Original Research Article

Effect Of CPAP, CPAP With Lifestyle Changes And CPAP With Pranayama On Sleep Pattern In Obese Diabetic Subjects With Obstructive Sleep Apnea

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Abstract

Background: The prevalence at an apnea-hypopnea index (AHI) of 5 or more occurrences per hour was greater in males (9%-38%) than in the general population. The prevalence of this trait rose with age, reaching as high as 90% in males and 78% in women among the elderly. Obstructive sleep apnea has been associated to metabolic dysregulation independent of obesity and OSA, and sleep fragmentation is a major consequence of OSA.
Method: In present study 246 subjects received polysomnography (PSG) and among them 192 assessed for CPAP titration. 78 participants were removed due to inclusion criteria, CPAP intolerance, refusal to participate, those who can't afford treatment, etc. The remaining 114 subjects were 61 obese non-diabetics and 53 obese type 2 diabetics. These 53 obese diabetic subjects were divided into 3 groups: CPAP group, CPAP with Lifestyle changes and CPAP with Pranayama group. Follow-up was done after six-month.
Result: All study groups had lower AHI scores. Sleep efficiency % increased across all trial groups. All research groups' stage I and Stage II sleep % were decreased and demonstrated increase in time in Stage III. All groups experienced more REM sleep, Improved SPO_2 % and lower Epworth Sleepiness Scale (ESS) scores.
Conclusion: The sleep pattern improved across all the different sleep stages. Using CPAP in conjunction with these two interventions not only enhances the success rate of treating OSA, but also shortens the overall time necessary for therapy.

Keywords: CPAP, PSG, OSA, lifestyle changes, pranayama, diabetic

Introduction

Sleep is a basic requirement in all human life for good health and good quality of life [1, 2]. Our body requires good quality of sleep and as well as good quantity is more important for its proper functioning. Good quality of sleep determines day-to-day performance and quality of life [3]. The prevalence at an apnea-hypopnea index (AHI) of 5 or more occurrences per hour was greater in males (9%-38%) than in the general population. The prevalence of this trait rose with age, reaching as high as 90% in males and 78% in women among the elderly. The frequency at 15 events/h AHI varied from 6% to 17% in the general adult population and reached as high as 49% in the elderly [4]. Obstructive Sleep Apnea (OSA) had a prevalence of 2% in women and 4% in men between 30 and 60 years in the year 1993, but current studies in 2008 show higher estimates ranging from 15 to 30% in men and 5 to 15% in women [5]. Sleep loss has been linked to increased body mass and obesity, which is directly linked with OSA [6, 7].

OSA is defined as the repetitive collapse of the upper airway during sleep leading to intermittent hypoxia and frequent arousals from sleep. It is the most common sleep-related breathing disorder which is increasing proportionally along with obesity prevalence worldwide [8]. Sleep fragmentation is an important consequence of OSA; Experimental sleep deprivation, as well as self-reported short sleep (< 6 hr/night), have been linked to metabolic dysregulation independent of obesity and OSA [9]. It is possible that obesity may worsen OSA because of fat deposition at specific sites. Fat deposition in the tissues surrounding the upper airway appears to result in a smaller lumen and increased collapsibility of the upper airway, predisposing to apnea. Moreover, fat deposits around the thorax (truncal obesity) reduce chest compliance and functional residual capacity and may increase oxygen demand. Visceral obesity is common in subjects with OSA. However, the relationship between OSA and obesity is complex. Although there is evidence showing that obesity, as well as visceral obesity, may predispose to OSA [10–13]. Recent studies suggest that OSA may itself cause weight gain [14]. Absence or Sleep deprivation has severe physiological consequences.

Sleep architecture/ pattern refers to the basic structural organisation of normal sleep. There are 2 types of sleep, non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. NREM sleep is divided into stages I, II, III and IV. Each has inimitable characteristics including variations in brain wave patterns, eye movements, and muscle tone [15]. Sleep cycles and stages were uncovered with the use of electroencephalographic (EEG) recordings that trace the electrical patterns of brain activity, chin and leg electromyography, electro-oculography, chest and abdominal inductance plethysmography, airflow (nasal) via a thermistor, oxygen saturation and heart-rate monitoring called as Polysomnography (PSG) [16].

Improvements in factors connected to obesity and OSA have occurred in conjunction with weight loss, suggesting that weight loss might be a keystone of treating both conditions. At present, Continuous Positive Airway Pressure (CPAP) is considered a gold standard treatment for OSA [8].

However, OSA is a complex condition, and treatment cannot be limited to any single symptom or feature of the disease. Rather, a multidisciplinary and integrated strategy is required to achieve effective and long-lasting therapeutic success, suggesting that other therapies are needed. Thus, the present study was designed to study eeffect of CPAP, lifestyle changes and pranayama on Sleep patterns in Diabetic obese subjects with obstructive sleep apnea patients.

Material and Methods

The present study is prospective study carried out in the Department of Biochemistry and

MGMIHS Sleep Medicine and Research Centre, MGM Medical College & Hospital, Navi Mumbai, in association with the Division of Sleep Medicine, University of Pennsylvania, USA. Study period from February 2016 to February 2019. The present study comprises obese diabetic with obstructive sleep apnea (OSA) subjects enrolled based on the Sleep Disorder Screening Questionnaire. The Institutional Ethics Committee approval (MGMIHS.RE.02:2015:23) was obtained before initiating the study.

Inclusion criteria

Obese diabetic with OSA.

Exclusion criteria

The following subjects were not included in the study: those under 20 and over 60, those with neurological or cardiovascular conditions, People in psychiatric facilities, pregnant women, hypothyroid patients, etc.

Study Procedure

246 subjects received polysomnography (PSG) and among them 192 assessed CPAP titration. 78 participants were removed due to inclusion criteria, CPAP intolerance, refusal to participate, those who can't afford treatment, etc. The remaining 114 subjects were 61 obese non-diabetics and 53 obese type 2 diabetics. Then subjects were further divided into 3 groups: CPAP only group, CPAP with Lifestyle changes and CPAP with Pranayama group. Patients were instructed to follow the intervention very strictly. Use of CPAP is recommended for 6-8 hours each night. After the intervention of six months, a follow-up study was done. Written consent was obtained from each participant.

Intervention
Group 1 (CPAP only group)
Group 2 (CPAP with Lifestyle changes)

Subjects were given the goal of losing 10% or more of initial weight so that the study group would attain a mean loss ≥ 7% within Six months. They were motivated to do aerobic activity, exercise or brisk walking by increasing their daily steps by 250 a week until they reach a goal ≥ of 10,000 steps/day. They were encouraged to replace two meals (typically breakfast and lunch) with a liquid shake (meal) and one snack. They were allowed to consume an evening meal of conventional food and emphasized eating more fruits & vegetables & other foods consistent with a low-energy-density diet [17].

Group 3 (CPAP with Pranayama group)

Subjects were instructed to practice Pranayama >200 min/week and completely smoking cessation.

Statistical analysis

SPSS Ver. 21 was used. Welch's t-test (Unequal sample size) was used to compare the Mean between the different groups. Descriptive were expressed as (mean ± SD).

Results

In our study, after six months of therapy, we discovered that the Apnea-Hypopnea Index (AHI) score dropped in all three research groups. It was very highly significant ($p<0.001$) in the groups i.e., the CPAP group, the CPAP group with lifestyle Change and the CPAP with pranayama group.

Sleep efficiency % improved across all research groups. It was statistically highly significant ($p<0.01$) in the CPAP group. But very highly Significant ($p<0.001$) in CPAP with Life Style Change and CPAP with Pranayama group. We have found a negative correlation with AHI in all groups and were statistically highly Significant ($p<0.05$) but no correlation found with CPAP with Pranayama group. (r = -0.54, -0.53 and -0.57, respectively)

A decrease in stage I sleep % was seen across all study groups. A strong level of statistical significance ($p<0.001$) was found in all the groups. The result was quite similar to standard physiological practice. We have not found any correlation with AHI in any groups.

There was a general decrease in the proportion of time spent in Stage II sleep % across all groups. Still, none of these variations met the criteria for statistical significance. The pathway was locking in on the physiological standard. We have found a negative correlation with AHI in all groups and were statistically significant ($p<0.05$). (r = -0.61, -0.57 and -0.63, respectively).

All groups showed an increase in time spent in Stage III sleep. The end result was quite consistent with accepted physiological practice. We have found statistically significant ($p<0.05$) in all groups. We have found a negative correlation with AHI in CPAP plus Life Style Change / Exercise group and it was statistically significant ($p<0.05$). (r = -0.46)

All three groups had an increased REM sleep %. Found statistically highly significant ($p<0.01$) in the CPAP group and CPAP plus Life Style Change / Exercise group. But very highly Significant ($p<0.001$) in CPAP with Pranayama group. The final result was relatively stable, heading in the direction of the expected range for physiological practice. We have found a negative correlation with AHI in all groups and it was statistically significant ($p<0.05$). (r = -0.51, -0.54 and -0.59, respectively)

The percentage of oxygen saturation (SPO2 %) in all study groups improved during sleep. There were statistically highly significant ($p<0.01$) in the CPAP group and CPAP plus Life Style Change. But very highly Significant ($p<0.001$) in CPAP with Pranayama group. We found a negative correlation with AHI in all groups and it was statistically significant ($p<0.05$). (r = -0.78, -0.82 and -0.89, respectively)

All groups showed decreased Epworth Sleepiness Scale (ESS) scores. It was a statistically very highly significant ($p<0.001$) difference. We have found a positive correlation with AHI in all groups and were statistically highly Significant ($p<0.01$). (r = 0.86, 0.90 and 0.91, respectively)

Table 1: Comparison of PSG and ESS within Groups after Six months of therapy

Groups/ Variance	Only CPAP		CPAP with life style change / exercise		CPAP with pranayam	
Mean± SD	**Baseline**	**After 6 Months**	**Baseline**	**After 6 Months**	**Baseline**	**After 6 Months**
AHI	38.49 ± 18.47	14.66 ± 7.19***	38.22 ± 9.78	13.47 ± 6.81***	38.60 ± 14.87	11.93 ± 3.52***
Sleep Efficiency %	78.80 ± 5.59	84.01 ± 3.69**	77.33 ± 8.47	85.28 ± 3.89***	78.27 ± 5.81	87.20 ± 3.26***
Stage I %	29.79 ± 10.76	14.59 ± 8.30***	30.53 ± 19.43	13.65 ± 5.62***	29.13 ± 9.00	9.45 ± 4.90***
Stage II%	50.61 ± 6.97	53.70 ± 5.20	46.85 ± 16.20	52.10 ± 6.99	45.91 ± 8.53	48.42 ± 6.35
Stage III%	9.17 ± 6.10	16.77 ± 7.56*	11.86 ± 11.06	17.27 ± 3.37*	14.07 ± 10.46	20.33 ± 5.63*
REM %	8.97 ± 5.63	14.94 ±3.31**	11.57 ± 5.60	17.31 ± 4.35**	10.86 ± 5.23	22.37 ± 3.07***
Mean SPO_2 %	91.60 ± 2.99	93.93 ± 1.84**	90.91 ± 2.06	94.68 ± 1.55**	90.88 ± 2.01	96.03 ± 0.96***
ESS	16.00 ± 2.58	5.71 ± 3.15***	16.50 ± 4.79	5.00 ± 3.33***	16.30 ± 3.13	4.60 ± 3.10***

Values are expressed as mean ± SD. ****p*<0.001 (Very highly significant), ***p*<0.01 (Highly Significant), **p*<0.05 (Significant); AHI: Apnea-Hypopnea Index; SE: Sleep Efficiency; S I: Stage I; S II: Stage II; REM: Rapid eye movement sleep; SPO_2: Mean Oxygen Saturation; ESS: Epworth Sleepiness Scale.

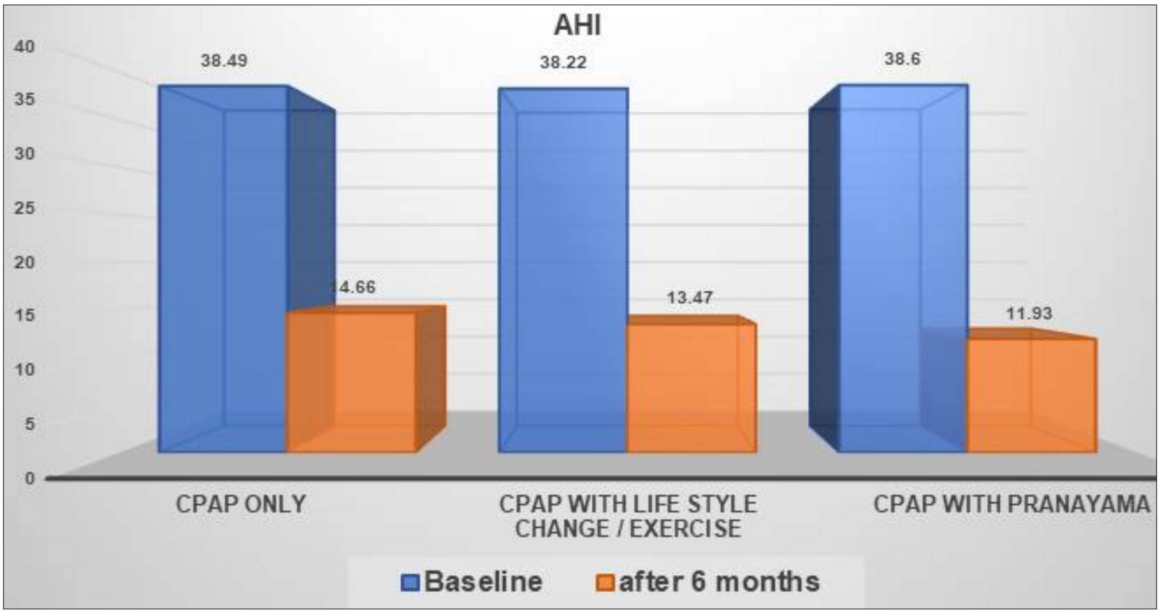
Table 2: Correlation between AHI with Polysomnography and ESS

AHI	Polysomnography and ESS	r value
Only CPAP Group	AHI	1
	Sleep Efficiency%	-0.54*
	Stage I %	-0.11
	Stage II%	-0.61*
	Stage III%	-0.22
	REM %	-0.51*
	Mean SPO_2 %	-0.78**
	ESS	0.86**
CPAP with Life Style Change / Exercise Group	AHI	1
	Sleep Efficiency %	-0.53*
	Stage I %	0.16*
	Stage II%	-0.57*
	Stage III%	-0.46*
	REM %	-0.54*

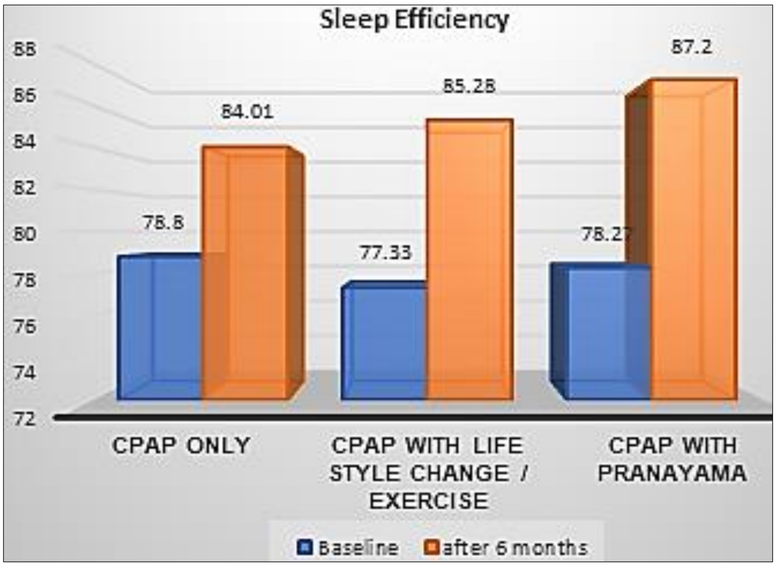
	Mean SPO_2 %	-0.82**
	ESS	0.90**
CPAP with PRANAYAM Group	AHI	1
	Sleep Efficiency %	-0.57*
	Stage I %	0.12
	Stage II%	-0.63*
	Stage III%	-0.17
	REM %	-0.59*
	Mean SPO_2 %	-0.89*
	ESS	0.91**

*. Correlation is significant at the 0.05 level (2-tailed).

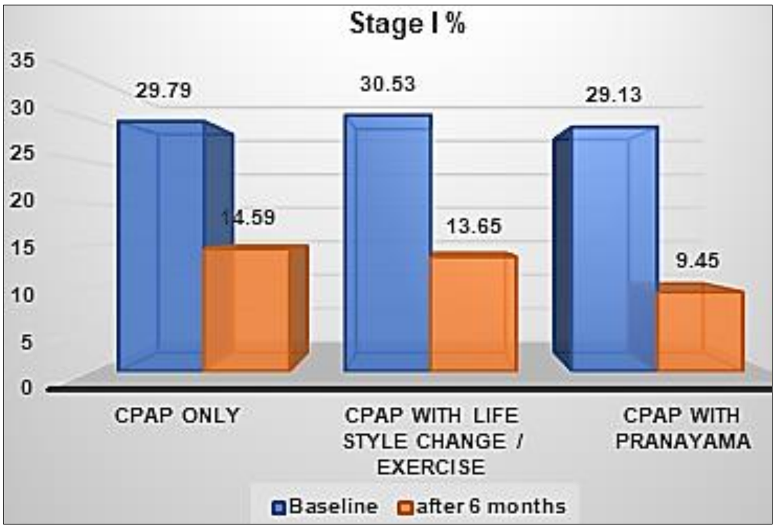
**. Correlation is highly significant at the 0.01 level (2-tailed).



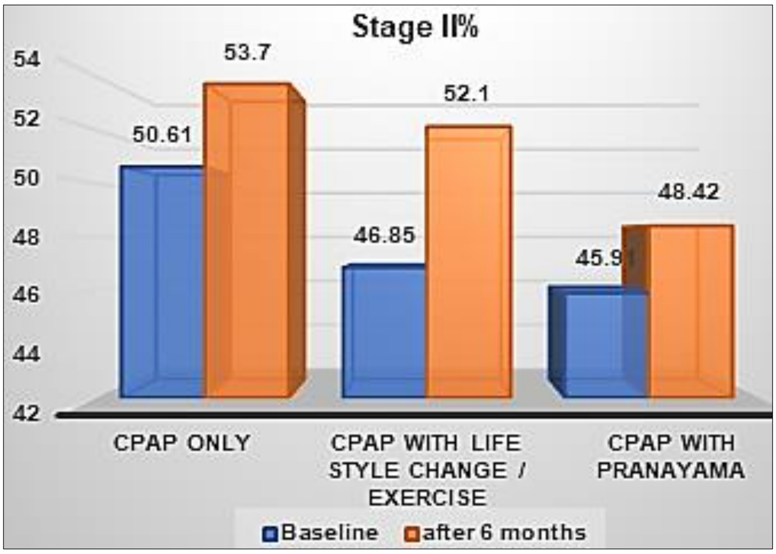
Graph 1: Shows Comparison of AHI Score in Diabetic groups



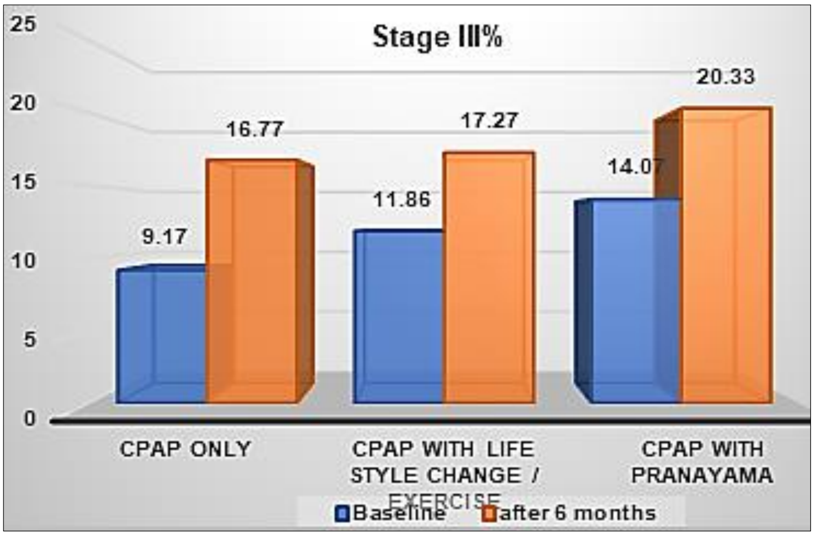
Graph 2: Shows Comparison of Sleep Efficiency % in Diabetic groups



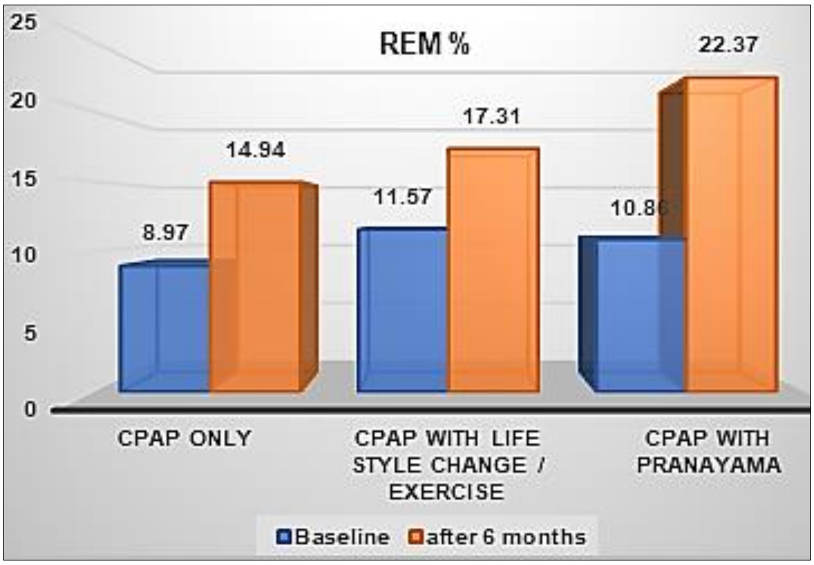
Graph 3: Shows Comparison of Stage I % in Diabetic groups



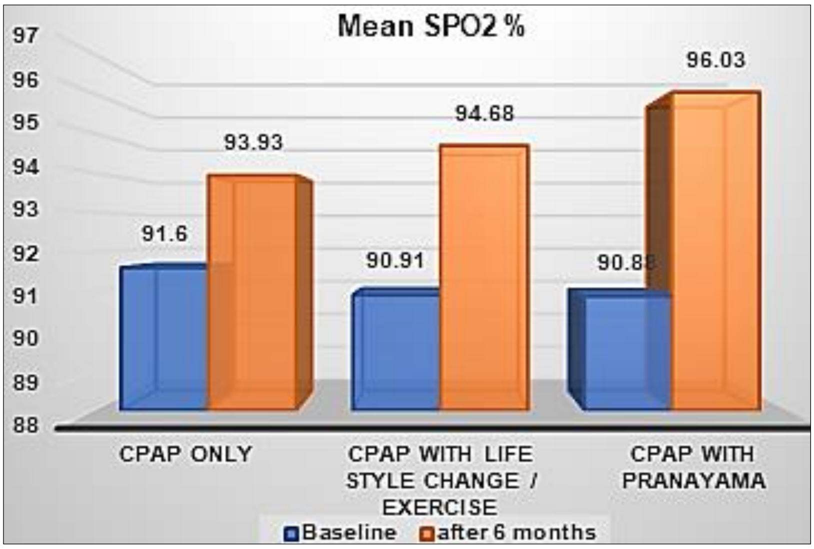
Graph 4: Shows Comparison of Stage II % in Diabetic groups



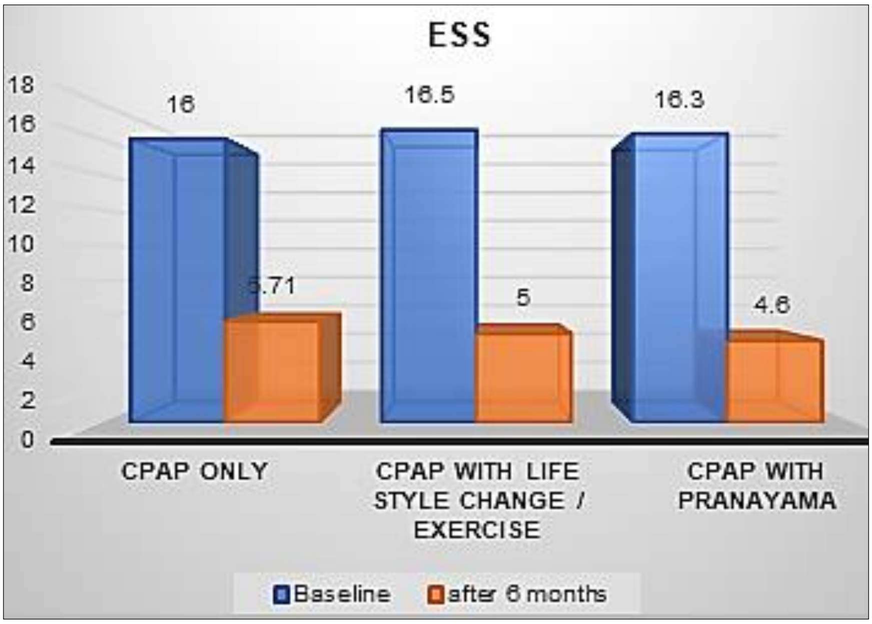
Graph 5: Shows Comparison of Stage III % in Diabetic groups



Graph 6: Shows Comparison of REM % in Diabetic groups



Graph 7: Shows Comparison of Mean SPO_2 % in Diabetic groups



Graph 8: Shows Comparison of ESS in Diabetic groups

Discussion

Several CPAP trials have been conducted on people with OSA. Only a small number of researches have looked at using CPAP in conjunction with other interventions for treating OSA. However, there is a lack of studies on combination therapy, which may shorten treatment duration without compromising effectiveness. To answer these questions, we set out to create this study. Too far, there has been no research on the effects of CPAP, CPAP with Life Style Change and CPAP with Pranayama on sleep pattern in individuals with type 2 diabetes with OSA. There are just a very few previous studies relevant to ours. Therefore, the

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current findings describe for the first time.

Studies conducted on the worldwide prevalence of diabetes have shown that, on average, the incidence of diabetes is more common in males than in women [18]. Our study also shows a similar depiction males (81%) had a prevalence of OSA that was much greater than that of obese diabetic women (19%). Diabetes is one of the risk factors for obstructive sleep apnea (OSA), and OSA is also one of the risk factors for diabetes. There is a two-way interaction between the two conditions [19]. Therefore, a reduction in OSA may result in a reversal or improvement in diabetes. According to Xu Pei Hang *et al*., in a 2019 study, moderate and severe OSA were independently related to incident T2D and the association was nonlinear throughout the AHI axis. Regular CPAP treatment for 7.3 years in people with moderate or severe OSA reduced metabolic risk to that of those without OSA after adjusting for confounding variables at baseline and subsequent weight change [20]. Their findings are similar to our research.

People were able to improve their oxygen saturation and have a sleep cycle that was less disrupted when the AHI was brought down. In addition to this, the quality of REM sleep was significantly improved. Grimaldi Daniela *et al*. in 2014 reported that using CPAP for 4 hours would leave 60% of REM sleep untreated. However, using CPAP for 7 hours would cover more than 85% of REM sleep [21].

There was also a clear change in the sleeping patterns, which we may note as an important positive change. There was a huge increase in the sleep efficiency percentage. The amount and quality of sleep that a person receives is directly related to how well their bodies are able to heal or restore body systems. The mood might benefit from getting a better night's sleep and it could also make it simpler to operate during the day. Last but not least, participants' ratings of sleepiness on the Epworth Sleepiness Scale (ESS) improved, which is the desired outcome of any sleep research.

Without a doubt, CPAP therapy enhances sleep quality generally, but our research shows that CPAP in combination with a healthy lifestyle and Pranayama has a much greater effect on the quality of sleep. When compared to only CPAP, the results are much better. Thus, goal and purpose of our research clearly reveals treatments with CPAP should be useful in treating patients and should be advised. A randomised controlled trial by Shen H H *et al*. in 2019 showed that Patients with OSAHS and T2DM who use nasal CPAP in conjunction with moderate-intensity aerobic exercise significantly improve PSG (Sleep) patterns [22]. This study strongly supports our study.

Conclusion

CPAP treatment of night-time breathing problem is the gold standard for clinical management of OSA, with the idea that the quality of sleep will improve once the breathing condition is corrected or under control. Three groups using CPAP as a treatment for sleep apnea had the most significant improvements: those practising Pranayama and then CPAP with lifestyle changes as compared to CPAP alone. Across the panel, there was an improvement in the patterns of sleep. The use of CPAP in combination with these two strategies is not only further successful in treating OSA, but also reduces the total time required for therapy.

Limitations of this study

Our research has of a small sample size, so to further investigate the relationship between CPAP therapy and improved sleep quality, larger trials that are prospectively controlled are required.

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