

RESEARCH ARTICLE

Sleep deprivation and its correlation with obesity

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ABSTRACT

Background: Sleep plays a key role in good health and well-being throughout life. Sleep has been known to influence the physical and emotional well-being by causing substantial biological and psychosocial changes. **Aim and Objective:** Few studies have examined the association of sleep duration with body composition in a representative sample of young adults. This is the age group where primary prevention plays the most vital part. Through our study, we decided to investigate the effect of sleep duration and body composition and suggest lifestyle modifications if any. **Materials and Methods:** After the ethical clearance from institutional ethical committee 62 healthy young adults aged 18–25 years were studied was to explore the effect of sleep on body composition with the help of Bodystat Quadscan 4000. **Results:** The study showed statistically significant differences in anthropometric as well as body composition parameters. **Conclusion:** Sleep duration has a significant role in altering body composition.

KEY WORDS: Sleep Deprivation; Obesity; Bio Electric Impedance Analyzer


INTRODUCTION

Obesity and sleep deprivation are the two epidemics that have not only affected the developed nations but also due to rapid industrialization have also affected the developing nations. The survey done by United States has shown a reduction in self-reported duration of sleep in the past 50 years by 1.5–2 h and the possible cause could be changing trends in lifestyles.^[1,2] Sleep has been frequently explored while searching the cause for modifiable risk factors. Adequate sleep is vital for good and normal functioning of the central nervous system.^[3] Sleep deficiency has shown correlation with atherosclerosis,^[4] coronary artery disease, hypertension,^[5] obesity,^[6] and

diabetes mellitus.^[7] Insufficient sleep results in adverse health effects as mentioned above and also influence body weight. Sleep has key role to play in determination of body composition although other factors such as physical activity, diet, and heredity also contribute toward body composition.^[8,9] Some cross-sectional studies have shown that the person who sleep <7 h/night is more prone for obesity.^[10] Sleep deprivation has also resulted in altered insulin secretion and a prediabetic metabolic state.^[11] Studies in humans have shown that reduction of sleep influences the neuro endocrine control of appetite and it also results in decreased levels of leptin whereas an increase in levels of ghrelin. An association of increased hunger and appetite ratings has also been observed.^[12]

It is worth noting that not all studies have shown relationship between duration of sleep and obesity. Two longitudinal studies have failed to demonstrate the relation between sleep duration and weight gain.^[13,14]

To the best of our knowledge, few studies have examined the association of sleep duration with body composition in a representative sample of young adults. This is the age

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group where primary prevention plays the most vital part. Through our study, we decided to investigate the effect of sleep duration and body composition and suggest lifestyle modifications if any.

MATERIALS AND METHODS

After the ethical clearance from institutional ethical committee, this study was conducted in the Department of Physiology, Subharti Medical College, Meerut. A total of 62 healthy young adults aged 18–25 years were randomly selected from Subharti University campus. Informed written consent was taken from the study subjects before beginning of study. Subjects were excluded for any cardio pulmonary, neuro endocrine, psychiatric, liver, or renal impairment. Those who were taking tobacco, sleeping pills, alcohol, or any recreational drug were also not included in the study. The subjects were explained in brief about the procedure. They were advised not to take tea, coffee, or food 1 h before the recording. They were asked to report to research lab of the department between 9:00 am and 11:00 am on the day of recording. They were asked to refrain themselves from heavy exercise on the day of examination. The young adults who participated in the study were asked to tell the duration of sleep in hours on most of the nights in a week for the past 1 year. The sleep duration and quality were assessed through a questionnaire^[15] and have been used in literature.^[16] The average duration of sleep on regular days as well as of weekend was calculated. The formula applied was: (weekday duration \times 5/7) + (weekend duration \times 2/7). Day time sleep was included in total duration of sleep at night. Duration of sleep $<$ 7 h was considered as inadequate sleep duration at night (IASDN) and more than 7 h as adequate sleep duration at night (ASDN).

Body weight (Wt) was recorded on an electronic weighing machine with bare footed and wearing minimal clothings. The height was measured using a stadiometer standing without shoes. Waist circumference (WC) and hip circumference (HC) were measured.

Recording Protocol

Participants were asked to lie in the supine position. All readings were taken within 5 min of lying down. Body composition and fluid assessment were done by multi-frequency bioelectrical impedance analyzer Bodystat QuadScan 4000. Body mass index (BMI), waist-hip ratio (WHR), body fat mass (FM), lean body mass (LBM), and total body water (TBW) were assessed

The data were analyzed using Analytical Software GraphPad Instat version 3.1, 32 bits for windows.

RESULTS

The IASDN group comprised 30 subjects and ASDN group consisted of 32 subjects. Both the groups showed a statistically significant difference ($P < 0.05$) on anthropometric parameters [Table 1]. The mean body weight in IASDN group was 68.43 ± 11.37 Kg, whereas in ASDN was 59.98 ± 10.67 kg which was highly significant ($P = 0.000$). WC was also higher in IASDN group (86.53 ± 9.29 cm) as compared to ASDN (79.94 ± 8.45 cm) and this exhibited a significance level of $*** (P = 0.000)$. HC was lower in ASDN group with a value of 89.69 ± 8.45 cm when compared to significantly higher ($P = 0.009$) values in IASDN group (WC= 96.03 ± 9.16 cm). WHR a predictor for cardiovascular and metabolic risk also showed a significantly higher value of 0.90 ± 0.03 in IASDN as compared to 0.89 ± 0.02 in ASDN. The p value for WHR is 0.000 which has the significance of $***$. Assessment of body composition parameters showed statistically significant elevated levels in IASDN group. BMI showed a statistically significant value of 22.97 ± 3.94 kg/m² in IASDN group as compared to 20.88 ± 3.05 kg/m² in ASDN ($P = 0.020$). The group with inadequate sleep duration showed a higher fat amount as compared to the group with adequate sleep duration (Body fat in IASDN = 8.79 ± 4.46 kg and ASDN = 6.45 ± 3.37 kg, $P = 0.20$). The LBM and TBW were also elevated in IASDN and this was statistically significant [Table 2].

DISCUSSION

The above-mentioned study was done to explore the effect of sleep duration on body composition with the help of Bodystat

Table 1: Anthropometric and body composition parameters in subjects of both groups

Parameters	IASDN (n=30)	ASDN (n=32)	P value
Body weight (kg)	68.43±11.73	59.98±10.67	$P < 0.001$
WC (cm)	86.53±9.29	79.94±8.45	$P < 0.001$
HC (cm)	96.03±9.16	89.69±8.45	$P < 0.01$
WHR	0.90±0.03	0.89±0.02	$P < 0.001$

Values are expressed as Mean±SD. The analysis of data was done using unpaired student's test; $***P < 0.001$, $*P < 0.05$ Statistically significant, WC: Waist circumference, HC: Hip circumference, WHR: Waist-hip ratio, IASDN: Inadequate sleep duration at night, ASDN: Adequate sleep duration at night

Table 2: Body composition parameters

Parameters	IASDN (n=30)	ASDN (n=32)	P value
BMI (kg/m ²)	22.97±3.94	20.88±3.05	$P < 0.05$
Fat (kg)	8.79±4.46	6.45±3.37	$P < 0.05$
LBM (kg)	59.65±8.58	53.50±9.15	$P < 0.01$
TBW (lit)	42.25±4.53	39.29±5.00	$P < 0.05$

Values are expressed as Mean±SD. The analysis of data was done using unpaired student's test; $*P < 0.05$ statistically significant; BMI: Body mass index, LBM: Lean body mass, TBW: Total body water, IASDN: Inadequate sleep duration at night, ASDN: Adequate sleep duration at night

Quadscan 4000. This study gives evidence that inadequate duration of sleep paves the way for higher body weight and fat gain in young adults. The study showed statistically significant differences in anthropometric as well as body composition parameters.

In our study, weight, WC, HC, and WHR were higher in the group with inadequate sleep duration ($P \leq 0.05$). BMI and body fat (kg) were found to be higher in IASDN group ($P = 0.020$). One study from Korea (National Health and Nutrition Examination Surveys [KNHANES]) validates our findings. They showed that less duration of sleep in subjects was associated inversely with BMI, WC, WHR, and body fat percentage and positively with skeletal muscle index.^[10] It was seen lesser the duration of sleep, higher the BMI, and vice versa.^[8] Other studies have also given evidences that duration of sleep is a risk factor for obesity in both children and adults.^[17,18] On the contrary another study from Gujarati young adults show less sleep (<7 h) does not affect the blood glucose levels.^[19] Various other studies also found that inadequate sleep leads to higher BMI and WC and frequent napping.^[20] Rathod *et al.* conducted a study on medical students and showed that among the obese students 61.54% were sleeping <6 h/night. The mean BMI was found to be higher in students with sleep duration <6 h/night ($P < 0.00001$).^[21] On the contrary, there is an interesting study by Sadanand CD, which showed no correlation between sleep quality as assessed by Pittsburgh Sleep Quality Index (PQSI) and various anthropometric parameters.^[22]

The probable mechanisms used to explain the link between short sleep duration and obesity is that inadequate sleep leads to change in the levels of several hormones. Altered regulation of orexin neurons and appetite regulating hormones may affect the food intake. It has been shown that levels of ghrelin increases with sleep restriction, whereas levels of leptin, a hormone leading to satiety decreases. Spiegel *et al.* measured the 24 h ghrelin levels in relation to meal and duration of sleep. They found that sleep has inhibitory effect on secretion of ghrelin

Strength and Limitation of the Study

Strengths of this study included use of objective measures of adiposity and involvement of young adults. Limitation of the study is small sample size. Statistical analysis was not done separately for both genders. Sleep duration was assessed subjectively. PQSI scale is a better tool to assess sleep quality of the participants. A study with large sample size may be warranted for better outcome. Serum levels of leptin and ghrelin should also be done.

CONCLUSION

Our study showed that inadequate sleep is associated with obesity. We recommend sufficient amounts as well as quality of sleep

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