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ORIGINAL ARTICLE

Impact of Continuous Positive Airway Pressure Therapy on Body Weight in patients with Obstructive Sleep Apnea

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ABSTRACT

Aim: To determine the impact of Continuous Positive Airway Pressure therapy on body weight in Obstructive Sleep Apnea patients and assess the relationship between the weight change and other associated symptoms of Obstructive Sleep Apnea.
Methods: From a Tertiary care Hospital, Karachi we enrolled 184 Obstructive Sleep Apnea patients of both gender with age more than 18 years of whom 92 patients were exposed to Continuous Positive Airway Pressure while 92 patients were not exposed. In a pre-and post-treatment, information on height, weight, Body mass Index, and neck circumference were recorded. Sleep score was evaluated through Epworth Sleepiness Scale.
Results: Results revealed that CPAP effects on weight and BMI. 24% of participants exposed with CPAP gained weight (p=0.03) whereas 72% of participants reduced the weights (p=0.004). The paired t-test showed the mean difference of 3.53±7.5kg (mean±SD, p-value: 0.00). The multivariate analysis showed that CPAP lessens the poor concentration (OR: -4.852; p-value: <0.001), decreases daytime sleepiness (OR: -3.91; p-value: <0.001) and the persons who used dietary plan with CPAP therapy were 6.3 times (p-value: <0.001) more likely to change the weight.
Conclusion: The weight of the patient changes with the treatment of OSA after taking a minimum of six months of CPAP therapy. The frequency of weight change in this study population was directed toward weight loss. Elimination of OSA symptoms is directly linked with weight reduction.
Keywords: Obstructive sleep apnea, Continuous Positive Airway Pressure therapy, Bodyweight.

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a serious public health problem with a variety of negative health effects on patients and a massive burden on health systems (Sullivan, 1981). Obesity is one of the leading causes of obstructive sleep apnea (OSA). The majority of the population with OSA who are recommended for treatment are overweight or obese (Young, 2002).

Sleep is a distinct neurological condition in which the central nervous system is disconnected from external environmental stimuli. Inadequate sleep leads to daytime sleepiness, which can lead to a decreased standard of living, attention problems, morning headaches, energy loss, irritability, and depression (Hussain, 2012, Sep). A subject's general level of sleepiness during the day is an important aspect that should be frequently determined in the assessment of sleeping habits and sleep dysfunctions (Johns M. W., 1992). The Epworth Sleepiness Scale (ESS) is an eight-item self-administered questionnaire that has been proposed as a basic tool for assessing adult daytime sleepiness (Johns M. W., 2010).

Obstructive Sleep Apnea (OSA) is a condition that is accompanied by the persistent events of partial or entire closure of upper airways and leads towards difficulty in breathing while sleeping termed as hypopneas or apneas respectively. It can also cause a drop in blood oxygen saturation (Sánchez, June 2009,). The number of apneas and hypopnea per hour of sleep is measured by the Apnea-Hypopnea Index (AHI) and the respiratory disturbance index (RDI) (Michailidis, 2011).

OSA can induce many impacts on an individual's health such as lack of concentration throughout the day, excessive daytime sleepiness, difficulty in maintaining the mood (Sánchez, June 2009,). Different risk factors like age, gender, and weight affect the severity of OSA (Booth, 2014). Medically it has been shown that OSA is linked with obesity. According to the Wisconsin Sleep Cohort Study, a 10% increase in weight was associated with a 32 % in the Apnoea–Hypopnea Index (AHI) and a sixfold increase in the probability of having moderate to severe Obstructive sleep apnea. On the other hand, a 10% weight loss expected a 26% reduction in the AHI (Peppard, 2000).

OSA individuals have a high level of leptin hormone as compare to BMI-matched controls (Hingorjo, 2012,). High levels in the blood cause a lack of sensitivity to the hormone named Leptin Resistance which causes inadequate leptin effects and fails to reduce hunger and stimulate energy consumption results in weight gain in OSA patients. Leptin resistance and weight gain were due to decreased physical activity from the poor standard of living and the excessive daytime sleepiness. In recent researches, fasting leptin levels in patients with OSA decreased after initiating CPAP therapy (Harsch, 2003).

CPAP is an effective remedy for OSA patients (Drager, 2015) who adhere to CPAP for a minimum of 6 months and 4 hours per night (Johns M. , 2015) . Since the observed results of CPAP are contradictory and of small size, we hypothesized that the commencement of CPAP therapy will turn out the weight changes in the OSA population (Jose M Garcia, 2011).

During the clinical practices, it has been seen that the patients feel comfortable after taking the CPAP therapy and believe that it reduces the OSA. Many health care workers and patients assume that CPAP affects weight reduction which is not scientifically proved.

Hence the study plans to figure out the impacts of CPAP therapy on the weight of patients having OSA in our Pakistani population and illustrate that CPAP decreases the associated symptoms of OSA, improves the standard of living, and their correlation with weight loss in the Sleep lab of Dow University Hospital, Karachi.

MATERIALS AND METHODS

A sample of 184 subjects, 92 were exposed with CPAP while 92 were non-exposed subjects was recruited for this **retrospective cohort study** which was conducted in a Tertiary Care Hospital, Karachi. Participants were included through non-random purposive Sampling after getting written informed consent and the research approval was taken by the ethical review board of the University.

We collected the secondary data of the participants who identified as a patient of obstructive sleep apnea from a sleep lab

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in Karachi and record the patient's height, weight, BMI, neck circumference, and the Epworth Sleepiness Scale from the medical record of a sleep laboratory. In the clinic, Pre and post-CPAP therapy questionnaires were documented, demographic information such as age, gender, height, weight, BMI. Knowledge related to apnea-hypopnea index determines through Polysomnography. The neurocognitive assessment was assessed through Epworth Sleepiness Scale. The questionnaire asks the respondent to score his or her possibility of falling asleep on a scale of 0 to 3 with eight different circumstances that most people experience regularly, but not necessary for every day. A total score of less than 9 is considered normal, while a score of more than 9 shows daytime sleepiness, the possibility of sleep problems, and the need for a PSG for further diagnosis. Weight measurements were done from digital scales, whereas height was measured through a stadiometer.

Frequency, means, standard deviation and percentages were calculated using SPSS statistics 25. Chi-Square test and the Fisher Exact test were performed for categorical variables and an independent-sample t-test was performed for continuous variables. Paired t-test was performed to compare the mean differences (± SD) of weight measurements at baseline and after six months of use of CPAP therapy. Statistical significance was < 0.05. Simple Linear Regression was used to assess the factors associated with weight change after taking the CPAP therapy. Multiple linear regression was used to approximate the relationship between a continuous dependent variable and two or more independent variables was done by backward deletion with a cut-off value of ≤0.2 and the biologically significant variables were included in the multivariate analysis. For the final model, took the cutoff values of ≤ 0.05 for the independent variables.

RESULTS

The mean age of OSA individuals was 51.8±12.2 and the mean height was 164.2±9.6 with no significant dissimilarities in exposed and non-exposed groups. 46% females in exposed group while 62% males in non-exposed group from which 94.6% in exposed and 89% in non-exposed groups were married. The employment status was almost identical among exposed 47(51.1%) and non-exposed 46(50%) respectively. The mean weight was 101.2±18.0, the mean BMI was 38.1 ± 8.9 and the mean neck circumference was 17.0±8.9. The individuals were selected through Apnea-Hypopnea Index (AHI). The mean AHI was 40.3 with SD ± 24.1. The Epworth Sleepiness Score was higher (16.0 ± 4.2) in the exposed than in the non-exposed group (11.6 ± 4.5). The severe Excessive daytime sleepiness was higher (65.2% and 18.5%) in the exposed than in comparison with the non-exposed group. The severity of OSA was higher in the exposed group with 71.7% and 41.3% in the non-exposed group. The frequently reported symptoms in the exposed group were lack of concentration (66.3%), daytime sleepiness (98.9%), snoring (100%), headache (72.8%), choking off the air (97.8%), and restless sleep (87%).

The weight and BMI were reduced to 100.2±16.7 and 37.7±9.2 among the exposed and 95.2±14.5 and 35.4±6.0 among the non-exposed group (P=0.03 and P=0.04) with CPAP therapy after the usage of minimum period of six months. The results of associated sleep parameters (Figure-1) were significantly reduced after taking the CPAP therapy. The lack of concentration was 10.9% and 29.3% among exposed than compare to non-exposed (p=0.00). Similarly, daytime sleepiness was 28.3% and 59.8% (p=0.00), mood disturbance was 9.8% and 27.2% (p=0.00), snoring 12.0% and 79.3% (p=0.014), headache 34.8% and 42.4% (p=0.00), restless sleep 13% and 53.3% (p=0.00), Nocturia 3.3% and 23% (p=0.002) among exposed than compare to the non-exposed group. Therefore, the results are statistically significant at a 5% significant level and hence conclude that there is an association between the weight change and the CPAP therapy in the OSA population.

At the baseline, the frequency of Severe excessive daytime sleepiness was 65.2% and it was reduced to 3.3% after adherence with CPAP therapy in the mean use of 15.8 months. The Daytime Sleepiness was also improved from ESS 16.0 to 4.9 in the exposed group.

Table-1 shows the weight changes in exposed and non-exposed groups. Weight gained in 22(24%) and 36 (39%), weight reduced in 66(72%) and 49(53%), and no change in weight was reported in 4(4%) and 7 (8%) among the exposed group as compared to the non-exposed group and the significant value is 0.035. The p-value of weight gain is 0.03 and the weight reduction is 0.004 in exposed and non-exposed groups.

The mean difference of weight is 3.53±7.5, BMI is 1.52±4.9 and the neck circumference is 0.29±0.06 with 95% confident. The mean difference of Epworth Sleepiness score is 6.96±7.7 with 95% confidence that the population means difference is between 5.56 and 7.82.

Since the BMI and the neck circumference are highly correlated with the weight change, therefore in the final model, after the adjustment of other variables, the variables that were selected are lack of concentration, daytime sleepiness, and the dietary plan with therapy. These are the variables that came out to be associated with the weight change.

The multivariate analysis shows a significant relationship between the concentration (OR:-4.85; 95% CI:-7.33, -2.32; p-value: <0.001), Excessive Daytime Sleepiness (OR: -3.91; 95% CI: -5.89, -1.92; p-value: < 0.001) and the use of dietary plan (OR: 6.29; 95% CI: 4.34, 8.24; p-value: < 0.001) on the body weight among Obstructive Sleep Apnea Individuals.

DISCUSSION

CPAP is considered as a gold standard treatment of OSA and appropriate CPAP pressures give tremendous results in eliminating the symptoms of OSA (Collard, 1997), reduced the anthropometric measurements, and improves the standard of living through physical activity and healthy eating habits. Weight loss would also be facilitated by a successful CPAP therapy (Carter III, 2008).

In a study, up to 50% of individuals who have mild OSA refused to take the CPAP trial (Rauscher H. P., 1991). This study also showed that the persons who have not taken CPAP therapy or any weight control therapy lead towards the deterioration of OSA symptoms and obesity.

he reason for weight reduction in OSA treatment is unclear. Anecdotal reports have illustrated that some patients with OSA rapidly facilitate weight loss after initiating CPAP treatment (Loube, 1997). Ou et al found that better quality of sleep and reduced daytime sleepiness will automatically improve the physical activity and took proper diet which leads to weight loss (Ou, 2019). CPAP treatment improves hyper somnolence throughout the day in OSA patients, resulting in an immediate increase in inactivity. This increase in activity can imitate the effects of exercise in OSA patients (Engleman, 1996). The physical activity and dietary plan with the CPAP therapy could be the effect modifiers as we found that out of 72% individuals have weight losses from which 8% have done the physical activity with the CPAP therapy and 14% have taken dietary plans. Some studies suggested that the increased leptin levels were reversed by OSA treatment with CPAP while this was linked with a reduction in fat accumulation (Çuhadaroğlu, 2009) (Harsch, 2003).

The persons who were not exposed to CPAP also reduced their weight through physical activities and the dietary plan which improves the ESS and the symptoms of OSA. In this study, CPAP combined with dietary plans has significant effects on weight reduction. Other factors showed that weight loss alone had tremendous effects on hyper somnolence and improves the Epworth Sleepiness Scale. For three patients who were non-exposed with CPAP therapy and have done Bariatric surgery, the symptoms of OSA were reduced. Improved OSA with weight loss

gives immense health benefits as compared to only weight loss (Grunstein, 2007).

In our research study, there was a significant association between Excessive Daytime Sleepiness and weight change. In our study, Polysomnography did not use to diagnose OSA after taking the OSA treatment but daytime sleepiness was measured through the Epworth Sleepiness Score. There was a strong association between the improvement in daytime sleepiness with OSA improvement and the weight change.

According to Antonelli et al., one out of every four newly diagnosed OSA patients had significant deterioration in neurocognitive functions, particularly in basic and logical thinking, along with constructive competence (Beebe, 2003). Cerebral dysfunction shows abnormal daytime sleepiness and a lack of concentration (Findley, 1991) in OSA individuals. Lack of concentration leads the road traffic accidents (Teran-Santos, 1999). This study found that CPAP adherence in OSA improves concentration, decreases daytime sleepiness, and has effects on weight.

To our knowledge, this is the first cohort study in Pakistan to document the association of weight changes in OSA patients with CPAP therapy. We selected the OSA participants from Polysomnography which is considered the gold standard for OSA diagnosis. In contrast, some other researchers investigated the OSA from the Epworth Sleepiness Scale and the OSA symptoms through the questionnaire. Another strength of the study is that we statistically assess the confounder variables; physical activity and diet plans and found them effect modifiers instead of confounders. Our study was strengthened to rule out the significant differences in anthropometric measurements and daytime sleepiness. This research adds to our understanding of the association between weight loss and daytime sleepiness, which could aid in the treatment of obesity-related EDS.

The expected limitation of the study is the small sample size. The selection of sample size was limited due to a single-centered tertiary care hospital in Karachi. The second limitation might be the lack of data on weight reduction with CPAP therapy, changes in dietary habits; the physical activity that could help us to better understand the consequences of CPAP on weights and BMI in OSA individuals. Another limitation is related to the current pandemic situation; some of the participants did not agree to come to the hospital for the follow-up clinics and faced improper responses from the participants. One more limitation is the duration of follow-up time between the researches, which ranges from 6 to 24 months. The total weight loss found in the exposed population was greatly influenced by the variations in follow-up time.

CONCLUSION

Weight change was measured as a continuous variable in this study and included both weight gain and weight loss. The frequency of weight change in this study population was directed toward weight loss. Our results showed that a minimum of six months of usage of CPAP therapy improves the OSA symptoms which enhance daytime alertness, a better standard of living that leads the way of weight change. Weight loss is significantly correlated with improved cognitive behaviors like lack of concentration and subside daytime sleepiness whereas weight gain induced daytime sleepiness in our study population.

Disclaimer: The manuscript was the part of my thesis work during Masters of Science in Public Health from SZABIST University.

Figure 1: Results of Weight change and associated scores after 6 months among Exposed and Non-Exposed Groups.

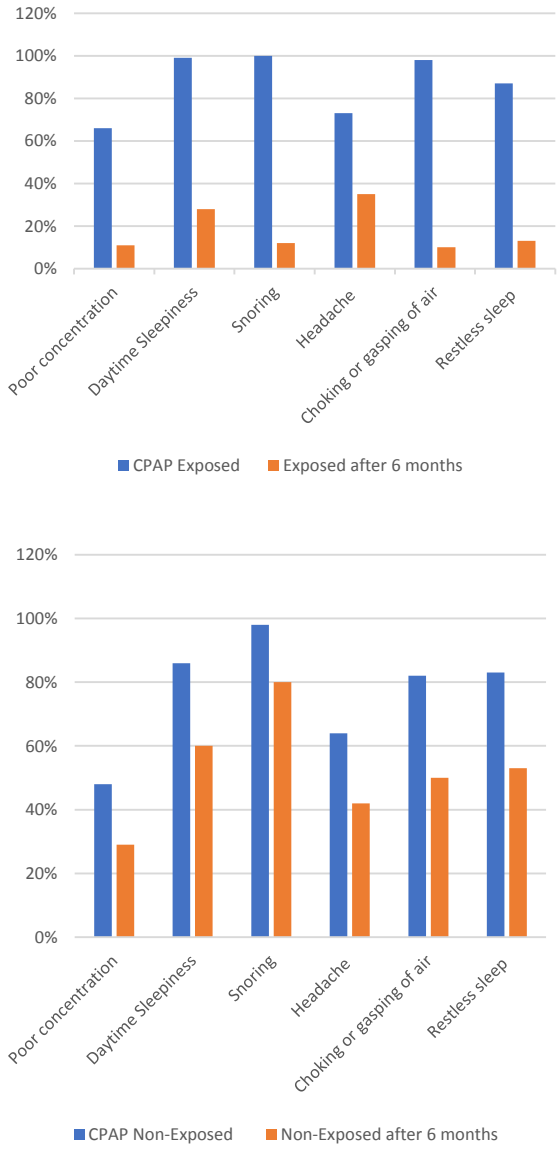

Table-1: Weight change in exposed and non-exposed cohorts.

Group of Persons	Weight Change		
	weight gain	weight reduction	No change in weight
Exposed (N = 92)	22(23.9)	66(71.6)	4(4.3)
Non-Exposed (N = 92)	36(39.1)	49(53.3)	7(7.6)
Total	58(31.5)	115(62.5)	11(6.0)

P value 0.035
Data are given as frequency and percentages.
Used Chi-square test for categorical variables.

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