cardiovascular morbidity and mortality.⁵ The consequences of OSA include excessive daytime sleepiness (EDS),⁷ impaired executive dysfunction,⁸ decreased vigilance⁸ and impaired health-related quality of life (HRQoL). The long-term sequelae of OSA include: obesity, cardiovascular disease, diabetes, and stroke,⁵ which are among the leading causes of death in the United States.⁹

In addition to the well-known relationship between neurocognitive deficits and OSA,¹⁰ recent literature suggests a relationship between OSA and psychological health. For instance, recent studies have shown an association between suspected OSA and psychological disorders¹¹ and OSA and anxiety¹². A small study of adults with suspected OSA found an association between habitual short sleep duration and depression.¹³ Earlier studies point to the fact that Non-Hispanic Blacks have higher OSA rates than their white counterparts in community and population based studies; but it is unknown if untreated psychological symptoms are the mechanism of this disparity.^{14,15} In a hospital clinic-based study in Brooklyn, NY among Non-Hispanic Blacks, it was found that 25% of patients who underwent polysomnography reported comorbid depressive symptoms and 24% of patients reported stress related symptoms.⁵ Several studies reveal that Non-Hispanic Blacks who report depressive and/or anxiety symptoms are more likely to experience negative cardiovascular consequences such as aortic calcification,¹⁶ hypertension,¹⁷ and cardiovascular disease (CVD) related mortality¹⁸; but the mechanism of these associations is unclear and could be mediated by OSA.

The prevalence of depressive and anxiety symptoms is mixed among Non-Hispanic Blacks and between Non-Hispanic Blacks and Non-Hispanic Whites. In 2007 Williams and colleagues found that 10.4% of African Americans, 12.9% of Caribbean Blacks and 17.9% of Non-Hispanic Whites had a Major Depressive Disorder (MDD) diagnosis in their lifetime.¹⁹ Alternatively, based on the Behavioral Risk Factor Surveillance System (BRFSS) data from 2006 and 2008, the prevalence “any current depression” including subclinical depression was contrastingly higher among Non-Hispanic Blacks (12.8%) than their Non-Hispanic White counterparts (7.9%).²⁰ The discrepancy in rates of depression may be due to the requirement for clinically significant impairment in the Diagnostic and Statistical Manual of Mental Disorders (DSM) IV-TR. For instance, in the 1999 National Health Interview Survey (NHIS) investigators found that although Non-Hispanic Blacks and Non-

Hispanic Whites have a similar prevalence of depressive symptoms, Non-Hispanic Blacks are less likely to fulfill the criteria for a depressive disorder than their white counterparts.²¹ Non-Hispanic Blacks may be less likely to seek clinical help or have less access to treatment. There is minimal information regarding the prevalence of anxiety symptoms in Non-Hispanic Blacks as well. Both Non-Hispanic Whites and Non-Hispanic Blacks do poorly at recognizing symptoms of anxiety²² but again Non-Hispanic Blacks are less likely to seek help for anxiety symptoms as demonstrated by data from the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey.²³ The inconsistencies in prevalence of mental health diagnoses may be largely due to help seeking behavior and how that relates to the diagnostic criteria of depression and anxiety. Additionally this poses a challenge in assessing the actual prevalence of comorbid OSA and mental health, such as depressive and anxiety symptoms, among Non-Hispanic Blacks.

Numerous studies suggest an association between OSA and psychological symptoms (e.g. depression).^{24–26} However, previous studies do not fully explain the overwhelming prevalence of OSA in psychiatric populations. While the prevalence of moderate to severe OSA (apnea hypopnea index ≥ 15) in a community-based cohort is estimated to be 5% and 14% in women and men, respectively;²⁶ previous studies have reported the prevalence of OSA in psychiatric patients to be anywhere from 10% to 59%.^{27–29} This variation in prevalence is likely due to the inclusion of specific psychiatric diagnoses, such as depression, as the prevalence appears to be highest in people with mood disorders.^{27,29}

One implication of this finding is that Non-Hispanic Blacks are at greater risk for OSA because of their comparatively higher prevalence of undiagnosed depressive symptoms, as suggested by Behavioral Risk Factor Surveillance System (BRFSS) and National Health Interview Survey (NHIS) data described above.^{20,21} The prevalence of moderate to severe OSA is 50–60% in people with metabolic syndrome which is diagnosed by at least three of the following: hypertension, diabetes, obesity and dyslipidemia. Furthermore recent literature suggest that OSA modulated cardiometabolic risk in people with obesity and metabolic syndrome.³⁰ We hypothesize the presence of depression and anxiety would have independent effects on the risk of OSA in a sample of Non-Hispanic Blacks with metabolic syndrome.

Methods

The present study utilized data from the Metabolic Syndrome Outcome (MetSO) study, an NIH-funded study of Non-Hispanic Blacks with metabolic syndrome.^{31,32} A total of 1,035 patients provided data for the analysis. These included sociodemographic factors, health risks, and medical history. Physician-diagnosed conditions were obtained using an electronic medical record system (HealthBridge). Patients provided informed consent under the supervision of the IRB at SUNY Downstate Medical Center, the main study site and at NYU Langone Medical Center.

Criteria for Classifying Metabolic Syndrome

Patients were diagnosed with metabolic syndrome using the National Heart, Lung and Blood Institute and the American Heart Association guidelines.³³ According to the joint interim

statement, metabolic syndrome is diagnosed when a patient has at least three of the following conditions: hypertension, diabetes, obesity and dyslipidemia (see Table I).

Criteria for Assessing OSA Risk

Patients were assessed for OSA risk using the Apnea Risk Evaluation System (ARES™), individuals with an ARES™ score ≥ 6 were considered at risk for OSA.³⁴ The ARES questionnaire has a sensitivity of 0.94, specificity of 0.79 (based on a clinical cut-off of AHI > 5), positive predictive value of 0.91 and negative predictive value of 0.86.³⁵ The questionnaire includes age, weight, height, neck circumference, report of comorbid illness such as high blood pressure, heart disease, diabetes, stroke, depression, lung disease, insomnia, sleep medication, pain medication and the Epworth Sleepiness scale. The ARES™ was used to identify OSA risk because of its accuracy in evaluating populations with a large pretest OSA probability.³⁴

Criteria for Assessing Psychological Health

The presence of depressive and anxious symptoms was assessed to ascertain the patients' psychological health. Depression was assessed using the Center for Epidemiological Studies-Depression (CES-D) scale, which is a 20-item questionnaire that asks individuals to rate how often over the past week they experienced symptoms associated with depression, such as restless sleep, poor appetite, and feeling lonely. Responses range from 0 to 3 for each item (0 = Rarely or None of the Time, 1 = Some or Little of the Time, 2 = Moderately or Much of the time, 3 = Most or Almost All the Time). Scores range from 0 to 60, with high scores indicating greater depressive symptoms. A CES-D score greater or equal to 16 was used to identify patients with clinically meaningful depression. The CES-D-20 has excellent internal consistency (Cronbach's $\alpha = 0.88-0.91$), excellent test-retest reliability (ICC= 0.87).³⁶ It has demonstrated adequate validity in measuring mental health (Pearson's $r=0.75$) and good sensitivity of 80.0%. Anxiety was measured with the Beck Anxiety Inventory (BAI), which is a 21-item questionnaire assessing anxiety symptoms such as "wobbliness in legs", "scared" and "fear of losing control".³⁷ Accordingly, respondents are asked to rate how much each of these symptoms bothered them in the past week, on a scale ranging from 0 (not at all) to 3 (severely, I could barely stand it). Scores range from 0 to 63, with a score of 16 or higher indicating moderate to severe anxiety. The scale was validated in a sample of 160 psychiatric outpatients with various anxiety and depressive disorders, diagnosed with the Structured Clinical Interview for DSM-III.³⁸ The BAI has a high internal consistency (Cronbach's $\alpha = .92$) and a test-retest reliability over one week of .75.³⁷ The CES-D and BAI are both scales which identify depressive and anxiety symptoms but they are not synonymous psychiatric diagnosis.

Statistical Analysis

Frequency and measures of central tendency were used to describe the sample. In preliminary analyses, Pearson and Spearman correlations were used to explore relationships between variables of interest. To determine the associations between psychological health measures and OSA risk among Non-Hispanic Blacks with metabolic syndrome, we utilized multivariate-adjusted logistic regression modeling. Covariates entered in the model were age, sex, and income. Before constructing the model, correlational analyses were performed

to assess associations between hypothesized predictors (i.e., depression and anxiety) and the dependent variable (i.e., OSA risk). Only factors showing significant correlations ($p < 0.05$) with the dependent measure were entered in the final regression model; this helped to reduce redundancy in the model. Effects of all factors entered in the model were simultaneously adjusted. Data was coded and analyzed using SPSS 19.0.

Results

A total of 1,035 patients with metabolic syndrome provided data for this study. The mean age of the sample was 62 ± 14 years (range: 20–97); 70% were female and 43% reported an annual income lower than \$10K. Of the sample, 93% were diagnosed with hypertension; 61%, diabetes; 72%, dyslipidemia; 90% were overweight/obese; 33% had a history of heart disease and 10% had a stroke. Descriptive characteristics of cardio-metabolic parameters are presented in Table II.

According to ARES™ data, 48% of the patients were at high risk for OSA. Of those who were high risk for OSA, 27% were characterized by depressed moods, based on CES-D scores, and 41% showed clinically meaningful anxiety symptoms based on BAI scores. Results show that 49.8% of women with a waist circumference greater than 35 inches, an indicator of visceral adiposity, were at risk for OSA and 50.2% of women with the same waist circumference were not at risk for OSA (see Table III).

Logistic regression analysis (Table IV), adjusting for effects of age and gender, showed that patients with moderate to severe depression had a nearly two-fold increased odds of being at risk for OSA (OR = 1.75, 95% CI = 1.02 – 2.98, $p < .05$). Likewise, patients with moderate to severe anxiety had a three-fold increased odds of being at risk for OSA (OR = 3.30, 95% CI = 2.11–5.15, $p < .01$). Also, age was positively associated with OSA risk (OR = 0.97, 95% CI = 0.95–0.98, $p < .01$). After adjusting for marital status and income (Table V), analysis showed that patients with anxiety had a 6% increase in OSA risk (OR=1.06, 95% CI= 1.04–1.09, $p<.05$) but depression was no longer significant.

Discussion

Our results suggest that Non-Hispanic Blacks with metabolic syndrome who experience psychological distress, as evidenced by depression and anxiety, are at an increased risk for OSA. Even after adjusting for marital status and income, moderate anxiety was still significantly associated with increased risk of OSA. The depression-OSA relationship may be attributed to the shared risk factors of diabetes, hypertension and cardiovascular disease.³⁹ The neurobiological risk factor of decrease serotonergic neurotransmission, has also been implicated in the etiology of both depression and OSA.⁴⁰ Additionally, OSA and depression share common symptoms such as sleep disturbance, irritability, cognitive impairment and concentration difficulties.³⁹ As a result, OSA may frequently be misdiagnosed as depression. In this study marital status and income confounded the association between depression and OSA risk. This was unexpected as one study did not show an effect of poverty level on OSA risk⁴¹ and another large population based study found an association between OSA and depression even after adjusting for poverty level.⁴²

Alternatively several studies have noted an association between marital status especially being separated/divorced/widowed and OSA risk and OSA.^{43–45} The relationship between OSA and anxiety is less apparent. Magnetic resonance T2-relaxometry identified more severe and additional brain deficits in patients exhibiting both anxiety and OSA, than patients with OSA alone.⁴⁶ Nonetheless, anxiety is known to occur more frequently in OSA patients than within a general population.⁴⁷ The most likely explanation for the association between OSA risk and depressive and anxiety symptoms is that these psychological symptoms are secondary to the physiological changes which occur in OSA. For instance, increased sympathetic tone would lead to anxiety symptoms. An alternative interpretation of this association is that moderate to severe depression and anxiety may cause OSA perhaps via metabolic syndrome. However utilizing a population of patients in which they all have metabolic syndrome would mean that depression and anxiety induce OSA by another mechanism like serotonin neurotransmission.

In the current study, associations were more striking for anxiety symptoms than depressive symptoms, as the presence of anxiety increased an individual's odds of OSA risk threefold and depression, twofold before adjusting for marital status and income. While our findings relate to OSA risk, this is consistent with the literature indicating individuals with severe mental illness^{27,48} and/or psychological distress, such as depression or anxiety, have a higher prevalence of OSA. As our study shows an association between moderate depression and anxiety and risk of OSA, current literature supports a bidirectional relationship.^{8,24,25,28,29,48} Additionally, older age represented an independent predictor of OSA risk. This finding identified older Non-Hispanic Black adults with metabolic syndrome, who presented with anxiety or depression as a high risk group for OSA. Consequently anxiety and/or depression in this high risk group should raise clinical suspicion for OSA and prompt screening for classic OSA symptoms like snoring, witnessed apnea or daytime sleepiness.⁴⁹

The strengths of this study include the use of a well-characterized cohort of Non-Hispanic Blacks with metabolic syndrome, who has historically been reluctant to participate in clinical research studies for a variety of reasons.⁵⁰ Additionally, this community dwelling cohort was not taking medications that could exacerbate metabolic syndrome such as antipsychotics although information on antidepressant use was unavailable. The limitations of the study include the fact that this was a cross-sectional study. This was a clinical sample of people with metabolic syndrome and may not be generalizable to community dwelling people without metabolic syndrome. Also the sample is very specific being composed of Non-Hispanic Blacks. Therefore the findings may not be generalizable to people of other ethnicities. Another important limitation relates to the fact that the majority of participants in the study were women, limiting our ability to assess gender-based differences, although prior studies indicate that women are more likely to report depressive symptoms than men.⁵¹

Given our preliminary findings regarding OSA risk, we identify several areas for future research. First, future studies should investigate the magnitude of the relationship between OSA and psychological health among men, relative to women. Second, well-characterized longitudinal cohort studies should be utilized to evaluate the incidence of OSA in people with depressive or anxiety symptoms. Third, although evidence supports a bidirectional

relationship between psychological symptoms and OSA, future studies should investigate the causal relationship between psychological factors and OSA in longitudinal study models.²⁴ There have already been several longitudinal studies which address the relationship between mental health and OSA. One prospective cohort study followed participants up to one year and found those with OSA have twice the risk of depression.⁵² Another smaller prospective study found the persistence of anxiety was linearly associated with the Apnea Hypopnea Index.⁵³ Lastly, there are no studies to evaluate the effect of treatment of depressive and anxiety symptoms in order to decrease OSA risk. In terms of evidence based clinical practice, the ARES™ questionnaire has been shown to be efficient and sensitive for screening OSA risk in a dental setting⁵⁴ and therefore future work should investigate how the ARES™ can be incorporated on ambulatory settings when screening patients with metabolic syndrome. The STOP-BANG questionnaire is another brief screening tool, which is part questionnaire and part demographic and physical measures with over 90% sensitivity or moderate to severe OSA.⁵⁵ Also the availability home based portable channel monitoring in lieu of in lab polysomnography has already been shown to be a practical and slightly less expensive modality to diagnosis OSA.⁵⁶

Conclusion

The findings of the present study support previous studies suggesting that individuals with comorbid metabolic syndrome and moderate anxiety symptoms and possibly depressive symptoms should be screened for OSA. The psychological health-OSA link may have serious medical implications and health risks, which include cardiac ischemia, cardiac arrhythmia, cerebrovascular disease and stroke. This suggests that appropriate management of these medical factors might necessitate diagnosis and treatment of OSA, a common and manageable condition among Non-Hispanic Blacks.

Acknowledgments

This research was supported by funding from the National Institutes of Health: R25HL105444, R01HL095799, RO1MD004113, and U54NS081765. The funding source had no role in the design, conduct, or analysis of the study, or in the decision to submit the manuscript for publication.

References

1. Mancuso M, Bonanni E, LoGerfo A, et al. Oxidative stress biomarkers in patients with untreated obstructive sleep apnea syndrome. *Sleep medicine*. 2012; 13(6):632–6. [PubMed: 22534161]
2. Nadeem R, Molnar J, Madbouly EM, et al. Serum inflammatory markers in obstructive sleep apnea: a meta-analysis. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*. 2013; 9(10):1003–12. [PubMed: 24127144]
3. Hoyos CM, Melehan KL, Liu PY, Grunstein RR, Phillips CL. Does obstructive sleep apnea cause endothelial dysfunction? A critical review of the literature. *Sleep medicine reviews*. 2014
4. Abboud F, Kumar R. Obstructive sleep apnea and insight into mechanisms of sympathetic overactivity. *The Journal of clinical investigation*. 2014; 124(4):1454–7. [PubMed: 24691480]
5. Jean-Louis G, von Gizycki H, Zizi F, Dharawat A, Lazar JM, Brown CD. Evaluation of sleep apnea in a sample of black patients. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*. 2008; 4(5):421–5. [PubMed: 18853698]
6. Cizza G, Piaggi P, Lucassen EA, et al. Obstructive sleep apnea is a predictor of abnormal glucose metabolism in chronically sleep deprived obese adults. *PloS one*. 2013; 8(5):e65400. [PubMed: 23734252]

7. Bixler EO, Vgontzas AN, Lin HM, Calhoun SL, Vela-Bueno A, Kales A. Excessive daytime sleepiness in a general population sample: the role of sleep apnea, age, obesity, diabetes, and depression. *The Journal of clinical endocrinology and metabolism*. 2005; 90(8):4510–5. [PubMed: 15941867]
8. El-Ad B, Lavie P. Effect of sleep apnea on cognition and mood. *International review of psychiatry* (Abingdon, England). 2005; 17(4):277–82.
9. Centers for Disease Control and Prevention. Leading Causes of Death. 2015. <http://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm> (accessed February 26th 2015)
10. Zimmerman ME, Aloia MS. Sleep-disordered breathing and cognition in older adults. *Current neurology and neuroscience reports*. 2012; 12(5):537–46. [PubMed: 22752614]
11. Garbarino S, Magnavita N. Obstructive Sleep Apnea Syndrome (OSAS), metabolic syndrome and mental health in small enterprise workers. feasibility of an Action for Health. *PloS one*. 2014; 9(5):e97188. [PubMed: 24810290]
12. Rezaeitalab F, Moharrari F, Saberi S, Asadpour H, Rezaeitalab F. The correlation of anxiety and depression with obstructive sleep apnea syndrome. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*. 2014; 19(3):205–10. [PubMed: 24949026]
13. Gyllen E, Anttalainen U, Saareanta T. Relationship between habitual sleep duration, obesity and depressive symptoms in patients with sleep apnoea. *Obes Res Clin Pract*. 2014; 8(5):e459–65. [PubMed: 25263835]
14. Ancoli-Israel S, Klauber MR, Stepnowsky C, Estline E, Chinn A, Fell R. Sleep-disordered breathing in African-American elderly. *American journal of respiratory and critical care medicine*. 1995; 152(6 Pt 1):1946–9. [PubMed: 8520760]
15. Redline S, Tishler PV, Hans MG, Tosteson TD, Strohl KP, Spry K. Racial differences in sleep-disordered breathing in African-Americans and Caucasians. *American journal of respiratory and critical care medicine*. 1997; 155(1):186–92. [PubMed: 9001310]
16. Lewis TT, Everson-Rose SA, Colvin A, Matthews K, Bromberger JT, Sutton-Tyrrell K. Interactive effects of race and depressive symptoms on calcification in African American and white women. *Psychosomatic medicine*. 2009; 71(2):163–70. [PubMed: 19188530]
17. Jonas BS, Franks P, Ingram DD. Are symptoms of anxiety and depression risk factors for hypertension? Longitudinal evidence from the National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study. *Archives of family medicine*. 1997; 6(1):43–9. [PubMed: 9003169]
18. Capistrant BD, Gilsanz P, Moon JR, Kosheleva A, Patton KK, Glymour MM. Does the association between depressive symptoms and cardiovascular mortality risk vary by race? Evidence from the Health and Retirement Study. *Ethnicity & disease*. 2013; 23(2):155–60. [PubMed: 23530295]
19. Williams DR, Gonzalez HM, Neighbors H, et al. Prevalence and distribution of major depressive disorder in African Americans, Caribbean blacks, and non-Hispanic whites: results from the National Survey of American Life. *Archives of general psychiatry*. 2007; 64(3):305–15. [PubMed: 17339519]
20. Prevention CfDCA. Current Depression Among Adults — United States, 2006 and 2008. *Morbidity and Mortality Weekly Report*. 2010; 59(38):1230–58.
21. Coyne JC, Marcus SC. Health disparities in care for depression possibly obscured by the clinical significance criterion. *The American journal of psychiatry*. 2006; 163(9):1577–9. [PubMed: 16946183]
22. Coles ME, Schubert JR, Heimberg RG, Weiss BD. Disseminating treatment for anxiety disorders: step 1: recognizing the problem as a precursor to seeking help. *Journal of anxiety disorders*. 2014; 28(8):737–40. [PubMed: 25222497]
23. Manseau M, Case BG. Racial-ethnic disparities in outpatient mental health visits to U.S. physicians, 1993–2008. *Psychiatric services* (Washington, DC). 2014; 65(1):59–67.
24. Andrews JG, Oei TP. The roles of depression and anxiety in the understanding and treatment of Obstructive Sleep Apnea Syndrome. *Clinical psychology review*. 2004; 24(8):1031–49. [PubMed: 15533283]

25. Bardwell WA, Ancoli-Israel S, Dimsdale JE. Comparison of the effects of depressive symptoms and apnea severity on fatigue in patients with obstructive sleep apnea: a replication study. *Journal of affective disorders*. 2007; 97(1–3):181–6. [PubMed: 16872682]
26. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased Prevalence of Sleep-Disordered Breathing in Adults. *American journal of epidemiology*. 2013
27. Hattori M, Kitajima T, Mekata T, et al. Risk factors for obstructive sleep apnea syndrome screening in mood disorder patients. *Psychiatry and clinical neurosciences*. 2009; 63(3):385–91. [PubMed: 19566771]
28. Ong JC, Gress JL, San Pedro-Salcedo MG, Manber R. Frequency and predictors of obstructive sleep apnea among individuals with major depressive disorder and insomnia. *Journal of psychosomatic research*. 2009; 67(2):135–41. [PubMed: 19616140]
29. Soreca I, Levenson J, Lotz M, Frank E, Kupfer DJ. Sleep apnea risk and clinical correlates in patients with bipolar disorder. *Bipolar disorders*. 2012; 14(6):672–6. [PubMed: 22938169]
30. Drager LF, Togeiro SM, Polotsky VY, Lorenzi-Filho G. Obstructive sleep apnea: a cardiometabolic risk in obesity and the metabolic syndrome. *J Am Coll Cardiol*. 2013; 62(7):569–76. [PubMed: 23770180]
31. Demede M, Pandey A, Zizi F, et al. Resistant hypertension and obstructive sleep apnea in the primary-care setting. *International journal of hypertension*. 2011; 2011:340929. [PubMed: 21755035]
32. Williams NJ, Jean-Louis G, Brown CD, McFarlane SI, Boutin-Foster C, Ogedegbe G. Telephone-delivered behavioral intervention among blacks with sleep apnea and metabolic syndrome: study protocol for a randomized controlled trial. *Trials*. 2014; 15:225. [PubMed: 24925227]
33. Grundy SM, Cleeman JJ, Daniels SR, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation*. 2005; 112(17):2735–52. [PubMed: 16157765]
34. Westbrook PR, Levendowski DJ, Cvetinovic M, et al. Description and validation of the apnea risk evaluation system: a novel method to diagnose sleep apnea-hypopnea in the home. *Chest*. 2005; 128(4):2166–75. [PubMed: 16236870]
35. Benoit J, Pandey A, Racine C, Zizi F, Zizi F, Francois A, Brown CD, Jean-Louis G. Differences in Sleep Measures between Caribbean- and US-Born Blacks with Metabolic Syndrome. *Sleep*. 2012; (35):305.
36. Lewinsohn PM, Seeley JR, Roberts RE, Allen NB. Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. *Psychology and aging*. 1997; 12(2):277–87. [PubMed: 9189988]
37. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. *Journal of consulting and clinical psychology*. 1988; 56(6):893–7. [PubMed: 3204199]
38. Spitzer RL, Williams JB, Gibbon M, First MB. The Structured Clinical Interview for DSM-III-R (SCID). I: History, rationale, and description. *Archives of general psychiatry*. 1992; 49(8):624–9. [PubMed: 1637252]
39. Schröder CM, O'Hara R. Depression and Obstructive Sleep Apnea (OSA). *Annals of General Psychiatry*. 2005; 4:13. [PubMed: 15982424]
40. Adrien J. Neurobiological bases for the relation between sleep and depression. *Sleep Medicine Reviews*. 6(5):341–51. [PubMed: 12531125]
41. Nitia O, Graur LI, Popescu DS, Popa AD, Boisteanu D, Graur M. Socio-demographic and lifestyle characteristics associated with the risk for obstructive sleep apnea syndrome in a rural population. *Revista medico-chirurgicala a Societatii de Medici si Naturalisti din Iasi*. 2012; 116(3):773–9. [PubMed: 23272526]
42. Hayley AC, Williams LJ, Venugopal K, Kennedy GA, Berk M, Pasco JA. The relationships between insomnia, sleep apnoea and depression: findings from the Australian National Health and Nutrition Examination Survey, 2005–2008. *The Australian and New Zealand journal of psychiatry*. 2015; 49(2):156–70. [PubMed: 25128225]

43. Charokopos N, Leotsinidis M, Tsiamita M, Karkoulas K, Spiropoulos K. Sleep apnea syndrome in a referral population in Greece: influence of social factors. *Lung*. 2007; 185(4):235–40. [PubMed: 17564744]
44. Kang K, Seo JG, Seo SH, Park KS, Lee HW. Prevalence and related factors for high-risk of obstructive sleep apnea in a large Korean population: results of a questionnaire-based study. *Journal of clinical neurology (Seoul, Korea)*. 2014; 10(1):42–9.
45. Sogebi OA, Ogunwale A. Risk factors of obstructive sleep apnea among Nigerian outpatients. *Brazilian journal of otorhinolaryngology*. 2012; 78(6):27–33. [PubMed: 23306564]
46. Kumar R, Macey PM, Cross RL, Woo MA, Yan-Go FL, Harper RM. Neural Alterations Associated with Anxiety Symptoms in >Obstructive Sleep Apnea Syndrome. *Depression and anxiety*. 2009; 26(5):480–91. [PubMed: 18828142]
47. Rezaeitalab F, Moharrari F, Saberi S, Asadpour H, Rezaeitalab F. The correlation of anxiety and depression with obstructive sleep apnea syndrome. *Journal of Respiratory Medical Sciences*. 2014; 19(3):205–10.
48. Alam A, Chengappa KN, Ghinassi F. Screening for obstructive sleep apnea among individuals with severe mental illness at a primary care clinic. *General hospital psychiatry*. 2012; 34(6):660–4. [PubMed: 22832135]
49. Jordan AS, McSharry DG, Malhotra A. Adult obstructive sleep apnoea. *Lancet*. 2014; 383(9918):736–47. [PubMed: 23910433]
50. Harris Y, Gorelick PB, Samuels P, Bemping I. Why African Americans may not be participating in clinical trials. *Journal of the National Medical Association*. 1996; 88(10):630–4. [PubMed: 8918067]
51. Kessler RC, McGonagle KA, Swartz M, Blazer DG, Nelson CB. Sex and depression in the National Comorbidity Survey. I: Lifetime prevalence, chronicity and recurrence. *Journal of affective disorders*. 1993; 29(2–3):85–96. [PubMed: 8300981]
52. Chen YH, Keller JK, Kang JH, Hsieh HJ, Lin HC. Obstructive sleep apnea and the subsequent risk of depressive disorder: a population-based follow-up study. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*. 2013; 9(5):417–23. [PubMed: 23674930]
53. Lehto SM, Sahlman J, Soini EJ, et al. The association between anxiety and the degree of illness in mild obstructive sleep apnoea. *The clinical respiratory journal*. 2013; 7(2):197–203. [PubMed: 22686135]
54. Enciso R, Clark GT. Comparing the Berlin and the ARES questionnaire to identify patients with obstructive sleep apnea in a dental setting. *Sleep & breathing = Schlaf & Atmung*. 2011; 15(1):83–9. [PubMed: 20127186]
55. Boynton G, Vahabzadeh A, Hammoud S, Ruzicka DL, Chervin RD. Validation of the STOP-BANG Questionnaire among Patients Referred for Suspected Obstructive Sleep Apnea. *J Sleep Disord Treat Care*. 2013; 2(4)
56. Kim RD, Kapur VK, Redline-Bruch J, et al. An Economic Evaluation of Home Versus Laboratory-Based Diagnosis of Obstructive Sleep Apnea. *Sleep*. 2015; 38(7):1027–37. [PubMed: 26118558]

Key Messages

- This study assessed associations of moderate to severe depression and anxiety with risk of OSA among Non-Hispanic Blacks with metabolic syndrome.
- Patients with depression had nearly a two-fold increased odds of being at risk for OSA.
- Patients with anxiety had a three-fold increased odds of being at risk for OSA.

Table I

Guidelines from the National Cholesterol Education Program (NCEP).

NCEP ATP III Definition of the Metabolic Syndrome	
Characteristic	NCEP ATP III
Hypertension	BP medication or BP > 130/85 mm/Hg
Dyslipidemia	Plasma triglycerides > 150 mg/dL; HDL cholesterol < 40 mg/dL in men and < 50 mg/dL in women
Obesity	Waist circumference > 40 inches in men and > 35 inches in women
Diabetes	Fasting plasma glucose > 110 mg/dL *
Requirements for Diagnosis	Any 3 of the above disorders

Note: BP denotes blood pressure; HDL, high-density lipoprotein.

* Fasting plasma glucose was recently updated to 100 mg/dl by the American Diabetes Association.

Table II

Metabolic characteristics of the study participants.

Variable	Mean	SD
Systolic BP (mmHg)	134.98	16.39
Diastolic BP (mmHg)	75.77	10.55
LDL Cholesterol (mg/dL)	105.6	36.88
HDL Cholesterol (mg/dL)	48.03	16.49
Triglycerides (mg/dL)	134.98	73.24
Glucose (mg/dL)	138.38	68.27
HbA1c (mmol/L)	7.93	1.63
BMI	33.8	8.56

Note: BP= Blood Pressure; LDL= Low-density lipoprotein, HDL = High-density lipoprotein; HbA1c= glycated hemoglobin; BMI= Body Mass Index in pounds.

Insulin=Fasting plasma glucose > 110 mg/dL; Dyslipidemia=Plasma triglycerides > 150 mg/dL, HDL cholesterol < 40 mg/dL in men and < 50 mg/dL in women; Elevated BP/Hypertension=BP medication or BP > 130/85 mm/Hg; Body Mass Index (kg/m²)

Table III

Cross-Tab with MetS indicators, Psychological factors and OSA risk

Variables	OSA risk	No OSA risk	Fisher Exact Significance (<i>p</i> value)
Insulin/Glucose	48.6%	51.4%	N.S.
Dyslipidemia	48.6%	51.4%	N.S.
Elevated BP/Hypertension (>130/85)	49.2%	50.8%	N.S.
Waist Circumference (Visceral adiposity) Male	42.5%	57.5%	N.S.
Waist Circumference (Visceral adiposity) Female	49.8%	50.2%	.004
Depression (CES-D)	55.1%	44.9%	N.S.
Anxiety (Moderate – Severe levels on BAI)	61.9%	38.1%	N.S.

Insulin/Glucose=Fasting plasma glucose > 110 mg/dL; Dyslipidemia=Plasma triglycerides > 150 mg/dL, HDL cholesterol < 40 mg/dL in men and < 50 mg/dL in women; Elevated BP/Hypertension=BP medication or BP > 130/85 mm/Hg; Waist Obesity=Waist circumference > 40 inches in men and > 35 inches in women; Depression= Depressive Symptoms on CES-D; Anxiety=Anxiety Symptoms on Beck Anxiety Inventory (BAI).

Table IV

Multivariate logistic regression analysis indicating odds ratios (ORs) for Psychological health associated with OSA risk in the MetSo; N= 1,035.

Variables	OR (Odds Ratio)	95% CI		p
Gender	0.93	0.55	1.57	0.77
Age*	0.97	0.95	0.98	<.01
Depression*	1.75	1.02	2.98	<.05
Anxiety*	3.30	2.11	5.15	<.01

Note: Depression = CES-D; Anxious = Beck Anxiety Inventory

* Significant $p < 0.05$

Gender=Male or Female; Age=years old; Depression= Depressive Symptoms on CES-D; Anxiety=Anxiety Symptoms on Beck Anxiety Inventory (BAI).

Table V

Multivariate logistic regression analysis indicating odds ratios (ORs) for OSA risk in the MetSo; N= 1,035.

Variables	OR (Odds Ratio)	95% CI		<i>p</i>
Gender	0.88	0.64	1.22	0.452
Age *	0.97	0.96	0.98	<.001
Marital Status	1.17	0.85	1.61	0.340
Income	1.30	0.96	1.75	0.093
Depression	0.98	0.95	1.00	0.084
Anxiety *	1.06	1.04	1.09	<.001

Gender=Male or Female;

Age=years old;

Marital Status= Reference is Married;

Income= Reference is >10,000

Depression = CES-D 16

Anxious = Beck Anxiety Inventory 16

Note:

* Significant $p<0.05$