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Review Article

Weight loss from lifestyle interventions and severity of sleep apnoea: a systematic review and meta-analysis

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ABSTRACT

Background: Excess body weight is a risk factor for obstructive sleep apnoea (OSA). The aim of the systematic review was to establish whether weight loss via lifestyle interventions such as diet and exercise are useful in the treatment of OSA.
Methods: A literature search was conducted between 1980 and February 2012. Systematic reviews and randomised controlled trials (RCTs) with participants who had OSA, were overweight or obese, and who had undergone lifestyle interventions with the aim of improving sleep apnoea were included. Meta analyses were conducted for a subset of RCTs with appropriate data.
Results: Two systematic reviews and eight RCTs were included. Meta-analyses were conducted for four RCTs comparing intensive lifestyle interventions to a control. The overall weighted mean differences for weight change, change in apnoea -hypopnoea index (AHI) and change in oxygen desaturation index of ≥4% were as follows: –13.76 kg (95% confidence interval (CI) –19.21, –-8.32), –16.09 (95% CI –25.64, –6.54) and –14.18 (95% CI –24.23, –4.13), respectively. Although high heterogeneity within the meta analyses, all studies favoured the interventions. Long-term follow-up data from three RCTs suggest that improvements in weight and AHI are maintained for up to 60 months.
Conclusions: Intensive lifestyle interventions are effective in the treatment of OSA, resulting in significant weight loss and a reduction in sleep apnoea severity. Weight loss via intensive lifestyle interventions could be encouraged as a treatment for mild to moderate OSA.

1. Introduction

Obstructive sleep apnoea (OSA) is characterised by repetitive episodes of upper airway obstruction, which can lead to a reduction in blood oxygen saturation and arousal from sleep [1]. OSA is strongly associated with central obesity and is independently associated with an increased risk of cardiovascular disease, hypertension, and stroke. In addition, OSA is associated with excessive daytime sleepiness, cognitive deterioration, motor vehicle accidents, and a reduction in quality of life [2]. OSA is estimated to affect 3–7% of men and 2–5% of women [3], with a predisposition in those who are male, middle-aged, overweight and with a family history of OSA [1,4]. It has been suggested that the true prevalence may be even higher, as undiagnosed OSA is common [5,6].

The most commonly used and effective management for OSA is the use of continuous positive airway pressure (CPAP) which acts as a pneumatic splint to maintain airway patency during sleep but relies on long-term adherence [7]. CPAP can result in nasal dryness and congestion, claustrophobia, facial skin abrasions, and conjunctivitis, all of which may affect compliance [8]. Similarly, the use of oral appliances to increase airway size during sleep is another possible management strategy. They are not as effective as CPAP therapy, but may lead to comparable health outcomes [9]. Weight loss via lifestyle modification or bariatric surgery may be effective treatments; however, the evidence for these is sparse [10].

Evidence is clear that excess body weight is a risk factor for OSA [4], with severity of symptoms generally increasing with body weight [1]. A recent review challenges the unidirectional relationship between obesity predisposing individuals towards airway collapse and development of sleep-disordered breathing, with the suggestion of a reciprocal relationship between obesity and OSA. This suggests that the metabolic derangement resultant from

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OSA contributes to either further weight gain or resistance to weight loss [11].

While weight reduction after the onset of the syndrome may lead to improvement of symptoms, this has not been conclusively shown [4]. Previous reviews of the effect of lifestyle intervention on OSA severity have been conducted, but have not included more recent randomised controlled trials (RCTs) in the area [12,13]. This systematic review aimed to evaluate the relationship between weight loss and severity of sleep apnoea to establish specifically whether weight loss via lifestyle interventions such as diet and exercise are useful in the treatment of OSA.

2. Methods

2.1. Data sources

To identify appropriate keywords, an initial limited search of MEDLINE was conducted, and the title, abstract and index terms used to describe the articles were reviewed. All identified keywords and index terms were used in the second search of Ovid MEDLINE, The Cochrane Library, EMBASE, CINAHL, Web of Science and Scopus. The reference lists of retrieved articles were also searched; however, no additional relevant studies were found.

2.2. Study selection

Keywords used were grouped into two main areas, those regarding sleep apnoea (apnea/apnoea, hypopnea/hypopnoea and OSA) and those concerning nutrition and physical activity interventions or weight loss (nutri*, diet, food, exercise, physical activity and weight). Keywords were agreed upon by the authors.

The review was limited to studies published between 1980 and February 2012, written in English, and conducted in humans. Studies with participants who had OSA, who were overweight or obese (body mass index (BMI) ≥ 25 kg/m^2 in Caucasian cohorts and BMI ≥ 23 kg/m^2 in Asian cohorts) and who had undergone lifestyle interventions with the aim of improving sleep apnoea were included if they reported both anthropometric and sleep apnoea outcomes. Studies where significant weight loss was not achieved were excluded, as were studies where weight loss occurred as a result of bariatric surgery or medications if it was not possible to separate results from other lifestyle interventions.

Once duplicates were removed, studies identified in the database search were assessed for relevance based on title and abstract. Studies meeting inclusion criteria were retrieved, as well as those for which it was uncertain. Initially, all study designs were included; however, as a sufficient number of systematic literature reviews and RCTs were identified, other study designs were later excluded. Levels of evidence were assigned using the National Health and Medical Research Council evidence tables [14].

2.3. Data extraction

Data were extracted using a developed data extraction form based on the Dietitians Association of Australia templates (LJM) [15]. Extracted information included populations (gender, age, BMI, OSA classification and co-morbidities), interventions (treatments provided and length of follow-up), comparators, sample sizes, outcomes, study designs, and funding sources. Extracted data were checked by an independent reviewer (ZED) and a consensus was reached where disagreement existed.

The quality of the included systematic reviews was first assessed using the American Dietetic Association criteria [16]. To determine the validity of included RCTs, studies were assessed for the adequacy of allocation randomisation and concealment, blinding of participants, personnel and outcome assessors and the completeness of outcome data reporting [17]. This was conducted by two independent reviewers (LJM and ZED) using the Cochrane Risk of Bias tool at the study level [17]. Criteria were discussed prior to assessment with disagreements resolved by consensus.

2.4. Results synthesis and statistical analysis

The relationship between weight loss from lifestyle intervention and severity of OSA was explored by meta-analysis. Firstly, weight changes were compared between those receiving the lifestyle intervention and those receiving control measures to demonstrate that the interventions were successful in achieving weight loss. Next, changes in the apnoea–hypopnoea index (AHI) and 4% oxygen desaturation index (ODI_4) between those receiving the lifestyle intervention and those receiving control measures were explored to determine the effect of weight loss on OSA severity.

Studies were included in the meta-analyses if they reported mean difference in weight, AHI and/or ODI_4 following the study period. Where data were reported in the format of baseline versus follow-up, the authors were contacted in order to obtain appropriate data points.

Analyses were undertaken using STATA (Version 11, StataCorp, 2009). The STATA *metan* command was used to calculate the overall WMD in weight, AHI and ODI_4 between those receiving the lifestyle intervention and those receiving control measures [18]. A random-effects model was used whereby the WMD was calculated and is reported as WMD (95% confidence interval (CI)). Heterogeneity was examined both qualitatively and quantitatively using the I^2 statistic: low heterogeneity is defined as <25%, medium as <50% and high as <75% [19].

Studies not included in the meta-analysis were evaluated and summarised qualitatively.

2.5. Follow-up data

Several of the included studies published additional follow-up data. These publications were identified and assessed for quality. Data were then extracted and included within the qualitative summary of results.

3. Results

3.1. Included studies

The search identified 3622 articles, 12 of which were included in the final review (Fig. 1). In addition, three articles reporting follow-up data were identified subsequent to the initial search. The two systematic reviews that met the inclusion criteria are outlined in Table 1. Both systematic reviews included weight loss via dietary means and its impact on OSA, one of neutral quality [13] and one of poor quality [20]. These systematic reviews both showed positive effects of weight loss on OSA; however, only two of 11 included studies were RCTs. A third systematic review which assessed weight loss, sleep hygiene or exercise programs versus placebo was retrieved; however, it was subsequently excluded because no studies met the review's strict inclusion criteria [12].

Thirteen publications from eight different RCTs were identified, with two of these being reported in the included systematic reviews [21,22]. The characteristics of the included publications are described in Table 2, while the results are reported in Table 3. Follow-up data were reported for three of the RCTs. Specifically, follow-up data from Kemppainen et al. [27] and Tuomilehto et al. [31] were reported at 24 and 60 months [32,33]; follow-up data from Foster [24] were reported at 24 and 48 months [28];