e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(9); 1083-1089
Original Research Article

A Study on the Effect of Obstructive Sleep Apnea on Lipid Profile

Tanweer Md. Iqbal[1], Syed Monawer Karim[2], Indushri[3], Arvind Kumar Pal[4]

[1]Assistant Professor, Department of Physiology, Katihar Medical College, Katihar, Bihar, India.
[2]Consultant Medical Oncologist, Department of Oncology, City Hospital, Nottingham, England.
[3]Assistant Professor, Department of Anatomy, Government Medical College, Kannauj, Uttar Pradesh, India.
[4]Assistant Professor, Department of Physiology, Autonomous State Medical College, Firozabad, Uttar Pradesh, India

Received: 25-07-2022 / Revised: 25-08-2022 / Accepted: 23-09-2022
Corresponding author: Dr. Arvind Kumar Pal
Conflict of interest: Nil

Abstract:

Objectives: This present study was to evaluate the effect of obstructive sleep apnea on lipid profile in terms of AHI.

Methods: A total of 60 participants of sleep apnea with age group of 25 to 65 years were enrolled in this study. All the subjects were divided into two groups. Each group had 30 subjects. Group A participants had AHI>10 and group B had AHI≤10. Polysomnography and relevant blood investigation were performed to all subjects.

Results: Mean ± Standard deviation of Age, AHI, BMI, total cholesterol, triglycerides, HDL cholesterol, VLDL cholesterol and LDL cholesterol were 52.61 ± 12.23, 49.42 ± 36.43, 34.87± 7.22, 183.71 ± 52.12, 175.91 ± 98.76, 33.82 ± 12.24, 32.12 ± 12.38, 122.92 ± 47.98 respectively in group A participants. Similarly, mean ± Standard deviation of Age, AHI, BMI, total cholesterol, triglycerides, HDL cholesterol, VLDL cholesterol and LDL cholesterol were 47.34 ± 16.21, 4.85 ± 4.16, 26.98 ± 4.89, 164.52 ± 33.98, 128.83 ± 54.72, 39.12 ± 14.21, 26.93 ± 11.97, 99.23 ± 42.24 respectively in group B participants.

Conclusions: Group A participants had increased BMI, total cholesterol, triglyceride, VLDL, LDL-Cholesterol, and decreased level of HDL -Cholesterol as compared to group B participants. Hence, AHI>10 participants were associated with changed lipid profile as compared to AHI≤ 10 participants.

Keywords: Obstructive Sleep apnea, Lipid profile, BMI

Introduction

Obstructive sleep apnea (OSA) is characterized by repetitive upper airway obstructions resulting in intermittent hypoxia and sleep fragmentation caused by arousals [1]. It has recurrent episodes of upper airway collapses during sleep. These recurrent episodes of upper airway collapse usually are accompanied by oxyhemoglobin desaturation and terminated by brief arousals which result in marked sleep fragmentation and chronic excessive daytime sleepiness (EDS) [1,2].

Among adults, 30–70 years of age, approximately 13% of men and 6% of women, have moderate to severe forms of OSA [3]. OSA is often closely associated with other conditions which are recognised causes of morbidity and mortality such as obesity, metabolic syndrome, atherosclerosis, systemic inflammation, insulin resistance and type 2 diabetes mellitus [4].

Obstructive sleep apnoea is associated with dyslipidaemia [5]. More importantly, OSA can further accelerate dyslipidaemia-related atherosclerosis by the oxidation of LDL particles [6]. Several mechanisms are responsible for the development of dyslipidemia in OSA [5]. First, patients with OSA tend to consume high-calorie and high-fat food diet [7]. Second, postprandial TG clearance is impaired due to reduced lipoprotein lipase activity [8]. Third, hepatic TG production is increased due to chronic intermittent hypoxaemia [9]. Fourth, the liberation of free fatty acids from adipose tissue is accelerated by the sympathetic bursts associated with OSA [10]. Finally, the reverse cholesterol transport is impaired in OSA due to reduced production of apolipoprotein A [11]. The gold standard for diagnosis of sleep apnea is polysomnography. It is simultaneous recording of multiple physiologic parameters, namely electroencephalogram, electrooculogram, electromyogram, oronasal airflow, chest wall and abdominal motion, body position, snoring, [12] electrocardiogram and oxyhaemoglobin saturation. Objectives of our study was to evaluate the effect of obstructive sleep apnea on lipid profile in terms of AHI.

Material & Methods

This present study was conducted in the department of Physiology, Katihar Medical College, Katihar, Bihar during a period from April 2021 to January 2022. Entire subjects signed an informed consent approved by institutional ethical committee of Katihar Medical College, Katihar was sought.

A total of 60 participants of sleep apnea with age group of 25 to 65 years were enrolled in this study. Participants who were suffered from other diseases were excluded from this study.

All the subjects were divided into two groups. Each group had 30 subjects. Group A participants had AHI>10 and group B had AHI≤10 on bases of severity of apnea.

Methods:

Polysomnography: Patients were called at 8:30 pm in sleep research center. Then procedures were explained to them. Height was recorded in cm with help of wall mounted measuring tape and weight was measured in kg with help of digital weighing machine and BMI was calculated. Followed by which electrodes were placed according to their positions for recording polysomnogram. After which the polysomnogram was recorded from 10 pm to 5 am.

Blood investigations: Fasting blood sample was collected in morning around 5:30 am after recording of polysomnogram. Then blood sample was sent to the biochemistry laboratory to get all blood investigation done. Serum total cholesterol (TCH) was measured by CHOD-TAP method. Serum triglyceride (TG) was performed by GPO- TRINDER method. Serum high-density lipoprotein (HDL Cholesterol) was performed by Phosphotungstic Acid method. VLDL Cholesterol was performed by Triglyceride/five. LDL Cholesterol was performed by Total cholesterol – (HDL cholesterol + VLDL).

Statistical Analysis

Data was analysed with the help of SPSS software. Mean ± Standard deviations were observed. Independent T-test was applied. P-value was taken less than or equal to 0.05 ($p \leq 0.05$) for significant differences.

Observations

Total of 60 participants were divided into two groups. Each group had 30 participants. Group A subjects had 22 males and 8 females. Similarly, group B participants had 18 males and 12 females. Out of total 60 participants, most of the participants 33(55%) were in age group of 35 to 45 years. When we compared the mean ± S.D of age of group A (52.61±12.23) and group B (47.34±16.21 years) participants. P-value was found to be 0.1605, which is not statistically significant. When we compared the mean ± S.D of AHI of group A (49.42±36.43) and group B (4.85±4.16) participants. P-value was found to be 0.0001, which is highly statistically significant. When compared the mean ± S.D of BMI of group A (34.87±7.22) and group B (26.98±4.89) participants. We found highly statistically significant (P < 0.0001). When we compared the mean ± S.D of total cholesterol of group A and group B patients. It was not statistically significant (p=0.0965). when compared the mean and standard deviation of triglyceride. Then, it was statistically significant differences (p=0.0261). similarly, when we compared the mean and standard deviation of HDL, VLDL of group A and group B participants respectively. Then it was not statistically significant differences (p=0.127, p=0.104). But when we compared the mean of LDL-Cholesterol of group A and group B participants. It was statistically significant differences (p=0.047).

Table 1: Comparison of age, BMI, lipid profile of non-diabetic groups AHI>10 and AHI≤ 10.

Variables	Group A: AHI>10 (n=30)	Group B: AHI≤ 10 (n=30)	t-value	P -value
Age	52.61±12.23	47.34±16.21	-1.421	0.1605
AHI	49.42±36.43	4.85±4.16	-6.658	< 0.0001
BMI (kg/m2)	34.87±7.22	26.98±4.89	-4.956	< 0.0001
Total Cholesterol(mg/dl)	183.71±52.12	164.52±33.98	-1.689	0.0965
Triglycerides(mg/dl)	175.91±98.76	128.83±54.72	-2.284	0.0261
HDL -Cholesterol (mg/dl)	33.82±12.24	39.12±14.21	1.548	0.127
VLDL-Cholesterol (mg/dl)	32.12±12.38	26.93±11.97	-1.651	0.104
LDL-Cholesterol (mg/dl)	122.92±47.98	99.23±42.24	-2.039	0.047

Discussions

Obstructive Sleep Apnea (OSA) is a common disorder, affecting approximately 4% of adult men and 2% of adult women in general [13] population. OSA is characterized by repeated episodes of complete [13] or partial obstruction of the upper air way during sleep. Apnea is the complete cessation of airflow lasting at least for 10 second and hypopnea is a discernible fall in airflow lasting for at least 10 second [12] accompanied by a decrease in oxygen saturation of at least 3%. Apnea hypopnea index (AHI) is the total number of apneas and [12] hypopneas per hour of sleep.

In our present study, mean age of both the group (group A & group B) was not statistically significant (p=0.1605). Most of the participants 33(55%) were seen in age group of 35 to 45 years. BMI and AHI of both the group (A &B) was highly statistically significant (p< 0.0001). Mean BMI of group A and group B patients were 34.87±7.22 and 26.98±4.89 kg.m2 respectively. Similarly, mean AHI of group

A and group B participants were 49.42±36.43 and 4.85±4.16 respectively.

According to previous studies, the prevalence of OSA is increased fourfold in patients with obesity. Obesity plays a major part in the development of the metabolic syndrome, which consists of insulin resistance, diabetes or impaired glucose tolerance, hypertension, and lipoproteinemia. The American Heart Health Sleep Study reported that apnea-hypopnea index (AHI) was inversely related to HDL-cholesterol levels in younger men and women, but not in older men, and triglyceride levels in younger men and women only [14]. In contrast, Lam et al. evaluated 255 patients between 30 and 60 years, and they did not find the association between OSA and HDL or TG levels, after controlling for confounding variables [15].

In our present study, mean total cholesterol level of group A and group B patients were 182.3±51.05 and 162.2±32.77 mg/dl respectively and it was not statistically significant (p=0.0965).

Young T in his two studies showed that an increasing BMI (in increments of 5.3 or 5.6 kg per m2) was associated with an increased risk of OSA [16, 1]. Bixler EO, Bixler EO noted that BMI greater than or equal to 31.1 kg per m2 in men and 32.3 kg per m2 in women was found to be predictive of OSA(OR = 7.8 and 12.8, respectively) [17,18].

Studies by Martinez-Rivera C and Ibrahim AS showed that a BMI greater than 30 kg per m2 was a dependent variable for OSA [20, 19]. Jianguo Li et al in 2007 found that chronic intermittent hypoxia leads to hypercholesterolemia and lipid peroxidation in the absence of obesity, and the degree of metabolic dysregulation is dependent on the severity of the hypoxic stimulus [20].

Ip MS et al in 200 noted that compare to control subjects with a similar BMI but without OSA, the OSA group had a significantly more dyslipidemia, and greater adiposity reflected by skinfold thickness [21].

In our present study, mean of triglyceride of both the groups A & B were 175.91±98.76 and 128.83±54.72 mg/dl respectively. But it was statistically significant (p=0.0261). Similarly, mean of HDL -Cholesterol (mg/dl) of group A and B participants were 33.82±12.24 and 39.12±14.21 mg/dl respectively. But, it was not statistically significant (p=0.127). Mean VLDL-Cholesterol (mg/dl) of group A and group B patients were 32.12±12.38 and 26.93±11.97 mg/dl. But, it was not statistically significant (p=0.104). Similarly, mean LDL-Cholesterol (mg/dl) of group A and group B participants were 122.92±47.98 and 99.23±42.24 mg/dl. But, it was statistically significant (p=0.047).

Kawano noted that HDL-Cholesterol was correlated negatively with the lowest arterial oxyhemoglobin saturation and LDL-Cholesterol was correlated positively with apnea-hypopnea index [22]. Our study shows similar findings of decrease in HDL and increasing LDL Cholesterol with increasing severity of OSA.

Shumizu et al. recruited 1528 Japanese male subjects, including 241 patients with OSA. They found that OSA was associated with elevated AIP but only in normal-weight subjects (BMI < 25 kg/m2) [23]. Wu et al. investigated 246 male bus drivers from Taiwan. TGs/HDL-C ratio was associated with OSA and correlated with disease severity [24]. The obvious criticism of these two studies is that they investigated men exclusively, while the association between OSA and dyslipidaemia. Silva et al. compared patients with mild OSA to controls and found increased TGs/HDL-C ratio in the OSA group. TGs/HDL-C ratio did not correlate with any parameters of sleep quality and was not related to sleepiness [25].

The two cardinal features of OSA are chronic intermittent hypoxaemia and

disruption of the sleep architecture. It is likely that hypoxaemia is the predominant mechanism responsible for dyslipidaemia in OSA. However, disturbed sleep may contribute via hyperphagia as well [26].

The present showed that there is an increase in levels of dyslipidemia in subjects with OSA including total cholesterol, low density lipoprotein, high density lipoprotein, and triglyceride. An obvious majority of studies [27,28] showed this effect, while few did not [29,30] Ozol et al. found less dyslipidemia in patients with moderate OSA than controls, most likely because their controls have high insulin resistance measured by HOMA and higher insulin levels than moderate OSA patients [29]. Moreover they found a high degree of dyslipidemia in their mild and severe OSA groups, which suggest that confounding factors may have played a role in their subjects' lipid levels (hypertension, obesity, and frequency of metabolic syndrome) in their sample. [30,31]

Conclusions

This present study concluded that the group A participants had increased BMI, total cholesterol, triglyceride, VLDL, LDL-Cholesterol, and decreased level of HDL - Cholesterol as compared to group B participants. Hence, AHI>10 participants were associated with changed lipid profile as compared to AHI≤ 10 participants.

References

1. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med. 199 3;328:1230-5.
2. Guilleminault C, Tilkian A, Dement WC. The sleep apnea syndromes. Annu Rev Med 1976; 27:465-84.
3. Dempsey J, Veasey S, Morgan B, O'Donnel C. Pathophysiology of sleep apnea. Physiol Rev. 2010; 90: 47–112.
4. Malhotra A, Loscalzo J. Sleep and cardiovascular disease: an overview. Prog Cardiovas Dis. 2009; 51:279-284.
5. Barros D., García-Río F. Obstructive sleep apnea and dyslipidemia: From animal models to clinical evidence. Sleep 2019; 42: zsy236.
6. Khatana C., Saini N.K., Chakrabarti S., Saini V., Sharma A., Saini R.V., Saini A.K. Mechanistic Insights into the Oxidized Low-Density Lipoprotein-Induced Atherosclerosis. Oxid. Med. Cell. Longev. 2020; 2020: 1–14.
7. Smith S.S., Waight C., Doyle G., Rossa K.R., Sullivan K.A. Liking for high fat foods in patients with Obstructive Sleep Apnoea. Appetite 2014; 78: 185–192.
8. Jun J.C., Shin M.-K., Yao Q., Bevans-Fonti S., Poole J., Drager L.F., Polotsky V.Y. Acute hypoxia induces hypertriglyceridemia by decreasing plasma triglyceride clearance in mice. Am. J. Physiol. Endocrinol. Metab. 2012; 303: e377–e 388.
9. Li J., Grigoryev D., Ye S.Q., Thorne L., Schwartz A.R., Smith P.L., O'Donnell C.P., Polotsky V.Y. Chronic intermittent hypoxia upregulates genes of lipid biosynthesis in obese mice. J. Appl. Physiol. 2005; 99:1643–1648.
10. Barceló A., Piérola J., De La Peña M., Esquinas C., Fuster A., Sánchez-De-La-Torre M., Carrera M., Alonso-Fernández A., Ladaria A., Bosch M. et al. Free fatty acids and the metabolic syndrome in patients with obstructive sleep apnoea. Eur. Respir. J. 2010; 37: 1418–1423.
11. Bikov A., Lazar Z., Horvath P., Tarnoki D.L., Tarnoki A.D., Fesus L., Horvath M., Meszaros M., Losonczy G. Kunos L. Association Between Serum Lipid Profile and Obstructive Respiratory Events During REM and Non-REM Sleep. Lung 2019; 197: 443–450.
12. McNicholas WT, Bonsignore MR. Sleep apnoea as an independent risk factor for cardiovascular disease: current evidence, basic mechanisms and research priorities. Eur Respir J 2007; 29: 156-78.

13. Punjabi NM. The epidemiology of adult obstructive sleep apnea. Proc Am Thorac Soc; 2008; 5: 136-43.
14. Newman AB, Nieto FJ. Relation of sleep-disordered breathing to cardiovascular disease risk factors—the Sleep Heart Health Study. Am J Epidemiol. 2001; 154: 50–59.
15. Lam JC, Lam B, Lam CL et al. Obstructive sleep apnea and the metabolic syndrome in community-based Chinese adults in Hong Kong. Respir Med. 2006; 100: 980-987.
16. Young T, Shahar E, Nieto FJ, et al. Predictors of sleep disordered breathing in community-dwelling adults: the Sleep Heart Health Study. Arch Intern Med 2002; 162(8):893-900.
17. Bixler EO, Vgontzas AN, Lin HM, et al. Prevalence of sleep-disordered breathing in women: effects of gender. Am J Respir Crit Care Med. 2001;16 3(3 pt 1):608-613.
18. Bixler EO, Vgontzas AN, Ten Have T, Tyson K, Kales A. Effects of age on sleep apnea in men: I. Prevalence and severity. Am J Respir Crit Care Med 1998;157(1):144-148.
19. Ibrahim AS, Almohammed AA, Allangawi MH, et al. Predictors of obstructive sleep apnea in snorers .Ann Saudi Med 2008; 28(1):64.
20. Jianguo Li, Vladimir Savransky, Ashika Nanayakkara, Philip L. Smith, Christopher P. O'Donnell, Vsevolod Y. Polotsky. Hyperlipidemia and lipid peroxidation are dependent on the severity of chronic intermittent hypoxia. Journal of Applied Physiology Published 1 February 2007; 102(2): 557-563.
21. Ip MS, Lam KS, Ho C, Tsang KW, Lam W. Serum leptin and vascular risk factors in obstructive sleep apnea. Chest. 2000; 118: 580–586.
22. Kawano Y1, Tamura A, Kadota J. Association between the severity of obstructive sleep apnea and the ratio of low-density lipoprotein cholesterol to high-density lipoprotein cholesterol. 2012; Feb;61(2):186-92.
23. Shimizu Y., Yoshimine H., Nagayoshi M., Kadota K., Takahashi K., Izumino K., Inoue K., Maeda T. Serum triglyceride levels in relation to high-density lipoprotein cholesterol (TG-HDL) ratios as an efficient tool to estimate the risk of sleep apnea syndrome in non-overweight Japanese men. Environ. Health Prev. Med. 2016; 21: 321–326.
24. Wu W.-T., Tsai S.-S., Shih T.-S., Lin M.-H., Chou T.-C., Ting H., Wu T.-N., Liou S.-H. The Association between Obstructive Sleep Apnea and Metabolic Markers and Lipid Profiles. PLoS ONE 2015; 10: e0130279.
25. Silva L.O.E., Guimarães T.D.M., Luz G.P., Coelho G., Badke L., Almeida I.R., Millani-Carneiro A., Tufik S., Bittencourt L., Togeiro S.M. Metabolic Profile in Patients with Mild Obstructive Sleep Apnea. Metab. Syndr. Relat. Disord. 2018;16: 6–12.
26. Gileles-Hillel A., Kheirandish-Gozal L., Gozal D. Biological plausibility linking sleep apnoea and metabolic dysfunction. Nat. Rev. Endocrinol. 2016; 12: 290–298.
27. Barceló A, Barbé F, Llompart E, et al. Effects of obesity on C-reactive protein level and metabolic disturbances in male patients with obstructive sleep apnea. Am J Med 2004; 117:118-21
28. Salord N, Mayos M, Miralda R, Perez A. Respiratory sleep disturbances in patients undergoing gastric bypass surgery and their relation to metabolic syndrome. Obes Surg 2009; 19:74-9.
29. Monneret D, Borel JC, Pepin JL, et al. Pleiotropic role of IGF-I in obesity hypoventilation syndrome. Growth Horm IGF Res 2010; 20:127-33.
30. Peled N, Kassirer M, Shitrit D, et al. The association of OSA with insulin resistance, inflammation and metabolic syndrome. Respir Med 2007; 101:169 6- 701.

31. Atbib Y., Essad A., Zhar H., Tadlaoui Yasmina, Ait E Cadi, M., & Bousliman Y. Impact de l'immunothérapie dans la prise en charge du cancer du poumon. Etude rétrospective menée à l'Hôpital Militaire d'Instruction Mohammed V-Rabat. Journal of Medical Research and Health Sciences, 2022;5(9): 2221–2243.