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The impact of lifestyle interventions targeting physical activity and healthy diet on treatment of Obstructive Sleep Apnea (OSA) – Review

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Abstract

Introduction and purpose: Obstructive Sleep Apnea Syndrome (OSAS) is a worldwide prevalent sleep-related medical condition characterised by upper airway collapse, leading to hypoxia and hypercapnia. Excess body weight is the risk factor of OSAS. Lifestyle interventions, particularly targeting weight loss, have emerged as potential management strategies for OSAS. The purpose of this review is to compile the information about the effectiveness of different forms of lifestyle interventions in the treatment of OSA.

Brief description of the state of knowledge:

While CPAP remains the current "gold standard" treatment of Obstructive Sleep Apnea, it's not always well-tolerated. Consequently, lifestyle interventions such as dietary modifications,

exercise programs, and behavioural therapies have emerged as important components in the management of this disease. The research has shown that these strategies not only reduce the severity of OSA but also improve quality of life.

Summary: Lifestyle interventions, including dietary modifications, exercise programs, and behavioral therapies targeting weight loss, have demonstrated promising results in reducing the severity of obstructive sleep apnea (OSA) and alleviating associated symptoms. However, further large-scale, long-term studies are necessary to validate their efficacy and understand their broader impact on OSA management.

Keywords: Obstructive Sleep Apnea, Lifestyle interventions, Dietary Modifications, Weight loss

Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is a chronic sleep-related medical condition characterized by a repetitive partial or complete upper airway collapse. The collapse results in intermittent episodes of hypoxia and hypercapnia. The gold standard of evaluation for OSA is polysomnography (PSG). The presence and severity of OSA are typically assessed through the apnea-hypopnea index (AHI). AHI is defined as the number of apneas plus hypopneas per hour of sleep. Severity is categorized as mild (5 to 15 events per hour), moderate (16 to 30 events per hour), or severe (more than 30 events per hour). [1,2,3] The global prevalence of obstructive sleep apnoea is almost 1 billion people with approximately 14% of men and 5% of women in adult population. [4,5] Common symptoms include snoring, daytime sleepiness and fatigue. [**6]** Obstructive Sleep Apnea (OSA) risk factors can be divided into unmodifiable and modifiable. Unmodifiable risk factors include male gender, age, race (African Americans and Hispanics,) genetic predisposition, and craniofacial anatomy, such as a narrow airway or specific facial structures. Modifiable risk factors include obesity, medications like muscle relaxants, sedatives, use of alcohol, smoking endocrine disorders such as hypothyroidism and polycystic ovarian syndrome (PCOS), nasal congestion or obstruction. Untreated OSA can lead to decreased quality of life, excessive daytime sleepiness, memory deficit and increased risk of cardiovascular disease for example: hypertension, arrhythmias, stroke, diabetes, heart disease and a higher risk of cardiovascular-related death. [7-11].

Obesity

The evidence strongly indicates that obesity significantly increases the risk of obstructive sleep apnea (OSA). [5] Excess body weight, particularly the fat deposition around the neck and throat, can lead to the narrowing or collapse of the upper airway during sleep. This obstruction disrupts normal breathing patterns, resulting in intermittent decreases in oxygen levels and fragmented sleep. [12,13]

Treatment in OSA

There are a variety of treatment options in managing OSA. It's becoming more evident that a personalized strategy and multidisciplinary approach is necessary and valuable.

Non-surgical methods include lifestyle modification (such as abstaining from alcohol and smoking, weight loss), medication, continuous positive airway pressure and oral appliance therapy. [14,15] Although CPAP stands as the primary and effective treatment for OSA, it may lead to nasal dryness and congestion, facial skin abrasions, feelings of claustrophobia and conjunctivitis, potentially impacting patient compliance. Patients who have anatomical abnormalities contributing to airway obstruction, severe OSA, multi-level obstruction may be qualified for surgical treatment. Weight loss achieved through lifestyle changes or bariatric surgery could potentially serve as effective treatments, nevertheless, the supporting evidence for their efficacy is limited. [16-19]

Aim

The aim of this study is to gather and analyse the current state of knowledge about the correlation between lifestyle interventions and severity of OSA with a focus on determining the effectiveness of weight loss, dietary modifications and exercise in the management of OSA.

Methods

The study contains data available in freely accessible databases like PubMed, the National Library of Medicine, Google Scholar. While searching the keywords such as Obstructive Sleep Apnea, Lifestyle Interventions, Weight Loss, Treatment were used. Articles were selected based on their title, abstract and were written in English.

Effects of lifestyle changes on OSA. Analysing the literature

From April 2019 to October 2020 Carneiro-Barrera et al randomised 89 Spanish men aged 18 to 65 years with moderate to severe OSA, BMI ≥25 who were receiving continuous positive pressure (CPAP) therapy, assigning 49 individuals to the control group (CPAP therapy)

and 40 to the intervention group. The intervention group took part in an 8-week weight loss and lifestyle modification programme. That involved nutritional behaviour change, sleep hygiene, aerobic exercise and alcohol, tobacco cessation combined with CPAP therapy. The result revealed a greater decrease in AHI in the intervention group (51% reduction, with a mean change of -21.2 events/h, $p<0,05$) compared to the control group (mean change of 2,5events/h, $p<0,05$) after 8 weeks. In the long term, 6 months after intervention the study group showed a 57% reduction of AHI, 61.8% participants no longer needed CPAP therapy and 29% of participants achieved full remission of OSA. [20]

10 year follow-up in Sleep AHEAD (Action for Health in Diabetes) was the longest longitudinal study examining the effects of an intensive lifestyle intervention (ILI) with weight loss on OSA severity and was conducted by Kuna et al. Participants with overweight or obesity (BMI>=25), type 2 diabetes mellitus and mild, moderate or severe OSA were randomised to receive either ILI for weight loss with a goal at least 10% in year 1 or diabetes support and education (DSE) as a control group. The intervention group received a specialised behavioural weight loss program focusing on diet modifications. Subsequently, the polysomnography (PSG) was performed to assess AHI at the baseline and years 1, 2, 4 and 10. The findings revealed that the ILI group had greater reductions in body weight and AHI compared to the DSE group at 1-, 2- and 4-years follow-ups, continued to be apparent even at the 10-year mark, although there was some attenuation of these effects over time ($p<=0.0001$). During the 10-year follow-up, it was observed that for each kilogram of weight lost in ILI participants compared to their baseline, the AHI decreased by 0.68 events per hour, whereas in DSE participants, the decrease was 0.54 events per hour ($p<0,0001$). It was also found that the occurrence of OSA remission was more prevalent among ILI participants (34.4%) compared to the DSE group (22.2%) especially among individuals with mild and moderate OSA at 10 years. Overall, the severity of OSA was generally diminished with ILI, and this enhancement was associated with reduction in body weight, initial OSA severity, and lifestyle intervention, regardless of weight fluctuations. [21,22]

Spörndly-Nees et al. conducted a trial with a follow-up at 18 months in which 60 overweight participants with moderate to severe obstructive sleep apnea were randomised to either a control group treated with CPAP or an experimental group treated with CPAP and a behavioural sleep medicine (BSM) intervention targeting physical activity and eating behaviour changes. They attended 8 to 10 individual sessions with a dietitian and physiotherapist over the

first 6 months. Between the 6th and 18th months, 4 additional booster sessions were conducted. Findings revealed that participants in the experimental group experienced a more substantial improvement (P=0.029) in AHI at the 18-month follow-up, compared to those in the control group, after accounting for baseline AHI and BMI. Additionally, a higher proportion of participants in the experimental group (36.7%) experienced an improvement in OSA category compared with the control group (6.7%). The inclusion of a BSM intervention focused on enhancing physical activity and promoting healthy eating habits demonstrated effectiveness in reducing AHI and improving OSA severity over the long term when compared to solely relying on CPAP treatment. [23]

Georgoulis et al. randomised 187 patients to one of the three study groups - a standard care group (SCG) or one of the two intervention arms: a Mediterranean diet group (MDG) and a Mediterranean lifestyle group (MLG). Each of the three study groups was provided with standard care for OSA management (CPAP). Besides, the SCG was provided with written guidance on maintaining a healthy lifestyle. Meanwhile, participants in the intervention groups underwent a 6-month behavioural program focused on achieving weight loss (aiming at a 5-10%) and improving adherence to the Mediterranean diet. Additionally, the MLG received counselling sessions addressing physical activity and sleep habits. The results revealed that the mean AHI change ($p<0.05$) was -4.2 for the SCG, -24.7 for the MDG, and -27.3 for the MLG. Moreover, other respiratory event indices, daytime sleepiness, and insomnia were significantly lower in both intervention arms compared to the SCG ($p < 0.05$).
Introducing a dietary and lifestyle intervention alongside standard care leads to notable improvements in both OSA severity and associated symptoms compared to standard care alone. These benefits persist regardless of CPAP usage or weight reduction. [24]

The next trial, conducted by Igelström et al., randomized 86 overweight patients (BMI ≥ 25) with moderate to severe obstructive sleep apnea (OSA), into either a control group or an experimental group. The control group was treated with CPAP and was given advice about weight loss, whereas the experimental group was treated with CPAP and BSM (behavioural sleep medicine) intervention targeting physical activity and eating behaviour. The BSM program consisted of 10 one-on-one sessions with both a dietitian and a physiotherapist, integrating behaviour change strategies like setting goals and self-tracking. Following a six-month period, ventilatory parameters were re-evaluated without CPAP. From baseline to follow-up, individuals in the experimental group exhibited a greater reduction in their AHI (-

9.9, ±13) compared to the control group (-1.9, ±19.9; p = 0.050), indicating a statistically significant difference. The findings of this study suggest that the BSM intervention for patients treated with CPAP therapy for moderate to severe OSA positively impacts OSA severity. Notably, the experimental group exhibited a 4.5 times greater likelihood of experiencing OSA improvement after 6 months, with this improvement being independent of CPAP therapy adherence. [25]

The study conducted by Ng et al. recruited 104 individuals aged 30 to 80 years, with BMI>25 kg/m2, diagnosed with moderate to severe obstructive sleep apnea (AHI >15 events/h) into a trial aimed at assessing the effectiveness of a 12-month lifestyle modification program (LMP) and weight reduction compared with usual care. Patients randomised to the intervention group were provided with dietary education. The initial goal was to achieve a 10% to 20% caloric reduction in daily energy intake from the patient's regular diet. Additionally, patients were encouraged to engage in 30 minutes of aerobic exercise two to three times per week. Participants in the control group received basic lifestyle advice from a clinician at the beginning of the study and again at the 6 months. In the intention-to-treat analysis (ITT), the LMP exhibited greater efficacy in reducing AHI from baseline, with 16.9% fewer events observed in the LMP group compared to 0.6% more events in the control group (P = 0.011). This study demonstrates that the Lifestyle Modification Program (LMP) effectively reduces the severity of obstructive sleep apnea (OSA) and daytime sleepiness. [26]

Tuomilehto et al. randomised controlled parallel-group study to determine whether a very low calorie diet (VLCD) with supervised lifestyle counselling could be an effective treatment for adults with mild OSA. 72 consecutive overweight individuals (BMI, 28–40) diagnosed with mild OSA were enrolled in the study. The intervention group underwent a 12-week VLCD program accompanied by supervised lifestyle modification. After the VLCD program, patients were advised to limit fat intake to no more than 30% of their total energy consumption by increasing their intake of fruits, vegetables, fish and lean meats, while limiting dairy fats, fatty meat ,and sweets. They were also encouraged to increase their overall daily physical activity. At the 1-year follow-up a greater decrease in AHI was observed in the intervention group compared to the control group (P=0.017). The changes in AHI were strongly linked to reductions in weight and waist circumference. Also, there was an improvement in common symptoms of obstructive sleep apnea. In addition, combining a VLCD with active lifestyle counselling proves to be a viable and efficacious treatment for the majority of patients

with mild OSA. Over the 4-year follow-up period the intervention led to a 61% decrease in the occurrence of OSA progression compared to the control group. [27,28]

Johansson et al. randomised 63 obese men with moderate (AHI 15-30) to severe (AHI>30) obstructive sleep apnea treated with continuous positive airway pressure into two study groups: an intervention group and a control group. The intervention group received a liquid very low energy diet (2.3 MJ/day) for 7 weeks followed by two weeks of gradual introduction of normal food with the end point at week 9 - 6.3MJ/day (weight loss programme). The control group got their usual diet. AHI as the major disease severity index for OSA was evaluated at the beginning and after the intervention. Over the 9-week study the intervention group exhibited a significant ($p<0.001$) change in weight, BMI and the reduction of AHI with a mean change of -25 events/h compared to -2 events/h in the control group. The reduction of AHI was significantly greater in patients with severe OSA than with moderate OSA. Moreover the reduction in daytime sleepiness score at week 9 was greater than in the control group ($p<0.001$). The study confirmed that applying the treatment with a low energy diet improved OBPS especially among patients with severe disease. Positive outcomes attained are sustained at the 1-year follow-up assessment [29,30]

Table 1. Studies on lifestyle interventions in OSA

Study	Type of lifestyle intervention	Results	Others comments
Carneiro-Barrera et al., 2022 [20]	Nutritional behaviour change, sleep hygene, aerobic exercise, alcohol and tobacco cessation	Reduction of AHI	The intervention group lowered their risk death from stroke (by 40%), ischaemic heart disease or other vascular causes (by 30%)
Kuna et al., 2020 [21,22]	Diet modifications	Reduction of AHI, body weight	The longest longitudinal study (10 years)
Spörndly-Nees et al., 2020 [23]	Physical activity and eating behaviour changes	Reduction of AHI	The BSM intervention was of most benefit to those with lower AHI and lower amount of body fat at study entry
Georgoulis et al., 2020 [24]	group 1: Mediterranean diet caloric reduction in daily energy intake group 2: Mediterranean diet physical activity sleep hygiene	Reduction of AHI improvement in daytime sleepiness and insomnia	Improvements in OSA severity are directly proportional to the degree of weight loss.
Helena Igelström et al., 2017 [25]	BSM intervention targeting physical activity and eating behaviour	Reduction of AHI	The BSM intervention in the present study was based on individual prerequisites and goals, not on a very low-calorie diet

			(VLCD).
Ng et al., 2015 [26]	Weight reduction dietary education caloric reduction in daily energy intake aerobic exercise	Reduction of AHI and daytime sleepiness, BMI	Lifestyle interventions have been shown to be effective in weight reduction with improvements in OSA parameters but not sufficient to normalise them.
Tuomilehto et al., 2008, 2013 [27,28]	Very low calorie diet program accompanied by supervised lifestyle modification	Reduction of AHI, weight reduction	Relatively short duration of intervention (12 weeks)
Johansson et al., 2009, 2011 [29,30]	Very low energy diet	Reduction of AHI, body weight, BMI and daytime sleepiness score	Relatively short duration of intervention (9 weeks)

Discussion

This review presents various studies examining the correlation between lifestyle interventions targeting weight loss and the severity of obstructive sleep apnea (OSA). All of the results demonstrated that lifestyle modifications were beneficial for patients' health condition because weight loss caused by the interventions led to significant reduction of AHI, OSA severity and alleviating symptoms of OSA. Even a weight loss of less than 5% can decrease respiratory events, but a weight loss of 5% or more is required to diminish the occurrence of severe obstructive sleep apnea (OSA). [31] However it's important to take into consideration that the research had some/its limitations. Firstly, the majority of the participants (in these studies) were males with Johansson et al. and Carneiro-Barrera et al. including only men.
This may result from the higher prevalence of OSA in males and can limit the generalisability of the findings. Another aspect is the small number of long-term follow-ups. Only one study lasted 10 years. Larger, long-term randomised trials are needed to confirm efficacy,

emphasising the importance of treating obesity among OSA patients. The heterogeneity among the samples presents a clear limitation in these analyses; nonetheless, this is unsurprising given the differing durations of the trials and variations in control groups.
Despite this, all studies consistently documented positive results, just with varying degrees.

Conclusions

The reviewed literature provides evidence for the effectiveness of lifestyle interventions, particularly those focused on weight loss, in managing obstructive sleep apnea (OSA). Lifestyle modifications such as dietary changes, exercise programs, and behavioural therapies have shown promising outcomes in reducing the severity of OSA and improving associated symptoms. Additionally, it's essential to acknowledge the risks associated with surgical interventions for OSA. Therefore, exploring non-invasive options such as lifestyle modifications becomes increasingly significant in effectively managing this condition. These findings underscore the importance of incorporating lifestyle changes as integral components of OSA management. However, larger, long-term randomised trials are needed to validate the efficacy of lifestyle interventions in OSA management and to explore their sustained effects over time.

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