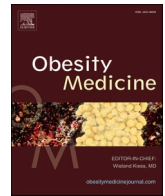




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## Review

## Coping strategies for obese individuals with obstructive sleep apnea during COVID-19 pandemic: A narrative review

K. Vaishali<sup>a</sup>, Aishwarya Gatty<sup>b</sup>, Prateek Srivastav<sup>a</sup>, Revati Ravi Amin<sup>a,\*</sup><sup>a</sup> Department of Physiotherapy, Manipal College of Health Professions, Manipal Academy of Higher Education (MAHE), Manipal, India<sup>b</sup> College of Physiotherapy, Srinivas University, Mangalore, India

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## ABSTRACT

**Background:** Patients infected with SARS-CoV-2- having pre-existing non-communicable diseases (NCDs)- are at a higher risk of complications. Obesity is one of the proven risk factors causing NCDs and can influence outcomes of COVID-19 patients. It is closely related to obstructive sleep apnea (OSA). The increased risk of COVID-19 and reduced access to treatment of non-COVID conditions during the pandemic may increase the stress in obese patients with OSA. This situation makes it necessary for them to cope with their condition by themselves. This review aimed at the effect of this pandemic on these patients and coping strategies for them.

**Methods:** Databases like PubMed and Scopus were searched using a combination of key words. Full-text articles meeting the inclusion criteria were selected.

**Results:** The search yielded eight studies, discussing about the potential interactions between the COVID-19, obesity and OSA, the impact of COVID-19 on them, and management of these patients.

**Conclusions:** Increased prevalence of COVID-19 was found among obese patients with OSA. The fear of COVID-19 and shift of health care workers to manage COVID-19 patients has affected their regular visits to the hospital. However, there is lack of coping strategies for them, which should soon be established for these patients.

## Introduction

Severe acute respiratory syndrome coronavirus 2 SARS CoV-2 causing coronavirus disease 2019 (COVID-19), has an acute and chronic effect on the health of an individual (van Doremalen et al., 2020). Patients affected by Covid-19 have shown a large spectrum of symptoms ranging from asymptomatic infection, mild upper respiratory tract illness, and severe viral pneumonia with respiratory failure and/or death (Thomas et al., 2020) Studies conducted worldwide have shown that patients infected with COVID-19 along with comorbidities had a higher rate of hospitalization, severe symptoms, and mortality. These studies have shown that patients with already existing diseases like non-communicable diseases (NCDs) have higher rates of ICU interventions, leading to fatality (Guan et al., 2019; Klang et al., 2020; Simonnet et al., 2020; Zhou et al., 2020). Obesity is one of the proven risk factors causing NCDs (Flier and Maratos-Flier, 2004). Studies have also shown that obesity can influence the prognosis of COVID positive patients (Guan et al., 2019; Klang et al., 2020; Sorbello et al., 2020).

Simonnet et al. (2020) found that 47.5% of patients admitted to

intensive care for SARS-CoV-2 were obese but they could not determine the cause of the relation between the two factors. The possible causes could be: altered baseline respiratory mechanics increasing pleural pressure and airway resistance (Hibbert et al., 2012), impaired ventilation of the basal lung segments causing reduced oxygen saturation of blood (Dixon and Peters, 2018), abnormal secretion of adipokines and cytokines causing inflammation that impairs immune response and affects lung parenchyma and bronchi (Guan et al., 2020; Huttunen et al., 2013). AbdelMassih et al. (2020) explained that hypoxia-inducible factor could be a link between obesity and COVID-19. Obesity may be an independent risk factor for COVID-19 and increase the severity and complications of the disease (Abbas et al., 2020; Ryan et al., 2020) According to study done in India, the odds of being COVID-19 positive increased by 1.8 times with every one unit increment in body mass index above 23 kg/m<sup>2</sup> (Ranjan et al., 2020). Also, the COVID-19 lockdown has brought about changes like increase in the food intake and decreased physical activity. This has led to rapid weight gain amongst individuals and is termed as ‘covibesity’ (Khan and Smith, 2020).

Obesity is also a precursor for various other respiratory diseases like obstructive sleep apnea (OSA) (Lévy et al., 2015). The prevalence of OSA

\* Corresponding author.

E-mail addresses: [vaishali.kh@manipal.edu](mailto:vaishali.kh@manipal.edu) (K. Vaishali), [ashgatty95@gmail.com](mailto:ashgatty95@gmail.com) (A. Gatty), [prateek.srivastav@manipal.edu](mailto:prateek.srivastav@manipal.edu) (P. Srivastav), [revatiamin12@gmail.com](mailto:revatiamin12@gmail.com) (R.R. Amin).

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**Abbreviations:**

SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
NCD	Non communicable disease
COVID-19	Coronavirus disease
OSA	Obstructive Sleep Apnea
BMI	Body mass index
ICU	Intensive care unit
CPAP	Continuous positive airway pressure
PAP	Positive airway pressure
BiPAP	Bilevel positive airway pressure
APAP	Autotitrating positive airway pressure

is estimated to be 45% in obese adults and 46% in obese children (Romero-Corral et al., 2010; Verhulst et al., 2008). With increase in body mass index (BMI), neck circumference increases, constricting the hypopharynx and the oropharynx. OSA is caused by repetitive upper airway obstruction during sleep because of narrowing of the respiratory passages. Causes include obstructed airway by base of the tongue, thickened lateral pharyngeal wall muscles and fatty tissue infiltration in the peripharyngeal area (Madani and Madani, 2007). Patients with OSA experience intermittent hypoxemia during sleep which increases oxidative stress, vascular and systemic inflammation, activates sympathetic system and dysregulates renin angiotensin system, elevating the blood pressure (Barceló et al., 2001; Dewan et al., 2015) These factors contribute to the pathophysiology of COVID-19 as well (Pinto et al., 2016) Also, OSA and COVID-19 have common risk factors like diabetes, hypertension, and cardiovascular disease that are linked to poor COVID-19 outcomes (Guan et al., 2020; Miller et al., 2020; Pinto et al., 2016; Simonnet et al., 2020).

COVID-19 pandemic has disrupted services for treatment of non-COVID conditions and reduced accesses to treatment. Some of the reasons for this disruption include shortage in medicine, diagnostic and other healthcare facilities and deployment of the healthcare workers to manage COVID patients. Fear among patients to visit hospitals has also affected their regular check-ups (Subhajit Hazra, 2020; World Health Organization, 2020).

This makes it necessary for these patients to manage their condition by themselves. Coping strategies -defined as an action, a series of actions or a thought process used in meeting a stressful or unpleasant situation or modifying one's reaction to a situation (American Psychological Association), can help the patients to deal with their existing respiratory distress during this pandemic. This study aimed at finding the effect of this pandemic on obese patients with sleep apnea, finding coping strategies for them and managing those affected with COVID-19.

**Material and methods**

The need for this review stems from the need of coping strategies for obese individual with sleep apnea especially during a pandemic like COVID-19, and the necessity to implement these strategies to reduce the health distress for the patients with sleep apnea.

The authors searched PubMed and Scopus electronic database using key words and boolean operators 'AND', 'OR' from the year 2000 onwards till date. Key words used for the search were COVID-19, pandemic, SARS-CoV-2, Obesity, body mass index, BMI, obese, Sleep apnea, Obstructive sleep apnea, OSA, sleep apnea syndrome, obstructive sleep apnea syndrome, sleep disorder, Sleep-disordered breathing, Sleep related breathing disorder, snoring, coping strategies.

The articles searched were in English language with the following inclusion criteria: full text articles, inclusive of study designs like randomized control trials, non randomized controlled trials, observational studies, case control studies, case series, case reports, systematic reviews and narrative reviews. Commentaries, studies not inclusive of COVID-19, studies not inclusive of obesity with OSA were excluded. A total of eight studies consisting of one survey, two observational studies, one case report, one review and three letters to the editor were included in the review. Data extraction is summarized in Fig. A1.

**Results**

Tables A.1 and A.2 summarizes that there is an increased prevalence of COVID-19 in obese patients with OSA and their existing condition could lead to poor outcomes in COVID-19 (Cariou et al., 2020; Ekiz and Pazarli, 2020; McSharry and Malhotra, 2020; Memtsoudis et al., 2020; Suen et al., 2020; Thorpy et al., 2020). These patients have more fear of contracting COVID19 (McSharry and Malhotra, 2020; Thorpy et al., 2020). Their regular visits to hospitals to the hospitals is affected due to factors like fear of the disease, health care workers being shifted for managing COVID-19 patients and closing of sleep centres thus affecting the management of OSA (Thorpy et al., 2020).

Studies discuss about strategies made by the hospitals for minimizing risk of COVID-19 transmission. These include negative pressure rooms, minimizing the entry of health care workers into these rooms, selecting least aerosol generating masks and viral filters for non-invasive ventilation, placing masks before turning on the ventilator, minimizing the number of appointments, reducing the number of staff, testing the staff who return from COVID- 19 duty, keeping mask, gloves and sanitizers for all patients and staff, installing air purifiers, fans and plastic vertical split screens outside the doors to minimize aerosolization (McSharry and Malhotra, 2020; Thorpy et al., 2020). But, none of the studies discuss about the coping strategies that can be used by the patients to manage their symptoms by themselves. In a respiratory pandemic like covid-19, these coping strategies become critical health priority due to limited health care access. There is limited data on coping strategies that can be used by obese individual with sleep apnea during the pandemic.

**Discussion**

The findings of the review suggest that the available studies on obese individuals with sleep apnea do not discuss about coping strategies during the pandemic. These strategies are the need of the hour as they are a critical part of management for this population whose access to health care has reduced due to the pandemic. Strategies like positioning, patient education and exercise have been recommended for patients with obstructive sleep apnea for managing their symptoms (Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine, 2009). The consensus seemed to be that these coping strategies need to be reassessed in respiratory epidemic like COVID-19 due many environmental and technical barriers.

Obese patients with OSA can have the following clinical features: nocturnal hypoxemia and asphyxia, snoring, day time sleepiness, decreased aerobic capacity, increased BMI (Madani, 2007), Day time sleepiness causes fatigue, intellectual impairment, memory loss, personality disturbances and can affect daily activities (Phillipson, 2004). Nocturnal hypoxemia, decrease aerobic capacity and anxiety can lead to dyspnea (Carrieri-Kohlman and Donesky-Cuenco, 2008).The features which require and could be managed using coping strategies are summarized in Fig. A2.

Coping strategies enable the patients to effectively manage the

symptoms and reduces reliance on health care system (Carrieri-Kohlman and Donesky-Cuenco, 2008). In this pandemic, when the access to health care is reduced, they can play an important role for obese individuals with sleep apnea. The coping strategies for these individuals include positioning, continuous positive airway pressure if available at home, breathing techniques, pacing and energy conservation techniques, relaxation, distraction, being positive, patient education, exercise and weight loss (Carrieri-Kohlman and Donesky-Cuenco, 2008; Cowan and Livingston, 2012). They are mentioned in Table A3.

Patients should use a positive airway pressure device and positioning while sleeping to improve their sleep quality so that they do not experience daytime sleepiness. PAP maintains a patent airway and may be delivered in continuous (CPAP), bi-level (BPAP), or autotitrating (APAP) modes. PAP applied through a nasal, oral, or oronasal interface during sleep is the preferred treatment for OSA. Positioning therapy focuses on keeping the patients in non-supine positions during sleep. Pillows can be used to assume a comfortable upright position. A non-supine position reduces the upper airway obstruction (Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine, 2009; American Association of Cardiovascular and Pulmonary Rehabilitation, 2010).

Forward leaning position to relieve dyspnea by improving mechanical efficiency of diaphragm and optimal functioning of accessory muscles (Carrieri-Kohlman and Donesky-Cuenco, 2008). Breathing strategy Pursed-lip breathing and active expiration (contraction of abdominal muscles during exhalation) help patients control and relieve breathlessness as well as reduce panic by improving their ventilatory dynamics and pattern (Cowan and Livingstone, 2012).

These patients may experience daytime sleepiness, fatigue, dyspnea due to disturbed sleep during their daily activities, which may cause anxiety to perform those activities. Energy conservation and activity modification reduce or prevent these symptoms. Strategies include pacing activities, slowing down, using good posture and breathing techniques in performance of any task, advanced planning of rest stations during activities, avoiding unnecessary movements, minimizing steps in tasks, and sliding or pushing items instead of pulling or lifting (Carrieri-Kohlman and Donesky-Cuenco, 2008).

Eating consists of multiple activities like chewing, swallowing and hand movements. Swallowing reduces airflow and might cause oxygen desaturation. Strategies like taking break between preparing and eating the meal and eating small proportions of food, supplementing solid food with liquid food frequently can prevent or reduce fatigue and dyspnea while eating (Carrieri-Kohlman and Donesky-Cuenco, 2008). Dietary modifications can aid in weight loss leading to improvement in severity of OSA (Cowan and Livingston, 2012).

Exercise also helps in weight loss and improves aerobic capacity consequently reducing the symptoms of OSA (American Association of Cardiovascular and Pulmonary Rehabilitation, 2010; Gottlieb and Punjabi, 2020). Various aerobic activities include walking, running, jogging, and ergometer exercises. The liberty to exercise according to choice is lost due to restrictions placed due to the pandemic and the time spent indoors has increased making the life style sedentary and deteriorating mental health. This can cause increase in BMI and increase the severity of the condition. Therefore, it is important to exercise in the accessible places during the pandemic. Activities can be modified according to home environment like walking in the corridor depending on the space available.

Patient education alters central perception and helps up with symptoms like dyspnea and anxiety (Carrieri-Kohlman and Donesky-Cuenco, 2008). Patients are explained about their symptoms,

severity of the disease, and monitoring of symptoms. A step-wise plan of managing each symptom is made. They are also explained how to operate and maintain a PAP machine (American Association of Cardiovascular and Pulmonary Rehabilitation, 2010; Carrieri-Kohlman and Donesky-Cuenco, 2008). Alcohol and sedatives before bedtime should be avoided (Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine, 2009).

In the time of pandemic, patients can communicate with health care professionals using telehealth. Patients can also be made aware of the COVID-19 symptoms, precautions to be taken during the pandemic, to call a health care provide in case symptoms worsen and can be assured to reduce their fear about the impact of pandemic on their existing condition. Strategies like relaxation, distraction and being positive can help to reduce anxiety, depression and fear due to the pandemic (American Association of Cardiovascular and Pulmonary Rehabilitation, 2010; Carrieri-Kohlman and Donesky-Cuenco, 2008).

Social support can be enhanced through educational presentations and patient involvement in support groups that encourage the sharing of personal experiences. The group environment favours participant sharing of disease-related information and successful coping skills and provides an outlet for emotional release (Cowan and Livingston, 2012). In the situation of pandemic, when gathering of people is not allowed, group meeting through social networking platforms can be organized.

Although, there is a lack of literature on coping strategies for OSA in obese patients, these strategies may enable obese individuals to cope better during the pandemic and improve their quality of life. In addition, the studies retrieved through the search were heterogeneous and did not include any high quality studies. They had small sample size, long-term effects were not studied and study designs were not uniform. Uniformity in study designs is required for obtaining high quality evidence. As uniformity in study designs is required for obtaining high quality evidence, further studies with a better study design addressing these limitations should be done to get good quality of evidence for this population.

## Conclusion

Increased prevalence of COVID-19 was found among obese patients with OSA. The fear of COVID-19 and shift of health care works to manage COVID-19 patients has affected their regular visits to the hospital. Hospitals have made strategies for minimizing risk. However, coping strategies for patients to manage their condition by themselves have not been stated. Studies should to establish coping strategies in obese patients with sleep apnea.

## CRedit authorship contribution statement

**K. Vaishali:** Conceptualization, Methodology, Resources, Data curation, Writing - original draft, Writing - review & editing, Supervision. **Aishwarya Gatty:** Conceptualization, Methodology, Resources, Data curation, Writing - original draft, Writing - review & editing. **Prateek Srivastav:** Resources, Writing - review & editing. **Revati Ravi Amin:** Conceptualization, Methodology, Resources, Data curation, Writing - original draft, Writing - review & editing.

## Declaration of competing interest

The authors declare no conflict of interest.

## Appendices.

**Table A.1**  
Studies on obese patients with sleep apnea and COVID-19

Sr. No.	AUTHOR YEAR	LOCATION	STUDY DESIGN AND SUBJECTS	RESULTS	CONCLUSION
1	<a href="#">Thorpy et al., 2020</a>	New York	Telephonic Survey –112 OSA patients aged between the 20–82 years	-Body mass index: 36.2 ± 7.3 kg/m <sup>2</sup> -Patients concerned about being tested positive for COVID-19 due to: OSA- 38% Obesity- 77% –88% of patients continued to use positive airway pressure device and 21 one of them had increased the use of the device –10 patients tested positive for COVID 19–100% of them were overweight or obese- 2 of them increased the use of positive airway pressure device -Median BMI-28.4(25.0–32.7) kg/m <sup>2</sup> -BMI associated with the tracheal intubation for mechanical ventilation (p = 0.0001) -Treated OSA-independently associated with the risk of death on day 7 -BMI -31.8 ± 7.9 kg/m <sup>2</sup> -Self-reported sleep duration - No significant difference -Insomnia- Increased post lock down (41 vs. 48%, p = 0.02) -Mean hours of positive airway pressure usage- No significant difference -Patient discharged with 2 L/min on fourteenth day of illness	-Sleep apnea is associated with risk factors like obesity that are similar to those associated with morbidity and mortality of hospitalized COVID-19 patients. -Patients used positive airway pressure devices with comfort during the pandemic and that they thought were at higher risk of COVID-19 complications because of their existing condition. -Treatment of these patients affected due to closing of sleep centres. -Developing appropriate strategies and telehealth have been suggested to provide services during the pandemic,
2	<a href="#">Cariou et al., 2020</a>	France	Observational 317 COVID-19 patients with diabetes	-BMI -31.8 ± 7.9 kg/m <sup>2</sup> -Self-reported sleep duration - No significant difference -Insomnia- Increased post lock down (41 vs. 48%, p = 0.02) -Mean hours of positive airway pressure usage- No significant difference	-BMI, was positively and independently associated with tracheal intubation and was found to be an independent prognostic factor for COVID-19 severity in these patients. -OSA in these patients was associated with risk of death on day 7 of admission -COVID-19 lockdown negatively affected sleep resulting in an increase in insomnia -Future long-term studies are needed to assess the effect of COVID-19 related stress on sleep duration and hours of positive airway pressure usage.
3	<a href="#">Anwar et al. 2020</a>	Boston	Retrospective study (Review of medical records) 123 patients with OSA (CPAP adherence data was available in the 12 months prior and in the month after the COVID-19 lockdown)	-Patient discharged with 2 L/min on fourteenth day of illness	-Self-regulated high velocity nasal insufflation by communication using smart phones proved beneficial in recovery of the patient. -Reduced overall requirement of personal protective equipment and a smaller number of direct contacts with the patient.
4	<a href="#">Ciment et al. 2020</a>	United States of America	Case Report 55-Year-old obese male with OSA and diabetes diagnosed with COVID-19		

BMI, Body mass index; OSA, Obstructive sleep apnea.

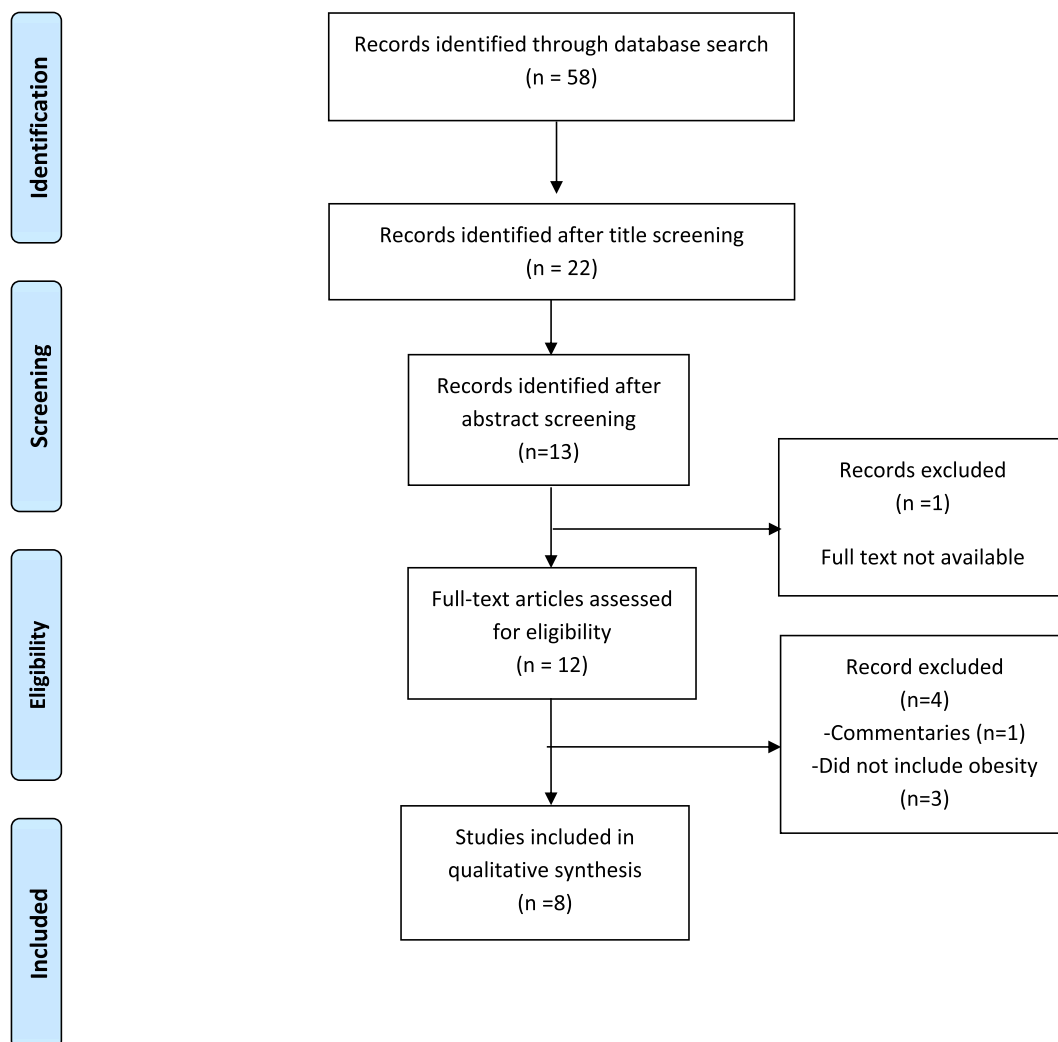
**Table A.2**  
Studies on obese patients with sleep apnea and COVID-19

Sr. No	AUTHOR YEAR	PLACE	STUDY DESIGN	STUDY DETAILS
5	<a href="#">Suen et al., 2020</a>	United States of America	Review	Explained various aspects of Covid-19 and obstructive sleep apnea like risk of COVID-19 in patients with OSA, management and safety regarding non-invasive ventilation. Recommended precautions for minimizing risk while using non-invasive ventilation.
6	<a href="#">McSharry and Malhotra, 2020</a>	Ireland and United States of America	Letter to editor	Since many studies linked COVID-19 with obesity and OSA the authors hypothesized that OSA with obesity could contribute to cytokine storm and hypoxemia in COVID-19. Also fear of contamination from using devices for treating OSA may interrupt treatment and increase patients' symptoms. They suggested further research to understand the possible link between OSA, obesity and COVID.
7	<a href="#">Ekiz and Pazarlı, 2020</a>	Turkey	Letter to editor	Correlation between obesity prevalence and deaths due to COVID-19 (p = 0.039, r = 0.464). Also, highlighted that fighting against COVID-19 in patients with obesity should consist of several multisystem approaches such as inhibiting Renin Angiotensin Aldosterone System, weight loss, vitamin D supplementation, management of OSA.
8	<a href="#">Memsoudis et al., 2020</a>	United States of America	Letter to Editor	COVID-19 causes more morbidities among people with older age and comorbidities like obesity, which is also a risk factor for OSA. They analysed all the mechanically ventilated critically ill patients diagnosed with COVID-19 from 3 randomly selected ICU at their institution and found that 33% of patients had BMI ≥30.

OSA, Obstructive sleep apnea; BMI, Body mass index.

**Table A.3**  
Coping strategies for obese patients with obstructive sleep apnea

COPING STRATEGIES	CLINICAL FEATURES						
	Nocturnal Hypoxemia	Snoring and daytime sleepiness due to disturbed sleep	Dyspnea	Fatigue	Anxiety	Depression	Increased body mass index and decreased aerobic capacity
Positive Airway Pressure therapy	✓	✓	✓				
Positioning	✓	✓	✓				
Breathing techniques			✓				
Eating right			✓	✓			✓
Pacing and energy conservation techniques			✓	✓			
Relaxation			✓	✓	✓		
Distraction			✓		✓	✓	
Being positive			✓		✓	✓	
Education			✓		✓	✓	
Social Support			✓		✓	✓	
Exercise and weight loss							✓



**Fig. A.1.** PRISMA flow diagram.

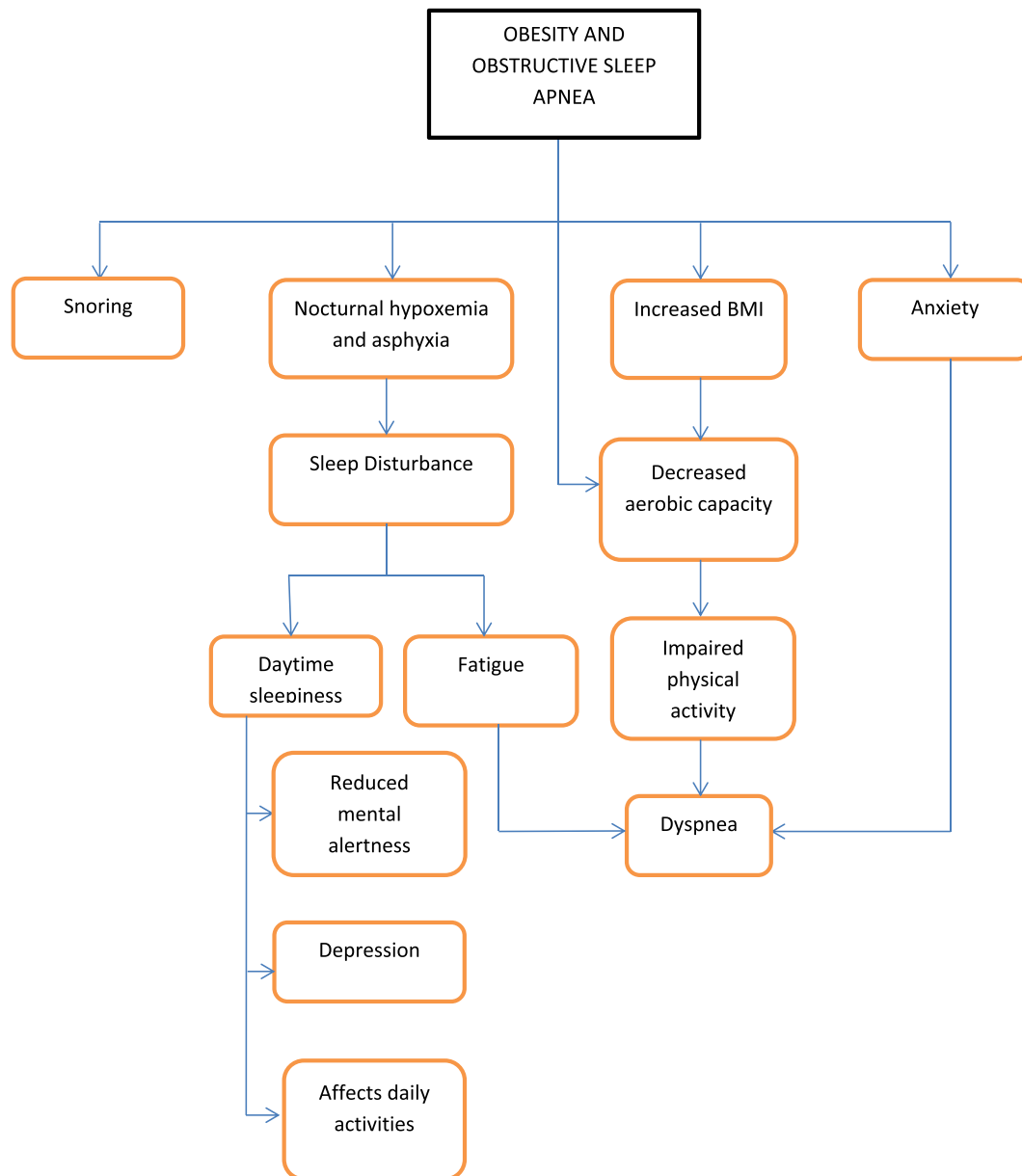


Fig. A.2. Clinical manifestations of obstructive sleep apnea in obese individuals that could be managed with coping strategies.

**Author agreement**

All authors have seen and approved the final version of the manuscript being submitted. They warrant that the article is the authors’ original work, hasn’t received prior publication and isn’t under consideration for publication elsewhere.

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