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Additive Effect of Oropharyngeal Exercises with Aerobic Training on Sleep Quality in Individuals with High Risk of Obstructive Sleep Apnea

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1. Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is a common form of sleep disorders characterized by repetitive complete and/or partial episodes of upper airway obstruction during sleep. [1] The prevalence of snoring around the world varies widely from 15 to 54%. The most common risk factors for OSA includes obesity, poor physical fitness, cigarette smoking and use of alcohol.[4] There is repetitive upper airway closing and opening during sleep. It results in vibrations of the upper airway, recurrent episodes of hypoxemia and hypercapnea which causes micro arousals during sleep. This increases the sympathetic tone resulting in systemic hypertension and modest pulmonary hypertension. [2, 3]Due to repetitive micro arousals during sleep there is excessive daytime sleepiness, fatigue, irritability which leads to increased risk of motor vehicle accidents, depression, deteriorated quality of life, and increased health care costs. [2, 6] The most commonly accepted interventions in the treatment of OSA include administration of continuous positive airway pressure (CPAP), which has associated device related complications like mask discomfort, rejection of partner, and cutaneous allergies which lead to low compliance of the patients to CPAP.[1, 6] Various surgical procedures like septoplasty, tonsillectomy, uvulopalatopharyngoplasty, and tongue base reductions do provide benefits in OSAS but their efficiency is only 40–50 % and symptoms tend to recur after 1–2 years. [2, 6]Non-surgical procedures include appropriate sleeping position, avoiding alcohol and smoking, reducing intake of sedatives, weight reduction, diet modification and exercise.[2,4, 6,]
American Sleep Apnea Association (ASAA) considers exercise as a non-pharmacological treatment modality for sleep disorders. [1] Oropharyngeal exercises are new, non-invasive, cost-effective treatment which acts by correcting the posture adequacy, sensibility, proprioception, tone and mobility of the orofacial and pharyngeal musculature, thereby dilating the upper airways during sleep. [6] It is more physiological and may bring long lasting benefits to the patient. [6] So the study aims to evaluate the effect of aerobic and oropharyngeal exercises on sleep quality in patients who are at high risk of sleep apnea.

2. Methodology

Institutional ethical committee approval was obtained and participants were screened for the inclusion and exclusion criteria. 60 participants both males and females were included in the study who could understand English and were at high risk of Obstructive sleep apnea on Berlins questionnaire .patients were excluded if diagnosed to have any psychiatric or psychological illness, craniofacial malformations, nasal congestion, and throat infection or on sedatives, having recent cardiovascular or neurological conditions.Informed written consent from the participants was taken, they were randomly allocated to Group A (Oropharyngeal exercise and Aerobic training) and Group B (Aerobic training)

Group A received Oropharyngeal exercise along with Aerobic training. Exercises were performed under supervision for 5 days per week for 6 weeks.

Oropharngeal Exercises

1) SOFT PALATE: - Participants were asked to say the alphabet “A” intermittently 20 times x 2 sets, and then continuously: - 10 seconds hold x 3sets.
2) TONGUE: - a. Brushing the superior and lateral aspect of the tongue with toothbrush gently, 5 times each movement, twice daily. b. Placing the tip of tongue behind the upper anterior incisive teeth and sliding it backwards against the hard palate, 20 times x 2 set. c. Forced tongue suction movement on the hard palate, and pressing the entire tongue against the hard palate, 20 times x 2 set.d. Placing the tip of tongue behind the lower incisive teeth, forcing the back of tongue on the floor of mouth, 20 times x 2 sets
3) FACIAL: - a. Participants was asked to purse lips with pressure and hold for 10 seconds x 3 sets. b.Suction movement of cheek, was performed by placing sterile finger on the inner aspect of cheek pushing the cheek outwards - 10 seconds hold x 3 set. c. Elevation of the angle mouth with pressure i.e. Smiling: - 10 seconds hold 3 set. d.Lateral jaw movements with alternating elevation of angle of mouth: - 20 times

Aerobic training: participants were told to walk according to the Rate of perceived exertion (RPE). Participants performed 5 mins of warm up including of Active exercises of neck, shoulder, elbow, wrist, hip, knee, and ankle :- 6-8 reps of each movement which was followed by brisk walking. Later, cool down exercises was given for 5 mins including hamstrings, rectus femoris, calf stretching, trunk side stretching for 15 sec hold x 3 set. Initial 2 weeks, participants performed 20 mins of brisk walking at RPE of 8-11 (i.e. extremely light to light). For the next 2 weeks,

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participants performed 30 mins of brisk walking at RPE of 11-13 (i.e. light to somewhat hard).Following 2 weeks, participants performed 30 mins of brisk walking at RPE of 13 (i.e. somewhat hard).

Group B performed Aerobic training i.e. brisk walking for 5 days per week for 6 weeks in same manner as the group A participants. No uneventful episode was recorded.

3. Results

SPSS statistics 20.0 was used to evaluate the data. Intragroup analysis was done using Paired t test and Intergroup analysis was done using Mann Whitney u test.

Table 1: Intragroup analysis of group A and Group B after 6 weeks of intervention

Variables	Group A			Group B		
	Mean		P value	Mean		P value
	Pre	Post		Pre	Post	
PSQI	9.20	7.70	<0.001	8.70	8.03	<0.001
BMI	28.89	28.53	0.002	27.75	27.53	0.016
NC	14.13	13.98	<0.001	14.48	14.49	0.326

There was significant improvement seen inPittsburgh **Sleep Quality Index** (**PSQI**), Body Mass Index and neck circumference (NC) in group A post six weeks of intervention. Whereas in Group B significant improvement is seen only in PSQI value and BMI $p<0.05$.

Table 2: Intergroup analysis between both the groups using MAN -WHITNEY U test

Variables	Mean Difference		P Value
	Group		
PSQI	A	1.5000	<0.001
	B	0.6667	
BMI	A	0.3580	0.317
	B	0.2163	
NC	A	0.1400	<0.001
	B	-0.0067	

Both the groups were comparable at baseline. There was significant improvement seen in group A in PSQI value and neck circumference $p<0.05$

4. Discussion

People with OSA have impaired sleep quality as compared with normal population due to repeated arousals during sleep which also results in day time sleepiness. [5, 11] Long-term exercise may be responsible for positive effects on sleep architecture, particularly in increasing slow-wave sleep, with a decrease in ApneaHypoapneaIndex as a consequence. Paul and Terry et al suggested that the involvement of the pharyngeal and glossal muscles during exercise might have training effect which helps them to maintain the patency of these muscles during periods of nocturnal airway obstruction. [7]

Studies have shown that regular physical activity reduced OSA symptoms either due to increased muscle tone of the upper airway or due to positive effects on the breathing efficiency. [1]

There were significant differences observed in BMI scores post intervention in both the groups. Exercise stimulates an enzyme, hormone sensitive lipase, to dissolve the lipid or triglyceride molecule into fatty acids and glycerol molecule the process known as lipolysis. There is negative energy balance created through regular exercise contributing towards reduction of total body fat.[15] However there was no difference seen when both the groups were compared. Recent studies have proved that the positive effects of exercise on the individual with OSA is possibly due to the rise in the respiratory drive and increased muscle tone of the upper airway independent of the body weight reduction. [5]

Kline and co-authors suggested that, there is leg fluid accumulation which is reduced due to exercises which preventaccumulation of nocturnal rostral fluid and help in decreasing theupper airway collapsibility during sleep. [5]

There was significant reduction in the neck circumference of the participants in the Experimental group post intervention as they were given oropharyngeal exercises in conjunction with Aerobic training for 6 weeks. The Oropharyngeal exercises given to the patientswere simple consisting of Isometric and Isotonic exercises for the tongue, soft palate, and facial muscles.As the patients with OSA may have enlarged tonsils, floppy soft palate and uvula, enlarged tongue, and inferior displacement of the hyoid bone.These exercises recruits muscle fibres of tensor and levator veli palatine, palatopharyngeal and palatoglossal muscles. [12]

Reduction in the neck circumference post intervention suggests that there has been upper airway remodelling induced by these exercises this lead to reduce upper airway collapsibility due to increased muscle tone. [12, 13] So the study suggest that along with giving the CPAP and pharmacological treatment, oropharyngeal exercise be considered as the part of treatment for patients at high risk of obstructive sleep apnea.

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7. Conflict of Interest

The Authors declare that there is no conflict of interest

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