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Effects of physical therapy with multilevel upper airway exercise for moderate and severe obstructive sleep apnea- A preliminary randomized controlled trial

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Abstract

Background: Obstructive apnea (OSA) is characterized with complete or partial obstruction of upper airway during sleep. Critically compromised by upper airway anatomical impaired properties, oropharyngeal muscle dysfunction is recognized as one of the primary phenotypic traits. The upper airway exercise was targeted on oropharyngeal muscle dysfunction by re-educating and re-shaping the oropharyngeal muscles to maintain the upper airway patency. Although OSA was thought as multilevel collapsibility of the upper airway, it still lacked clinical evidence to prove an effective model of upper airway exercise. Therefore, the purpose of this study was to exam the clinical effects of physical therapy with multilevel upper airway exercise for moderate and severe OSA.

Methods: Fifteen subjects with newly diagnosed moderate or severe OSA (AHI≥15) were randomized into intervention group and control group. The intervention group (N=8) underwent a 12-week-intervention of hospital based rehabilitation program, while the control group (N=7) was kept on waiting for 12 weeks. The multilevel upper airway exercise comprised retropalatal, retroglossal, hypopharynegal, facial and TMJ levels. The primary outcome was Polysomnography (PSG) data, including apnea-hypopnea index (AHI), arousal index, mean SpO2, and oxygen desaturation index (ODI). Additionally, the secondary outcome was oropharyngeal and respiratory muscle function.

Obstructive sleep apnea (OSA) is a prevalent sleep disorder, affecting up to 15% of the population. If left untreated, OSA has potentially severe health consequences, like cognitive impairment, disorder, diabetes, and early mortality.

Unfortunately, treatment options for OSA remain limited. Although continuous positive airway pressure (CPAP) is effective when used, much of its benefits go unrealized in practice because of low adherence. Other treatment options, like oral appliances and upper airway surgery, only partially reduce OSA severity and produce frequent side effects. In addition, the consequences of those treatments on the health consequences of OSA aren't well established.

The possible utility of exercise training within the management of OSA has not been thoroughly investigated despite intriguing preliminary evidence. Epidemiologic research has suggested that individuals who are physically active have a reduced risk of OSA compared to individuals who are less active. Moreover, small-scale (often uncontrolled) experimental studies have found the apnea-hypopnea index (AHI) to be reduced up to 50% following chronic exercise training.

Although weight loss is that the most blatant plausible mediator explaining how exercise may reduce OSA severity, decreases in AHI following exercise training are found to be independent of changes in body weight in the limited epidemiologic and experimental studies that have examined this hypothesis. Other possible mechanisms of improvement in OSA following exercise training include a general strengthening and fatigue resistance of the ventilatory and upper airway dilator muscles, attenuation of respiratory instability from reduced sleep fragmentation, decreased nasal resistance, and prevention of lower-extremity fluid accumulation.

Regardless of whether OSA severity is improved, exercise training may improve sleep in this population. There is a consistent epidemiologic association between exercise and sleep quality, and experimental studies utilizing individuals without OSA have found that chronic exercise training significantly improves sleep. However, experimental research in individuals with OSA has produced conflicting results about changes in objective sleep from exercise training, and subjective sleep quality has not been evaluated.

The primary purpose of this investigation was to look at the efficacy of a 12-week moderate-intensity exercise educational program for reducing the severity of OSA in currently untreated adults. A secondary purpose of the study was to work out whether exercise training improved subjective and objective sleep. Finally, we explored possible mechanisms by which exercise training may reduce OSA severity, namely via changes in weight, respiratory muscle strength, sleep quality, and lung function. Individuals were recruited from local sleep clinics and from the general population via media advertisements. Following an initial phone screen, individuals were mailed additional screening materials, including the Berlin Questionnaire.22 Individuals who were previously diagnosed with OSA or classified as “high risk” for OSA based on the Berlin Questionnaire and otherwise eligible were invited to the laboratory to further review the protocol. At the conclusion of the visit, participants provided written informed consent approved by the Institutional Review Boards of the University of South Carolina and the WJB Dorn VA Medical Center. Participants were then scheduled for one night of laboratory polysomnography (PSG) to further screen for OSA. Individuals with a screening AHI ≥ 15 were enrolled within the study.

Prior to baseline assessment, participants were required to meet with the study team on 2 occasions to become familiar with the research facility, practice study procedures, and view a presentation on OSA (prevalence, pathophysiology, established treatment options). The primary purposes for these “run-in” visits were to educate the participants on OSA and to establish whether the participants were committed to participating in the study.

Individuals who completed the run-in visits were scheduled for 3 baseline assessments, which took place over a 7-10 day period. The assessments were conducted on separate days and consisted of: (1) one night of laboratory PSG; (2) a laboratory assessment, during which body composition, pulmonary function, and respiratory muscle strength were assessed; (3) a physician-supervised graded exercise test to screen for possible adverse responses to exercise. Throughout this era, participants

continuously wore a wrist actigraph to watch sleep reception.

Once baseline assessments were complete, participants were randomized to either a 12-week exercise training or stretching control treatment. Following completion of the intervention, participants completed the same assessments as at baseline following a day without exercise

Results: In intervention group, AHI significantly improved (46.96±19.45 versus 32.78±10.78 events/h, p=0.017); in control group, AHI significantly worsened (35.77±17.49 versus 42.96±17.32 events/h, p=0.043). While the control group remained no change after intervention, the intervention group demonstrated other PSG outcomes significantly improvement, including arousal index (46.04±18.9 versus 32.98±8.35/h), mean SpO2 (92.88±2.1 versus 94.13±1.46%), ODI (31.13±19.48 versus 20.57±7.83/h). Besides, the intervention group demonstrated significant improvement on oropharyngeal and respiratory muscle function compared to the control group.

Conclusion: This physical therapy with multilevel upper airway exercise can be proven a non-invasive approach with the significant clinical improvement on sleep apnea for moderate and severe OSA.