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Association Between High Risk of Obstructive Sleep Apnea and Excessive Daytime Sleepiness in Elderly People Based on Epworth Sleepiness Scale and Karolinska Sleepiness Scale after Exposure to Low Frequency Whole Body Vibration

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ABSTRACT

Background: The most common symptom of obstructive sleep apnea (OSA) is excessive daytime sleepiness (EDS).
Aim: To look for the high risk of OSA in the elderly population and its association with increased Epworth sleepiness scale (ESS) and Karolinska sleepiness scale (KSS) scores after exposure with low-frequency whole body vibration (LFWBV).
Method: This study used a one group pretest-post test design. Subjects examined for Snoring Score (SS), ESS and KSS scores, after which subjects were given exposure to LFWBV and examined for post-exposure KSS scores.
Results: There were more elderly people who have a high risk of OSA. The ESS score showed a non-significant relationship between high risk of OSA and the incidence of EDS based on an increase in ESS score (r 0.401; p value 0.064) and the degree of sleepiness based on the KSS score after LFWBV exposure (r 0.296; p value 0.181), although ESS scores were higher in the group with high risk of OSA (mean score 4.85; p value 0.003).
Discussion: The results of this study are consistent with several other studies which show no significant correlation between high risk of OSA and increased ESS scores. LFWBV does provide comfort and increases the degree of sleepiness in subjects with or without a high risk of OSA.
Conclusion: Older age increases the risk of OSA, but does not cause EDS. LFWBV caused an increase in the degree of sleepiness, both the high-risk and non-high-risk OSA groups.

Keywords: Obstructive sleep apnea, Epworth sleepiness scale, whole body vibration, Karolinska sleepiness scale.

INTRODUCTION

OSA has become one of the main health problems in society because most of the cases are often undiagnosed. OSA is one of the most common sleep-related breathing disorders. OSA is caused by obstruction of the airway, either partial or total, resulting in repeated episodes of apnea and hypopnea during sleep. It is estimated that about one-seventh of the world's adult population or about 1 billion of the 7.3 billion world population aged 30-69 years suffer from OSA. The prevalence of mild OSA ranged from 7.8% (Hong Kong) to 77.2% (Malaysia), and moderate-severe OSA ranged from 4.8% (Israel and Ireland) to 36.6% (Switzerland). The ten countries with the highest prevalence of OSA (apnea-hypopnea index (AHI) 5/hour) are China, followed by the United States, Brazil, India, Pakistan, Russia, Nigeria, Germany, France, and Japan.[1,2]

Of the 11 epidemiological studies published from 1993-2013, the prevalence of OSA was more in men (22%) than women (17%), with the incidence of excessive daytime sleepiness in men ranging from 6% and women to 4%. A significant risk factor for OSA is obesity, where a 10% increase in body weight can increase the risk of OSA up to six times.[2]

In addition to obesity, increasing age is also a risk factor for OSA due to physiological changes in the body due to age, such as a decrease in pharyngeal muscle function. The prevalence of sleep disordered breathing (SDB) in the elderly varies between 20-40%, with a peak age of 60-65 years.[3]

The diagnosis of OSA is established through history taking, physical examination, scores, as well as polysomnography examination consisting of electroencephalogram (EEG), electro-oculogram (EOG), submental electromyogram (EMG), electrocardiogram (ECG), breath flow, oxygen saturation, and breath effort. Some scores are used as a simple method to assess the risk of OSA in a person, one of which is SS which can be used to assess the presence of snoring or a high risk of experiencing OSA in a person.[4]

EDS is the most common symptom of OSA. EDS occurs as a result of intermittent chronic hypoxia and sleep fragmentation that occurs in people with OSA. To assess the degree of EDS, there are several objective tests used such as multiple sleep latency test (MSLT) or maintenance wakeful test (MWT). These tests are quite expensive and take a long time. Epworth Sleepiness Scale (ESS) is a simple questionnaire that can be used to assess the degree of sleepiness of person with OSA when in 8 different situations that are part of daily life activities.[5]

The effects of sleepiness can also be caused by LFWBV. Research conducted by Utami et al showed results that exposure to low-frequency vertical WBV using specially designed beds led to comfort and sleep with faster onset.[6,7]

This study aims to determine whether people at high risk of experiencing OSA based on the results of SS are associated with the incidence of EDS based on scores from ESS and KSS after exposure to LFWBV using a specially designed bed.

MATERIALS AND METHODS

This study uses a one group pretest-post test design where the subject is first checked for weight, height, neck circumference, vital signs, and then look for SS, ESS and KSS values. After that, the subject was exposed to WBV with a frequency of 1 Hz and a displacement of 0.094-0.0397 mm with a vertical vibration direction using a bed that was specially designed and validated by the Vibration Laboratory of the Faculty of Mechanical Engineering, Gajah Mada University. Subjects were then examined for their KSS scores after exposure to the LFVBW.

The target population is all the elderly in the city of Denpasar, Bali. The research sample was taken from a population with non-probability sampling and will be used entirely if it meets the eligibility criteria. Inclusion criteria were all elderly who were registered in the elderly association, agreed to participate in the study by signing the informed consent, and were cooperative. Exclusion criteria were elderly with impaired mobility, or physical/mental/medical disorders that could affect the study, such as paralysis or other neurological deficits, impaired cognitive function making it difficult to understand the meaning of the question, shortness of breath, psychiatric disorders, or other moderate to severe medical illnesses, and not present at the time of data collection research.

The research location was conducted in the Dangin Puri Village area, Denpasar City, Bali. The time of the study was carried out in September 2021. The study was conducted by applying the Health protocol to prevent the transmission of the Covid-19.

Statistical Methods

Statistical analyses were performed using the SPSS software program ver. 20.0. With respect to baseline characteristics of the subjects, continuous data with normal distribution were presented as mean SD. Count Data were tested using chi-square tests. Pearson correlation were used for the bivariate analysis of the association between high risk of OSA with ESS score and high risk of OSA with KSS score post exposure with LFWBV.

RESULTS

From the 22 eligible samples, based on the results of SS, more elderly people were found to have a high risk of suffering from OSA, which was 13 people (59.1%, p value <0.00). ESS examination showed an average normal result, which is 3.95 (2.73%, p value 0.04). There was an increase in the average KSS from before and after exposure with LFWBV, which was 1.32 (0.57%, p value <0.00) and 6.32 (1.55%, p value 0.02)

Table 1. The result of SS, ESS, dan KSS

Variabel	N(%)	Mean score (± SB)
SS • Non high risk OSA • High risk OSA	 9(40.9) 13(59.1)	
ESS		3.95(2.73)
KSS • Before exposure with LFWBV • After exposure with LFWBV		 1.32(0.57) 6.32(1.55)

In the elderly with a high risk of OSA, the number of men and women is almost the same, which was men 6 people and women 7 people. The average BMI of subjects in the high-risk group was still within the normal range, which was 22.63. The average neck circumference of subjects with a high risk of OSA is 34.38 cm. The average ESS score in the high risk of OSA group was higher than the non high risk of OSA group, which was 4.85 and 2.67 (p value 0.003). The average KSS score after exposure to LFWBV in the high risk of OSA group was higher than the non high risk of OSA group, which was 6.69 and 5.78 (p value 0.198).

Table 2. Characteristics of subjects with high risk of OSA based on SS

Variable	High risk of OSA (n = 13)	Non high risk of OSA (n = 9)	P value
Gender			
Men Women	6 7	2 7	P 0.251
BMI (mean)	22.63	21.14	
Neck circumference (mean)	34.38	32.11	
ESS (mean)	4.85 (3.08)	2.67 (1.50)	0.003*
KSS post exposure with LFWBV (mean)	6.69 (1.10)	5.78 (1.98)	0.198

From this study, there was an insignificant association (moderate correlation) between the high risk of OSA based on SS and ESS score (r 0.401, p 0.064). From this study, it was also found that there was an insignificant weak correlation between high risk of OSA based on SS and KSS after exposure to LFWBV (r 0.296, p 0.181).

Table 3. Correlation between high risk of OSA with ESS score and KSS score post exposure with LFWBV

Variable	Analysis		P value
	r	interpretation	
ESS	0.401	Moderate correlation	0.064
KSS post exposure with low frequency WBV	0.296	Weak correlation	0.181

*p < 0.05: statistically significant

DISCUSSION

Epidemiological studies on OSA show that in general the prevalence of OSA is more in men than women. Of the 11 epidemiological studies published from 1993-2013, the prevalence of OSA was more in men (22%) than women (17%).[2] In another study, the prevalence of sleep apnea in men was 3.9% and women was 1.2% with the ratio of sleep apnea in male: female was 3.3: 1 (p 0.0006). The study also found that the prevalence of sleep apnea in

premenopausal women (0.6%) was almost the same as in postmenopausal women receiving hormone replacement therapy (HRT) (0.5%). However, the prevalence of sleep apnea in postmenopausal women who did not receive HRT was significantly higher than that in premenopausal women who received HRT (2.7 and 0.6%, p = 0.02) and was almost the same as the prevalence of sleep apnea in men. (3.9 %).[8] In this study, research subjects with a high risk of OSA were found between men and women were almost the same, namely 6 men and 7 women. The post-menopausal effect causes women to tend to increase their weight so that BMI increases, neck circumference becomes larger, and waist: hip ratio increases.[9] Decreased hormone (progesterone) in postmenopausal women is a contributing factor to sleep apnea because progesterone deficiency affects pharyngeal dilator muscle activity and stabilizes the effect of decreased respiratory drive.[10]

In this study, based on Pearson correlation tests, there are an insignificant relationship between the high risk of OSA based on SS with increased degrees of sleepiness assessed from ESS scores. Subjects with a high risk of OSA based on a SS had an average ESS score of less than 10, but the average score in the high-risk OSA group was higher compared to non high risk of OSA group (p 0.003). In another study that assessed the correlation between ESS and respiratory distress during sleep in men and women, it was found that ESS was not associated with respiratory distress during light and moderate sleep in women and had a smaller association than men in respiratory disorders during heavy sleep.[11] Another study found no significant association between increased ESS scores and sleep apnea based on apnea-hypopnea-index (AHI) scores ≥ 5 per hour from polysomnography. As many as 82% of patients with OSA complained of EDS, but only 57% had an increased ESS score. ESS sensitivity to predicting sleep apnea is said to be weak (57.7%).[12] This is likely because ESS assessment is subjective, and subjects are asked to imagine degrees of sleepiness in situations that are not necessarily experienced by the subject.

This study found a non-significant correlation between a high risk of OSA (based on SS) and an increase in post-exposure KSS scores with LFWBV. All study subjects, both those who had a high risk of OSA and those who were not at high risk of OSA experienced an increase in KSS scores after exposure LFWBV, but subjects with a high risk of OSA had a higher mean score of 6.69 than those who were not at high risk, which is 5.78. KSS is a scale used to assess a person's assessment where 0 indicates the most alert condition, while a value of 9 indicates the sleepiest condition. Several studies have shown that LFWBV can provide comfort and sleep with a faster onset, and can reduce the Alpha Attenuated Coefficient (AAC) which indicates a decrease in the level of wakefulness.[6,7]

OSA is caused by obstruction of the airway, either partial or total, resulting in repeated episodes of apnea and hypopnea during sleep. Increasing age, especially in the elderly, causes an increased risk of OSA due to physiological changes in pharyngeal muscle function. The most common symptom of OSA is EDS. The risk of developing OSA can be assessed subjectively using a SS, and EDS can be assessed using an increased score from the ESS, and KSS following LFWBV exposure. LFWBV is said to provide comfort and sleep with a faster onset, as well as lowering AAC which indicates a decreased level of wakefulness.

CONCLUSION

In this study, it was found that most of the elderly have a high risk of OSA. However, there was an insignificant relationship between the high risk of OSA based on SS and the increasing degree of sleepiness assessed from the ESS, although the group with high risk of OSA had a higher ESS score than the group not at risk of OSA. This study also found a non-significant relationship between high risk of

OSA and increased post-exposure KSS scores with LFWBV, although the group with high risk of OSA had higher KSS scores than the group without OSA risk.

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