ORIGINAL ARTICLE

PHYSICAL ACTIVITY AND APNOEA-HYPOPNEA INDEX IN OBSTRUCTIVE SLEEP APNOEA

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Background: Obstructive sleep apnoea is a silent killer as majority of people are unaware of having it. Its aetiology and pathophysiology of comorbidities are not fully understood. We aimed to determine the physical activity levels in sleep apnoea patients and compare it with their apnoea-hypopnea-index (AHI). **Methods:** This cross-sectional study was carried out on 50 obstructive sleep apnoea cases selected after confirmation of their diagnosis through overnight polysomnography, and 50 normal controls. Polysomnographic sleep study evaluated their sleep phases and AHI. Physical activity was measured by International Physical Activity Questionnaire (IPAQ). Cut-off metabolic energy turnover value of 600 was considered to categorize them active or inactive. **Results:** More than two third of sleep apnoea patients were physically inactive (68% *vs* 32%). Mean physical activity score was not significantly different in both groups, however, statistically significant negative correlation was present between Physical activity and sleep apnoea score (r= -0.591, p<0.001), showing a decreasing tendency of Physical activity value with increasing severity of apnoea or apnoea-hypopnea index. **Conclusions:** Overall physical inactivity was a characteristic among individuals with obstructive sleep apnoea. There was a moderate negative correlation between physical activity and obstructive sleep apnoea (OSA) scores. Proper physical activity and exercise could be a therapeutic alternative for these patients, being simple, inexpensive and having many systemic benefits.

Keywords: Physical Activity, exercise, obstructive sleep apnoea

Pak J Physiol 2019;15(3):67–70

INTRODUCTION

Sleep is a fundamental physiological process with significant restorative functions that are necessary for optimal daytime functioning. It is involved in regulation of major organ systems and functions in human body. Any disruption in normal sleep potentially can evoke organ dysfunction.[1] Several studies showed that inadequate or poor quality sleep has been correlated with neuro-cognitive impairments, chronic health conditions, end-organ dysfunction and increased mortality.[2,3]

Obstructive Sleep Apnoea (OSA) is a common sleep related breathing disorder (SRBD) characterized by repetitive collapse (apnoea) or partial collapse (hypopnea) of the upper respiratory passage during sleep. These repetitive airway obstructions followed by progressively forceful respiratory efforts to re-open the airway in order to revive respiration and mitigate hypoxemia, usually correlate with an arousal from sleep. Severity of OSA can be defined as apnoea-hypopnea-index (AHI) which is the average number of apnoea or hypopnea events during each hour. These short term events also expose the person to large swings in intrathoracic pressure and sympathetic activation which have significant deleterious consequences.[3,4] OSA has many adverse neurological and behavioural consequences. It reduces cognitive performance and increases risk for motor vehicle and occupational accidents.[5–7] It causes chemical changes in the brains of children affected with OSA and influences their learning, memory, and executive functioning.[1] OSA has been linked with a number of cardiovascular disorders, including myocardial ischemia, systemic arterial hypertension, stroke, cardiac arrhythmia, and increased arterial stiffness. OSA has also been found to be associated with increase systemic inflammatory response, which contribute in the development of atherosclerosis, insulin resistance, type 2 diabetes mellitus and dysregulation in lipid metabolism.[8–10] Deleterious effects of OSA and its co-morbid disorders have huge contribution in morbidity and mortality.

The aetiology of OSA is multifactorial including anatomical changes, neuromuscular factors and genetic predisposition. Treatment options are continuous positive airway pressure (CPAP), oral appliances and corrective upper airway surgery. American Academy of Sleep Medicine has mentioned CPAP as a treatment of choice for patients with AHI >15 events/h. Although CPAP is effective to maintain a positive pharyngeal transmural pressure but it might not be tolerated by some patients. Hence, alternative supportive methods are required to treat OSA as well as its cardiovascular consequences.[10] Recent studies have suggested that low level of physical activity (PA) is related with higher odds of OSA.[10–12]

US Centre for Disease Control and Prevention (CDC), defined PA as any body movement produced by contraction of skeletal muscle that enhances energy expenditure. It is now considered as one of the most powerful health-promoting behaviour.[13] A regular daily routine of at least 30–45 minutes of physical activity like brisk walking, bicycling, and even working around the house or surrounding can reduce risks of developing hypertension, coronary heart disease, colon cancer, and diabetes.[14]

Studies have suggested physical activity as a low-cost and easy-to-use treatment modality which is not only helpful in reducing OSA severity but is also helpful in mitigating other destructive consequences of OSA, which include CVDs, hypertension, glucose intolerance, and fatigue. Initially it was assumed that beneficial effects of PA for OSA are related to weight loss but now it is clear that these benefits for OSA patients are independent of reduction in weight or BMI.[10,12] A meta-analysis in 2014 reported significant reduction in the AHI, daytime sleepiness, improvement in sleep efficiency and peak oxygen consumption (V_{O2peak})[12] without any proper reduction in BMI. A meta-analysis carried out in 2016 also confirmed the beneficial role of PA and exercise for reducing AHI and daytime sleepiness.[15] A large community based cohort study explained the relationship of proper physical activity with decrease in OSA prevalence.[16] Despite multiple proposed mechanisms to justify this relationship, exact mechanism is not well-understood.

Low level of physical activity is proposed as part of OSA aetiology while studies also suggest that OSA subjects might have low level of physical activity secondary to fatigue and daytime sleepiness present in OSA which in turn increases the severity of apnoea. Studies have concluded that regular physical exercise, especially aerobic exercise training significantly decreases the severity of OSA despite no significant weight change.[10]

The objective of this study was to compare OSA patients and healthy individuals and to find a relationship of physical activity with their AHI using metabolic energy turnover (MET) value.

MATERIAL AND METHODS

Study approval was taken from University Ethical Committee. OSA patients having excessive day time somnolence or snoring, referred for polysomnography (PSG) to Sleep Laboratory were included in the study.

A questionnaire was designed to record age, sex, anthropometric measurements, ESS score, physical activity (frequency, time duration, intensity or type of exercise), medical and surgical history, use of sedatives, smoking, alcohol etc., and specific questions to evaluate socioeconomic status. Suspected OSA cases were examined through overnight polysomnography for OSA diagnosis and to evaluate AHI score. AHI at least 5/hr was taken as the cut-off for diagnosis of OSA. Fifty confirmed OSA patients were selected. Mild, moderate and severe OSA sub-groups were categorized with AHI 5–15, 15–30 and >30 respectively.[4] Age, gender, and BMI matched normal controls were selected from university employees, doctors, and general community.

Types of physical activity were divided into 5 groups with different level of intensity with Metabolic Energy Turnover (MET) from 7.5 to 2.5 for each group according to compendium of physical activity.[17] One MET equals to energy expenditure at rest, or roughly 3.5 ml oxygen consumed per Kg of body weight per minute. Categories of physical activities were:

- Vigorous intensity aerobic activities like cycling, running and vigorous swimming (MET= 7.5).
- Vigorous intensity intermittent sport activities like racquet balls, tennis and basketball (MET= 7).
- Moderate-intensity aerobic activity like light jogging and moderate intensity cycling (MET=6).
- Moderate intensity activity like brisk walking and recreational volleyball (MET= 3.5).
- Light aerobic activity such as golfing or normal walking (MET= 2.5).[18]

Determination of physical activity was done according to standard manoeuvre calculation as following:

Physical activity=

MET value × duration of activity in minutes per session × frequency activity per week

To categorize them as 'active' or 'inactive' person cut-off value was consider as 600. Physical activity >600 MET-minutes/week was categorized as 'Active' and <600 was considered 'inactive'.[18]

RESULTS

Mean value of physical activity for cases was 540.8 and for controls it was 639.7 (p=0.054). With cut-off MET 600, mean physical activity value of cases was below minimum activity level. Cross-tabulation by Chi-square (Table-1), indicated that only 32% subjects in OSA group were active whereas 68% subjects were inactive. Mean physical activity score among cases and controls was not significantly different.

When sleep apnoea group was analyzed on the bases of AHI (Figure-1), there was a decreasing tendency of physical activity with increasing OSA severity or AHI. There was intermediate negative correlation found between physical activity and AHI (r= -0.591, p<0.001). Regression analysis showed that with one unit increase in AHI score, physical activity will decrease up to 6.104 units and the average value of physical activity will be 760.185 if the effect of apnoea is removed. It also explained that 35% of total variation in physical activity is explained by AHI score or apnoea severity.

Table-1: Frequency distribution of activity level in case and control groups

Physical activity	Groups		*p*
	Case [n (%)] n=50	Control [n (%)] n=50	
Inactive	34 (68)	29 (58)	0.408
Active	16 (32)	21 (42)	
Total	50 (100)	50 (100)	

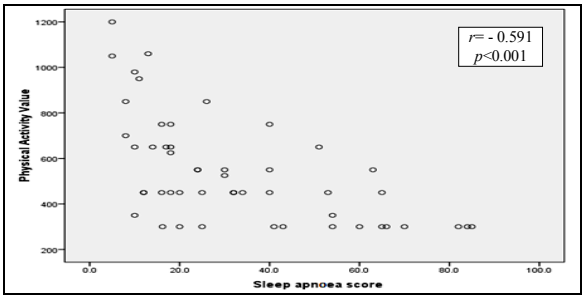

Figure-1: Scatter plot showing relationship between physical activity (MET) and sleep apnoea score (AHI)

Table-2: Correlation analysis between physical activity (MET) and sleep apnoea score (AHI) in case group

		Physical Activity (MET)	Apnoea Hypopnoea Index (AHI)
Physical Activity Value	Pearson Correlation	1	-0.591**
	Sig. (2-tailed)		0.000
	N	50	50
Apnoea Hypopnoea Index (AHI)	Pearson Correlation	-0.591**	1
	Sig. (2-tailed)	0.000	
	N	50	50
**Correlation is significant at the 0.01 level (2-tailed)			

DISCUSSION

Study revealed better physical activity levels in controls as compare to cases. Low level of physical activity in OSA subjects might be correlated with the aetiology of OSA, but it could be secondarily to daytime sleepiness which is a cardinal feature of OSA. In this study, more than two thirds (68%) of sleep apnoea patients were physically inactive.

Some interventional studies showed that exercise decreases the AHI due to its beneficial effects on reduction in BMI. However, many recent studies described the protective association between physical activity and OSA, independent of weight loss. Quan *et al*[16] and Kline *et al*[19] emphasized that physical activity is important to decrease severity of apnoea. A meta-analysis by Iftikhar *et al*[12] explained a statistically significant positive role of exercise in improvement of apnoea without significant change in weight. Their meta-analysis defined that mean AHI reduction was 6.27 episodes per hour after exercise training program, showing significant reduction in OSA severity. They suggested significant effects of exercise on daytime sleepiness and sleep efficiency as well as on multiple body systems especially for cardiorespiratory fitness. Simpson *et al*[20] conducted a case-control study with 2,340 cases with sleep abnormalities and 1,931 controls in Australia. They demonstrated the relationship of higher physical activity with reduced odds of moderate-severe OSA. They also explained the positive role of physical activity to reduce fatigue, depression and blood pressure. Findings were aligned with those determined by Sleep Heart Health Study, that 3 hours of moderate/ vigorous physical activity is related with an adjusted OR of 0.80 (95% CI, 0.66–0.96) for moderate-severe OSA. All these findings are emphasizing the potential role of physical activity for management of OSA.

Multiple mechanisms have been explained to relate physical activity with reduction in AHI or severity of apnoea. Exercise can gradually increase upper airway dilator muscle strength so it reduces chances of collapsibility. Sedentary lifestyle and decreased ambulation are related with fluid retention in legs. During sleep, fluid displaces from lower body parts and accumulates in the neck, which results in laryngeal compression to worsen OSA. It is assumed that regular physical exercise can improve leg fluid dynamics and consequently, apnoea. OSA is related with delayed and reduced slow-wave sleep (stage 3 NREM sleep) while increased physical activity increases slow-wave sleep, and decreases severity of apnoea. Reduced body weight, redistribution of fat in neck muscles, and reduced systemic inflammatory response are also associated with physical activity and exercise.[10,12]

Health benefits of proper physical activity are beyond any doubt, even if it has no significant or direct impact to reduce apnoea severity, its indirect benefits to improve metabolic profile, decrease blood pressure, and improve overall cardiovascular health are undebatable.[10] Studies enumerated numerous health benefits of exercise, for example, prevention of CVDs and type 2 diabetes, and improvement in physical and mental health. It has also been correlated with reduced risk for development of some cancers and all-cause mortality.[21] Physical inactivity is an underappreciated primary cause of most chronic conditions and poor health outcomes, and now it is being considered as the fourth leading cause of death worldwide.[22] Surprisingly, majority of our controls were medical university employees and must had knowledge regarding health benefits of exercise, but the level of physical activity was not appropriate in our control group either, which is really alarming.

Mental and physical health benefits of physical activity are well-determined. But there are multiple barriers which are source of discouragement to increase physical activities like health-related barriers or presence of some physical disease. Some individuals explained barriers associated with their life routine, such as lack of time, being unmotivated, or feeling lazy, not enjoying physical activity, or not feeling 'sporty'.[23] Inactive occupations are now increasingly prevalent in our

community. Technological advancement like excessive use of computer and smart phone, availability of social media, online sources of all kind of knowledge, online working, bill payment, and online shopping are pushing us toward more sedentary life style. We really need to combat the issue of physical inactivity. In order to improve health many counties have developed physical activity guidelines for adults and suggested for being active on most (if not all) days of the week and perform either moderate intensity physical activity for 150–300 minutes or vigorous activity for 75–150 minutes per week or it can be a combination of both.[21]

In our country, OSA is still an underestimated, underdiagnosed and undertreated syndrome with its multiple co-morbidities. There is paucity of information about this syndrome in Pakistani population. Multiple comorbid diseases, sudden heart attacks, death during sleep and accidents due to daytime sleepiness in sleep apnoea indicate that more effort needs to be placed on health and welfare of these patients. Our study findings are encouraging to propose exercise as an alternative or additional treatment for OSA and its complications.

CONCLUSION

Physical inactivity was found to be a characteristic among individuals with obstructive sleep apnoea. Although no statically significant differences were found between mean physical activity scores among cases and controls, there was a negative moderate correlation between physical activity and OSA scores. Increase in physical activity could be a modifiable factor to reduce the risk of OSA and its severity. Awareness regarding importance of physical activity and exercise to maintain good health, to reduce chances of many diseases, and to improve quality of life is recommended.

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Received: 8 Jul 2019 **Reviewed: 20 Nov 2019** **Accepted: 26 Nov 2019**