

Association between Body Mass Index and Sleep Duration amongst the Adult Assamese Population

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Abstract: *Introduction and objective:* Obesity is a public health issue with increasing incidence and prevalence all over the world. Among the all modifiable factors of obesity like diet, exercise, life style, sleep etc. Sleep is the most focused factor of obesity currently. Normal sleep duration has a high impact on body weight. Diet and exercise applied on the treatment of obesity are not always effective as expected. Therefore we can modify the sleep pattern as a part of obesity treatment. The objective of our study was to find the presence of positive association between decrease sleep duration and increased body mass index (BMI) if any and to apply adequate sleep as a part of treatment of obesity in the Assamese population. *Material and method:* 219 subjects participated in the current cross sectional study. BMI was calculated for each subject using the formula weight (kg)/squared height (m²). We considered as increased BMI value when it is greater than 25kg/m². The average daily sleep duration were self reported as per study questionnaire. The association between sleep duration and BMI was statistically tested. *Result:* Out of the 219 participants 135 were male and 84 were female and all were within age group of 18 to 30 years. We observed a strong negative correlation between sleep duration and BMI In females and a moderately negative correlation between sleep duration and BMI in males. Overall we observed a moderately negative correlation between these two variables which show a significant result at P<0.05. *Conclusion:* Sleep duration is a potentially modifiable risk factor for obesity, which can be included in therapeutic approach and management of obesity. Early diagnosis and treatment of sleep disorder is important in obesity prevention.

Keywords: Sleep duration, BMI, obesity, prevention

1. Introduction and Objective

Obesity and overweight expressed by increased body mass index (BMI) are public health issues. Obesity also represent as an important risk factor for other diseases^{1, 2}. Obesity is a state of excess adipose tissue mass in the body. Although not a direct method to measure adiposity, the most widely used method to gauge obesity is the body mass index (BMI), which is equal to weight/height² (in kg/m²). Large epidemiological studies suggest that almost all causes of death like metabolic, cancer and cardiovascular morbidity begin to rise when BMI >25. Data from National Health and Nutrition Examination Surveys (NHANES) show that the American adult population with obesity (BMI>30) has increased from 14.5% (between 1946 and 1980) to 33.9% (between 2007 and 2008). India saw a more significant rise in obesity from its 19th position for both men and women in 1975 to ranking 5th and 3rd respectively in 2014, reflecting increasing obesity rates among women worldwide⁽⁴⁾. Based on two national data sources, prevalence of obesity particularly high in rural areas^(6,7). This increasing prevalence of medically significant obesity raises great concern and suggest that cut off for obesity should be lowered⁽³⁾.

The reason for the obesity epidemic seem to be multifactorial, involving an interaction of genetic, environmental and lifestyle factors⁽⁸⁾. Short sleep duration one of the potential causes of obesity is of increasing interest. A growing number of epidemiological studies have observed this association⁽⁹⁻¹¹⁾. Physiological studies demonstrating possible hormonal mechanism, that act through decreased leptin and increased ghrelin support a link between short sleep duration and heavier weight. Leptin and ghrelin levels are positively associated with satiety and hunger respectively^(12,13). In one of the largest studies,

elevated BMI was positively associated with sleep duration less than 7-8 hours per day¹⁴. Nearby the abundant energy intake and low physical activity, there are many other factors which could be behind the recent obesity prevalence⁽¹⁵⁾.

Given the opportunity most adult will sleep 7-8 hours per night, although timing, duration and internal structure of sleep vary among the healthy individual and as a function of age³. So 7-8 hours sleep is considered as normal average sleep duration for healthy adult. It was hypothesized that lack of sleep and later bedtime are associated with greater daily energy intake, lower leptin level and higher ghrelin level and ultimately leading to obesity. It was predicted that the hypothesis could be accepted if the data analysis indicated a negative correlation between BMI and sleep duration⁽⁵⁾. One still unresolved question is whether sleep duration is differentially associated with BMI across population subgroups, such as gender or age. Some studies have observed gender specific association and found stronger association among males^{9,16-18}. Other studies have found stronger effects among females or no gender difference.¹⁹⁻²¹ It has also been hypothesized that sleep BMI association may be weakened with age. Studies in children have yielded stronger and more consistent estimates of effects than studies in adults²²⁻²⁴. To our knowledge; no study has examined the association in a representative sample of young adult in this region of India. This age group merits attention, as the transition to adulthood associated with important changes in personal circumstances and behaviors that may impact both sleep and BMI such as changes in physical activity, diet and social structure.

The current study was an effort to observe the relationship between sleep duration and obesity with the objective to diagnose the cause, therapeutic management and prevention

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of obesity in the state of Assam, India. We were specifically interested in examining gender specific association, given the conflicting results in the literature about possible gender differences.

2. Material and Method

The study was carried out in the department of Physiology, Fakhruddin Ali Ahmed medical college. The study work was approved by the institutional ethics committee of Fakhruddin Ali Ahmed medical college and hospital, Barpeta Assam.

This was a cross sectional study where only YOUNG adult healthy subjects participated after a random selection. Any history chronic metabolic and debilitating disease, history of alcoholism, hypertension and genetic exposure to obesity were under exclusion criteria during the process of subject selection. Individuals with eating disorders like anorexia nervosa and with abnormal thyroid status in the form of hypothyroidism or hyperthyroidism were also excluded from the study. Out of total 219 participants the study population comprised of 135 male and 84 female subjects. All the subjects were between the age group of 18 to 30 years.

Weight and height were measured by trained research staff using a scale and a stadiometer, both of which were calibrated on a regular basis. BMI was calculated as weight in kilogram divided by height in meter squared¹⁷(Kg/m²). Weight was defined according to current BMI guidelines for adults(overweight - BMI>25kg/m²; Obese-BMI>30kg/m²).

Sleep was assessed through some validated questionnaire which drew information about the weekday sleep duration and weekend sleep duration in the 7 days of the week. Average weekday and weekend sleep duration was calculated from the time provided. From this an overall daily sleep duration was calculated as (weekday duration 5/7)+(weekend duration2/7)²⁶.

Descriptive statistic for potential confounding or mediating variables are presented as means and standard deviations or percentage according to sleep duration categories (<7,7-9,>9 hours/day) and by gender. The relation between sleep duration and BMI was determined by using categorical logistic regression test with adjustment for gender. BMI and overweight /obesity results are shown for the total sample as well as within strata of gender.

3. Result

The participants of our study comprised of 61.64% male and 38.36% female within the age group of 18-25 years.

Overall 32.87% participant reported average 7-9 hours night sleep per day, 61.19% reported less than 7 hours sleep and 5.94% reported more or equal to 9 hours sleep per day. Overall mean sleep duration of the sample population was 6.63± 1.36 hour per night and mean BMI was 25.112±7.7. On analysis with categorical regression test it shows a moderate negative correlation between mean sleep duration and mean BMI, indicating a tendency for high BMI score to go with decrease sleep duration. It shows a significant negative correlation at P <0.05.

On examining the data of the male fraction of the sample group it is observed that mean sleep duration was 6.62± 1.29 hours per night and mean BMI of the same group was 24.49 ±7.5. Categorical regression test shows a moderate negative correlation, which indicate a tendency of increasing BMI score along with decreasing average daily sleep duration.

Similarly while examining the data of female fraction of the sample population, we found mean sleep duration of 6.65±1.5 hours per day and mean BMI of 26.28±8.11. After categorical regression test it was observed that there was a strong negative correlation between the two variables in females, showing a significant result at P < 0.05.

In the current study Categorical sleep duration was inversely associated with BMI in the total sample and men with moderate significance. Among women this inverse association is strongly significant.

We did not find statistical evidence of interaction by socioeconomic status in the association between sleep duration and mean BMI (data not shown). Differences between weekday and weekend sleep duration and variation in typical bedtimes were not associated with mean BMI (data not shown).

Table 1: Break up of sample according to gender

	No of subjects	Percentage
Total	219	100%
Male	135	61.64%
Female	84	38.36%

Table 2: Break up of sample according to average daily sleep duration

	< 7 hours /day	7-9 hours/day	>9 hours/day
Total	134(61.19%)	72(32.87%)	13(5.94%)
Male	66(30.14%)	62(28.31%)	7(3.20%)
Female	48(21.92%)	30(13.705%)	6(2.73%)

Table 3: Gender specific distribution of BMI according to sleep duration

Total (219)	<7 hours/day	7-9 hours/day	>9 hours/day
Overall mean BMI	21.92	22.19	18.23
Male BMI	21.93	21.14	18.43
Female BMI	22.99	21.74	18

Table 4: Gender specific mean BMI Estimates according to category of sleep duration.(R- Regression co efficient)

Category	No	Percentage	Sleep duration (hour/day)Mean SD	BMI Mean SD	R	R ²
Total	219	100%	6.63±1.36	25.112±7.7	-0.6741	0.4508
Male	135	61.64%	6.62±1.29	24.49±7.5	-0.6722	0.4519
Female	84	38.36%	6.65±1.5	26.28±8.11	-0.7651	0.5854

After analyzing the data of the current study the hypothesis on the relationship between shorter sleep duration and higher BMI can be accepted.

4. Discussion

The current study shows that people with shorter sleep duration (<7 hours/day) have a increased odd ratio for BMI. To our knowledge in the local population of Assam this is the first study that has been carried out to examine effect of short sleep duration on BMI in young adult, which shows that sleep duration has an independent affect on BMI in young adult.

This result shows a consistent similarity with the findings of previous cross sectional studies done in different region and in different age group samples^{13,25,26}.

However our study was a gender specific study and here the male fraction of the population has shown a moderate negative relationship between sleep duration and BMI, whereas the female fraction has shown strong negative relationship between the two variable. This finding contradicts the observation of Katie et al, Knutson KL, Ko GT et al. Ganwisch et al. where they found a stronger sleep duration BMI association among males^{9,17,18,25}. But some other studies have shown similar gender variation like the current study showing a stronger negative association between sleep duration and BMI among the female subgroup of the sample¹⁹⁻²¹.

How sleep curtailment may interact with body weight is unknown, but hormones regulating appetite and energy expenditure may be involved. Ghrelin is a stomach derived hormone peptide that stimulates appetite and leptin is a adipocyte derived hormone that suppress appetite. Studies have hypothesized that these two key opposing hormones may play a significant role in interaction between short sleep and high BMI¹¹.

Our study has limitations. Sleep was not assessed in a long term basis. Our measure of sleep was on the basis of a single self report, so the temporal relation between sleep and BMI couldn't be established. Longitudinal and interventional studies are required for stronger evaluation of the association. Because, benefits of sleep are accepted in the public health community, as evidenced by new Healthy people2020²⁷ Objective related to sleep duration and timing, therefore future work into effective ways to intervene on sleep patterns – particularly in younger people is needed.

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