ORIGINAL RESEARCH

Submitted: 27.01.2023; Accepted: 15.02.2023; Published online: 25.02.2023

# Oropharyngeal Exercises on Snoring, Daytime Sleepiness and Anthropometric Measurement Among Adults with Obstructive Sleep Apnea

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## ABSTRACT

**Introduction:** Obstructive sleep apnea (OSA) is the most common sleep-related breathing disorder. Untreated OSA is associated with potential long-term adverse health consequences. Oropharyngeal exercise is one of the treatment modalities to manage the symptoms of OSA. Hence, the current study was conducted to evaluate the effectiveness of oropharyngeal exercises on snoring, daytime sleepiness, and the selected anthropometric measurement among adults with obstructive sleep apnea. **Methods:** Quasi-experimental research design was adopted to conduct the study with 60 samples that met the inclusion criteria at Saveetha Medical College and Hospital. Samples were selected by convenience sampling technique and were assigned to the experimental group (n=30) and the control group (n=30). Samples were determined using the Berlin questionnaire, and the pre-test assessment was done by using the snoring sleepiness scale (SSS), Epworth sleepiness scale (ESS), and anthropometric measurements for both groups. The experimental group received the oropharyngeal exercise twice daily for 15 days. The control group received the day-to-day practices. The post-test assessment was done using the same tool at the end of 15 days for both groups. **Results:** There was a statistically significant change in snoring, daytime sleepiness, BMI, and neck and waist circumference between pre and post-intervention within the experimental group and post-intervention between the experimental and control group at the level of P<0.001.**Conclusion:** The present study›s findings conclude that oropharyngeal exercise effectively reduces snoring, daytime sleepiness, and associated factors of BMI and neck and waist circumference among adults with complaints of obstructive sleep apnea. Moreover, this exercise is cost-effective, time-consuming, easy to administer, and has no side effects.

## Keywords

Anthropometric measurements, BMI, Daytime sleepiness, Neck circumference, Oropharyngeal exercise, Snoring, Waist circumference

## Imprint

Sabitha R., Thenmozhi P., KalaBarathi S. Oropharyngeal Exercises on Snoring, Daytime Sleepiness and Anthropometric Measurement Among Adults with Obstructive Sleep Apnea. Cardiometry; Issue No. 26; February 2023; p. 747-753; DOI: 10.18137/cardiometry.2023.26.747753; Available from: http://www.cardiometry.net/issues/no26-february-2023/oropharyngeal-exercises-snoring

## Introduction

Obstructive sleep apnea (OSA) is the most common sleep-related breathing disorder. It is caused by repetitive collapse of the upper airway during sleep and manifested as obstructive apneas, hypopneas, and respiratory effort-related arousals. Older males are the most common group affected by OSA, but it can also affect females and children [1]. It is estimated worldwide that 936 million adults, including males and females aged 30-69 years, have mild to severe OSA, and 425 million adults between the age group of 30-69 years have moderate to severe OSA [2]. The prevalence of OSA increases from young adulthood to older adulthood, with males more common two to three times more than females; nevertheless, the risk appears to be similar among peri- and postmenopausal women. [3-7]. The risk factors connected with OSA are the body mass index (BMI) [8, 9], Craniofacial or upper airway abnormalities, nasal congestion [9], Smoking [10], genetic predisposition of craniofacial structure [11], neck size or waist circumference is more strongly correlated with OSA than general obesity [12]. Untreated OSA is associated with potential long-term adverse health consequences, including cardiovascular disease [13, 14], metabolic disorders

[15], cognitive impairment [16], depression [17]; and Common symptoms include excessive daytime sleepiness, fatigue, non-refreshing sleep, nocturia, morning headache, irritability, and memory loss [18, 19]. The management of OSA aims to alleviate the signs and symptoms, normalize the apnea-hypopnea index, and improve sleep quality and oxyhemoglobin saturation levels. The treatment modalities of OSA include behavior modification, sleep position, weight reduction, positive airway pressure, and concomitant medications, intra-oral appliances [20]. Recent studies have demonstrated that training the upper airway muscles can ameliorate moderate OSA and be effective in mitigating several harmful consequences of OSA [21, 22]. It also proved that mouth and throat exercises could help to increase the muscle tone around the airway. These exercises are called myofunctional therapy or oropharyngeal exercises. The muscles of the pharyngeal wall, tongue, and soft palate are the main structures involved in these exercises, and they are responsible for chewing, speech, breathing, and swallowing. The effects of oropharyngeal exercise are increased upper airway muscle activation to increase upper airway diameter, reduced airway resistance, and opposed pharyngeal collapse during sleep. Oropharyngeal exercises help improve the genioglossus and pharyngeal musculatures as they are essential in maintaining upper airway patency [23]. It may decrease the upper airway edema and collapsibility, improve tongue position and overcome the harmful action of a long floppy soft palate and uvula. It also increases facial muscles' contractility to elevate the mandible and hyoid bone to avoid mouth opening [24, 25]. After reviewing the related literature, the study was focused on the hypothesis of significant changes in snoring, daytime sleepiness, and anthropometric measurement after administering oropharyngeal exercise among adults with obstructive sleep apnea.

## Material and Methods

A quasi-experimental research study was conducted at Saveetha Medical College and Hospital after obtaining formal permission from the hospital authority. The Institutional Ethical Committee of Health Sciences approved the study ethically under the Saveetha Institute of Medical and Technical Sciences. A total of 60 samples were selected by convenience sampling and assigned to the experimental group (n=30) and control group (n=30). The sample size was estimated by power analysis with 95% of confidence and 80% power of the study. The inclusion criteria were adults between 20-59 years of age, both male and female having >2 positive responses under the Berlin questionnaire, complaints of snoring, daytime sleepiness, obesity, and with co-morbid conditions of hypertension and hyperlipidemia. Adults with craniofacial malformation, physical obstruction in the nose or throat, abnormally large tonsils, mouth ulcers, and uncorrected deviated septum were excluded from the study. The investigators explained the purpose of the study to the participants in their regional language and clarified their doubts. Informed consent was obtained from the participants after assuring confidentiality. Demographic and clinical variables were collected using a structured questionnaire in the interview method. Pre-test assessment on snoring, daytime sleepiness, and anthropometric measurements was assessed. Snoring and daytime sleepiness were assessed by using the snoring severity scale (SSS) and Epworth sleepiness scale (ESS). Anthropometric measurements such as height, weight, neck circumference, and waist circumference. Participants in the experimental group received oropharyngeal exercise twice daily for 15 days with the help of video clips after the demonstration by the investigators. The duration of exercise in each session was 20 minutes. The sequential step of the exercise was to push the tip of the tongue against the hard palate and slide the tongue backward (20 times), suck the entire tongue up against the palate (20 times), force the back of the tongue against the floor of the mouth while touching the tip of the tongue to the bottom incisors (20 times), elevation soft palate and uvula while intermittently saying "A" (20 times), place finger in the mouth while pressing buccinator muscle outward (10 times per side), chew and deglutinate on both sides of mouth whenever eating. The control group received routine day-to-day practice. Post-test was conducted at the end of 15 days of intervention for both groups using the same tool. The ethical principles were adhered to protect the participants' rights and maintain confidentiality throughout the study. The data were analyzed by descriptive and inferential statistical methods using SPSS statistical package, and the probability of 0.05 or less was taken as statistically significant.

## Results:

Table 1 shows that most of the adults with obstructive sleep apnea 11 (36.7%) in the experimental group

were in the age group of 20 – 30, 18 (60%) were male, and 10(33.4%) had completed the schooling till primary education. 16(53.4%) were self-employed and 17(56.7%) were doing the moderate activity in both experimental and control group

Table 1

Description of demographic variables:

| Demographic Variables | Experimental Group | | Control group | |
|---|---|---|---|---|
| | No | % | No | % |
| Age in years | | | | |
| 20 – 30 years | 11 | 36.7 | 7 | 23.3 |
| 31 – 40 years | 7 | 23.3 | 8 | 26.7 |
| 41 – 50 years | 9 | 30.0 | 11 | 36.7 |
| 51 – 59 years | 3 | 10.0 | 4 | 13.3 |
| Sex | | | | |
| Male | 18 | 60.0 | 19 | 63.3 |
| Female | 12 | 40.0 | 11 | 36.7 |
| Education | | | | |
| No formal education | 4 | 13.3 | 6 | 20.0 |
| Primary education | 10 | 33.4 | 12 | 40.0 |
| High school | 7 | 23.3 | 7 | 23.3 |
| Graduate | 9 | 30.0 | 5 | 16.7 |
| Occupation | | | | |
| Agriculture | 7 | 23.3 | 8 | 26.7 |
| Self-employed | 16 | 53.4 | 15 | 50.0 |
| Unemployed | 1 | 3.3 | 3 | 10.0 |
| Govt. employee | 6 | 20.0 | 4 | 13.3 |
| Residence | | | | |
| Rural | 17 | 56.7 | 18 | 60.0 |
| Urban | 12 | 40.0 | 10 | 33.3 |
| Semi urban | 1 | 3.3 | 2 | 6.7 |
| Activity | | | | |
| Sedentary | 4 | 13.3 | 7 | 23.3 |
| Moderate | 17 | 56.7 | 17 | 56.7 |
| Heavy | 9 | 30.0 | 6 | 20.0 |

In the experimental group, 20 (66.7%) had sleep apnea, 16 (53.4%) had sleep disorder for less than one year, 14 (46.6%) had slept at night time for 4 – 6 hours, 18 (60%) had slept 2 – 3 hours in day time, 22(73.4%) had the complaints snoring loudly at night, 20(66.7%) suddenly falling as sleep, and 18(60%) had hypertension. Whereas in Control group, 19 (63.4%) had sleep apnea, 16(53.4%) had 2-3 hours of sleep at day time, 18(60%) had suddenly falling asleep, and 15(50%) had hypertension as depicted in Table 2.

Table 2

Description of Clinical Variables

| Demographic variables | Experimental Group | | Control group | |
|---|---|---|---|---|
| | No | % | No | % |
| Sleep disturbances | | | | |
| Sleep apnea | 20 | 66.7 | 19 | 63.4 |
| Hypersomnia with sleep apnea | 3 | 10.0 | 1 | 3.3 |
| Insomnia | 7 | 23.3 | 10 | 33.3 |
| Duration of sleep disorder | | | | |
| <1 year | 16 | 53.4 | 11 | 36.7 |
| 2 to 4 years | 13 | 43.3 | 18 | 60.0 |
| >5 years | 1 | 3.3 | 1 | 3.3 |
| Duration of sleep at night time | | | | |
| 2 – 3 hours | 8 | 26.7 | 6 | 20.0 |
| 4 – 6 hours | 14 | 46.6 | 12 | 40.0 |
| Above 6 hours | 8 | 26.7 | 12 | 40.0 |
| Duration of sleep at day time | | | | |
| 2 – 3 hours | 18 | 60.0 | 16 | 53.4 |
| 4 – 6 hours | 11 | 36.7 | 13 | 43.3 |
| Above 6 hours | 1 | 3.3 | 1 | 3.3 |
| Symptoms at night | | | | |
| Snoring loudly | 22 | 73.4 | 18 | 60.0 |
| Walking up frequently to urinate | 4 | 13.3 | 9 | 30.0 |
| Walking up in the morning with a headache | 4 | 13.3 | 3 | 10.0 |
| Sleepiness | | | | |
| Suddenly falling asleep | 20 | 66.7 | 18 | 60.0 |
| Falling as sleep at appropriate times or places | 7 | 23.3 | 7 | 23.3 |
| Fighting to stay wake during the day. | 3 | 10.0 | 5 | 16.7 |
| Co-morbid condition | | | | |
| Hypertension | 18 | 60.0 | 15 | 50.0 |
| Hyper lipidemia | 2 | 6.7 | 4 | 13.3 |
| Other condition | 10 | 33.3 | 11 | 36.7 |

Table 3 shows that in the pre-test of the experimental group, 20 (66.7%) had very intense snoring, 8 (26.6%) snoring made the partner leaves the room and 2 (6.7%) had high snoring. Whereas in the post-test, after the oropharyngeal exercise 27 (90%) had high snoring and 3 (10%) had mild snoring. In the pre-test of the control group, 5 (50%) snoring made the partner leaves the room, 13 (43.3%) had very intense snoring and 2 (6.7%) had high snoring whereas, in the post-test, 18(60%) had very intense snoring, 8(26.7%) on snoring made the partner leaves the room and 4(13.3%) had high snoring.

Table 3

Pre-test and Post-test level of snoring in the experimental and control group.

| Level of Snoring | Experimental Group | | | | Control Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Pre-test | | Post Test | | Pretest | | Post Test | |
| | F | % | F | % | F | % | F | % |
| Mild snoring (1 – 3) | 0 | 0 | 3 | 10.0 | 0 | 0 | 0 | 0 |
| High snoring (4 – 6) | 2 | 6.7 | 27 | 90.0 | 2 | 6.7 | 4 | 13.3 |
| Very intense (7 – 8) | 20 | 66.7 | 0 | 0 | 13 | 43.3 | 18 | 60.0 |
| The partner leaves the room (9) | 8 | 26.6 | 0 | 0 | 15 | 50.0 | 8 | 26.7 |

Table 4 shows that in the prettiest of the experimental group, 30 (100%) had abnormal daytime sleepiness whereas in the post-test, after the oropharyngeal exercise, 16 (53.4%) had borderline daytime sleepiness, 13 (43.3%) had normal daytime sleepiness and 1 (3.3%) had abnormal daytime sleepiness. On the pretest and posttest of the control group, all 30 (100%) had abnormal daytime sleepiness

Table 4

Pre-test and post-test daytime sleepiness in the experimental and control group.

| Level of Day Time Sleepiness | Experimental Group | | | | Control Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Pretest | | Post Test | | Pretest | | Post Test | |
| | F | % | F | % | F | % | F | % |
| Normal (0 – 9) | 0 | 0 | 13 | 43.3 | 0 | 0 | 0 | 0 |
| Borderline (10 – 11) | 0 | 0 | 16 | 53.4 | 0 | 0 | 0 | 0 |
| Abnormal (12 – 24) | 30 | 100.0 | 1 | 3.3 | 30 | 100.0 | 30 | 100.0 |

Table 5 shows that in the prettiest of the experimental group, 13 (43.4%) had normal BMI, 10 (33.3%) were overweight and 7 (23.3%) were obese whereas, in the post-test, 30 (100%) were obese. On the pretest and posttest of the control group, 13 (43.4%) had normal BMI, 10 (33.3%) were overweight and 7 (23.3%) were obese. In the pretest of waist circumference in the experimental group, 19 (63.3%) had an average, 7 (23.3%) were obese and 4 (13.3%) were normal waist circumference. In control group 23(76.6%) were in overweight, 7(23.3%) were obese. The neck circumference in experimental 24(80%) was average neck circumference, 4(13.3%) were in increased neck size, and 2(6.6%) were normal neck circumference. In control group 26(86.6%) were average neck circumference, 2(6.6%) were normal and 2(6.6%) were increase in neck size.

Table 5

Description of pretest and post test level of anthropometric measurement (BMI, neck and waist circumference) in experimental and control group.

| Level of BMI ($kg/m^2$) | Experimental Group | | | | Control Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Pre test | | Post Test | | Pretest | | Post Test | |
| | F | % | F | % | F | % | F | % |
| Normal (18.5 – 24.9) | 13 | 43.4 | 0 | 0 | 13 | 43.4 | 13 | 43.4 |
| Overweight (25 – 29.9) | 10 | 33.3 | 0 | 0 | 10 | 33.3 | 10 | 33.3 |
| Obese (30) | 7 | 23.3 | 30 | 100 | 7 | 23.3 | 7 | 23.3 |
| Level of Waist circumference (cm) | | | | | | | | |
| Normal (64 – 94) | 4 | 13.3 | 3 | 10 | 0 | 0 | 1 | 3.33 |
| Overweight (94 – 102) | 19 | 63.3 | 27 | 90 | 23 | 76.6 | 29 | 96 |
| Obese (>102) | 7 | 23.3 | 0 | 0 | 7 | 23.3 | 0 | 0 |
| Level of neck circumference(cm) | | | | | | | | |
| Normal (32.35cm) | 0 | 0 | 0 | 0 | 2 | 6.6 | 2 | 6.6 |
| Average (35-48.3 cm) | 6 | 20 | 19 | 63.3 | 24 | 80 | 26 | 86.6 |
| increase neck size(>50cm) | 24 | 80 | 21 | 70 | 4 | 13.3 | 2 | 6.6 |

Table 6 shows that in the experimental group, the pre-test mean score of snoring was 7.97±0.85 and the post-test mean score was 4.53±0.82.The mean difference score was 3.43.The calculated paired 't-test value of t=18.082 was found to be statistically significant at p<0.001 level. The pre-test mean score of daytime sleepiness was 18.93±3.33 and the post-test mean score was 8.93±2.27.The mean difference score was 10.0.The calculated paired 't-test value of t=15.677 was found to be statistically significant at p<0.001 level. This clearly shows that there was a significant reduction in the level of daytime sleepiness after the administration of oropharyngeal exercise among the adults with obstructive sleep apnea.

The Table 7 shows that in the experimental group the pre-test mean score of BMI, Neck Circumference and Waist Circumference was compared with post-test mean score by paired t test. The calculated paired 't' test value of BMI, Neck Circumference and Waist Circumference was t=26.899, t=37.558, t=20.792 respectivelywhich found to be statistically significant at

Table 6

Within group analysis of snoring, daytime sleepiness in the experimental group.

| Variables | Experimental Group | | | | Mean difference score | Paired t-test & p-value |
|---|---|---|---|---|---|---|
| | Pre-test | | Post test | | | |
| | Mean | SD | Mean | SD | | |
| Snoring | 7.97 | 0.85 | 4.53 | 0.82 | 3.43 | t = 18.082 p = 0.0001 S= Significant |
| Daytime sleepiness | 18.93 | 3.33 | 8.93 | 2.27 | 0.44 | t = 15.677 p = 0.0001 S =Significant |

Table 7

Within group analysis ofanthropometric measurement (BMI, neck circumference, waist circumference) in experimental group.

| Anthropometric measurement | Experimental group | | | | Mean difference score | Paired t-test & p-value |
|---|---|---|---|---|---|---|
| | Pre-test | | Post test | | | |
| | Mean | SD | Mean | SD | | |
| BMI | 25.87 | 5.47 | 55.10 | 7.78 | 29.23 | t=26.899 p=0.0001 S*** |
| Neck circumference | 93.50 | 9.26 | 26.91 | 4.61 | 66.59 | t=37.558 p=0.0001, S*** |
| Waist circumference | 54.01 | 6.72 | 89.41 | 8.32 | 35.40 | t=20.792 p=0.0001 S*** |

S*** – Significant

p<0.001 level. It clearly shows that there was significant improvement in the level of BMI, Neck Circumference and Waist Circumference after the administration of oropharyngeal exercise.

The experimental group post-test level of level of snoring, daytime sleepiness and anthropometric measurement was compared with control group post-test level by independent test. The calculated student independent 't' test value ofsnoring, daytime sleepiness, BMI, neck circumference and waist circumference was t = 14.103, t = 15.833, t=17.625, t=35.491 and t=18.243 respectively. It clearly infers that there is a significant improvement in the selected variables of the experimental group than the control group.

## Discussion:

Obstructive sleep apnea (OSA) is a recurrent bout of partial and total airway blockages during sleep and repetitive apneas and hypopneas. Healthcare professionals' main challenge is screening the OSA, as most

Table 8

Between group analysis of snoring, daytime sleepiness and anthropometric measurement between theexperimental and control group.

| Variables | Experimental group | | Control group | | Mean difference score | Student independent 't' test & p-value |
|---|---|---|---|---|---|---|
| | Post-test | | Post-test | | | |
| | Mean | SD | Mean | SD | | |
| Snoring | 4.53 | 0.82 | 7.83 | 0.99 | 3.30 | t = 14.103 p= 0.0001 S*** |
| Daytime sleepiness | 8.93 | 2.27 | 18.37 | 2.34 | 9.44 | t = 15.833 p = 0.0001 S*** |
| BMI | 55.10 | 7.78 | 25.67 | 4.81 | 29.43 | t=17.625 p=0.0001 S*** |
| Neck circumference | 26.91 | 4.61 | 93.47 | 9.18 | 66.56 | t=35.491 p=0.0001 S*** |
| Waist circumference | 89.41 | 8.32 | 54.96 | 6.14 | 34.45 | t=18.243 p=0.0001 S*** |

S*** – Significant

patients frequently fail to recognize the symptoms. The underlying Pathology of OSA is multifactorial, and anatomical and physiological factors affect it [26]. OSA treatment aims to restore optimal breathing, especially during nighttime, and decrease complications [27]. Myofunctional therapy includes functional exercises of respiratory, swallowing, and chewing to improve tonus and mobility of oral and cervical structures [28]. In the present study, most participants had sleep apnea with complaints of snoring loudly, suddenly falling asleep, and with comorbidity of hypertension. In the pre-test, more than 80% had intense snoring and borderline to abnormal daytime sleepiness. Therefore, the current study intensively analyzed to determine the effectiveness of oropharyngeal exercise on snoring, daytime sleepiness, and the anthropometric measurement and found significant changes in the level of snoring, daytime sleepiness, BMI, neck, and waist circumference. These findings are supported by the study conducted by Jaspreet Kaur et al., who concluded that oropharyngeal exercises are effective in reducing daytime sleepiness, snoring, and the risk of obstructive sleep apnea among adults having to snore [29]. Vanessa Ieto et al. also found that oropharyngeal exercises effectively reduce snoring when measured objectively [30]. Similarly, Kátia C Guimarães et al. reported that Oropharyngeal exercises significantly

reduce OSAS severity and symptoms and represent a promising treatment for moderate OSAS [22]. Another study by NurelBellur et al. was conducted on the effects of oropharyngeal exercises on anthropometric measures and symptoms in patients with obstructive sleep apnea syndrome. And found that oropharyngeal exercises significantly reduce symptoms associated with OSA and anthropometric neck circumference measurements, but there are no changes in the body mass index and abdominal circumference [31]. But in the present study, there were significant changes in BMI and waist circumference. Ahmed Sh. Mohamed et al. revealed that upper airway exercises are effective in improving AHI, O2 saturation, and snoring and also concluded that this exercise can be a novel, easy, non-invasive technique to treat OSAS patients, mainly moderate type [32]. A study by Roshan K Verma et al. proved that graded oropharyngeal exercise therapy increases compliance and significantly improves sleep indices like minimum oxygen saturation, time duration of Sao2 < 90 %, sleep efficiency, arousal index, and total sleep time N3 stage of sleep at the end of the study [33]. EsraAtilgan et al. examined the oropharyngeal exercises on sleep quality, general health, and functional capacity. They found them to improve in all parameters among patients with OSA [34]. José-Ramón Rueda et al. also demonstrated that myofunctional therapy on daytime sleepiness might increase sleep quality and found improvement in both within the short term [35]. Many previous studies strongly support the current research; however, the present study lacks in measuring the sleep quality and associated parameters like arousal index, total sleep time, stages of sleep, and the vital parameters of oxygen saturation and polysomnography. Hence, the current study recommends further measuring the parameters, such as sleep quality, symptoms of OSA, and polysomnography, to design and strengthen the protocol for the management of OSA.

## Conclusion:

The present study's findings conclude that oropharyngeal exercise effectively reduces snoring, daytime sleepiness, and associated factors of BMI and neck and waist circumference among adults with complaints of obstructive sleep apnea. Moreover, this exercise is cost-effective, time-consuming, easy to administer, and has no side effects. Nurses may incorporate oropharyngeal exercise as a promising adjuvant therapy for patients with obstructive sleep apnea, thereby preventing the sequelae of obstructive sleep apnea.


## Acknowledgment

Authors would like to appreciate and thank all the participants who actively participated in the study and extend their cooperation to compete the study successfully.


## Conflict of Interest

Authors declare no conflict of Interest.


## Funding

Self-funded


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