ASSOCIATION BETWEEN SHORT SLEEP DURATION AND OBESITY IN MEDICAL STUDENTS

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ABSTRACT

Objective: Adequate sleep has been considered important for the adolescent's health and well-being. On the other hand, self-imposed sleep curtailment is now recognized as a potentially important and novel risk factor for obesity. The objective of the study is to find the association between short sleep duration and obesity (by calculating the body mass index [BMI]) among medical students.

Methods: The study was conducted on 100 medical students. A brief history of sleep duration was taken. The height and weight were taken and the body mass index (BMI) was calculated by formula weight in kg / height in m^2. Based on the BMI criteria the students were classified into six groups: Underweight, normal, overweight, obese class I, obese class II and obese III. The waist circumference (WC) was also taken. The data obtained were statistically analysed by ANOVA test and the $p < 0.5$ was considered significant.

Results: The present cross-sectional study showed that there is an association between short sleep duration and obesity which was highly significant ($p<0.001$). This study also shows that there is an association between short sleep duration and waist circumference which was also highly significant ($p<0.001$).

Conclusion: The present study observed a high association of short sleep duration among medical students of IMS and SUM Hospital and that short sleep duration was significantly associated with increased risk of overweight and obesity. We should further investigate whether adults adopting a healthy lifestyle with short sleep duration would improve their sleeping habits or not.

Keywords: Sleep duration, Body mass index, Waist circumference, Obesity.

INTRODUCTION

Sleep serves an important restorative function in humans, and a growing body of research is unraveling the possible roles of sleep in helping to maintain the homeostasis of numerous physiological functions [1] The 2004-2007 National Health Interview Survey revealed that approximately 28.3% of adults report sleeping 6 hrs or less per night, and other studies have indicated that the prevalence of short sleepers (adults who report an average of ≤6 hrs of sleep within a 24-hrs period) has significantly increased in recent decades [2,3]. Obesity is a medical condition in which excess body fat has accumulated to the extent that it may trigger risk of chronic illness, reduce life expectancy, and affect quality of life. Body mass index (BMI), which relates the body's weight with height, has been widely used and accepted as a simple method to classify medical risk by weight status [3]. There have been a lot of mechanisms which have been proposed, how short sleep duration may increase the risk of being overweight or obese. Studies found that the levels of hormones ghrelin, leptin, and cortisol are altered by sleep restriction [4-8]. In many cases [4-7], but not all [8], these hormonal changes have been accompanied by decreased energy expenditure and/or increased energy intake by increasing appetite, thereby causing weight gain. Sleep restriction has also been linked with altered food preferences (specifically increased snack consumption, particularly snacks with high carbohydrate content) in the absence of hormonal changes [9]. This is because many people assume primary responsibility over their eating for the first time in their lifetime. Moreover, there are a lot of fast-food restaurants, and other restaurants nest most of their campuses which also negatively impact on eating behavior of the students [10]. These findings lend support to the hypothesis that short sleep may facilitate weight gain by altering energy expenditure and intake [11]. Spiegel *et al.* [4] found that cases undergoing 2 nights of sleep restriction (4 hrs time in bed/night) with controlled energy intake via an intravenous glucose infusion exhibited increased levels of ghrelin (an orexigenic hormone released from the stomach) and decreased levels of leptin (an anorexigenic hormone released from adipocytes). These neuroendocrine changes were accompanied by significant increases in self-reported ratings of hunger and appetite, specifically for foods with high carbohydrate content [4]. Some of the experiments shows that sleep loss increases ghrelin levels and decreases leptin in calorically restricted humans [12,6]. Sleep restriction also affects macronutrient intake and meal frequency. Adolescents who habitually slept <8 hrs/night consumed a higher proportion of calories from fat and a lower proportion of calories from carbohydrates and protein than those who slept 8 hrs or more per night [13]. In adults, sleep restriction has been associated with increased craving for foods high in carbohydrate content [4], greater consumption of calories from carbohydrates [9] or fats [14], and increased caloric intake derived from snacks. In addition to daily caloric intake, meal timing is an important contributor to weight gain [15,16].

Aim and Objectives

The aim and objectives of the study is to determine the association between sleep duration and obesity.

METHODS

The present cross-sectional study was carried out in the Department of Physiology, IMS and SUM Hospital, Bhubaneswar, Odisha. A number of 100 MBBS students were taken as cases. A brief history of sleep duration was taken. The height, weight, and waist circumference (WC) were taken, and BMI was calculated. The dependent variables used in the study were the cases' BMI (i.e., weight in kilograms divided by the square of height in meters-kg/m^2) and obesity status based on BMI. The independent variable used in the study was the cases' self-reported average number

of hours of sleep obtained per night. The question asked was, "How many hours of sleep do you usually get a night (or when you usually sleep)?" Questions were also asked about trouble waking up during the night and daytime sleepiness. If the number of hours of sleep obtained per night was represented in the regression models as a continuous variable, the assumption would have to be made that each additional hour of sleep per night is associated with the same change in the dependent variable, regardless of the number of hours of sleep. When measuring WC, the tape was loosely held without pressing the skin. WC in girls was measured with light shirt on, and this was later adjusted (corrected) using a correction factor of - 1 cm, based on the results of a small pilot study.

RESULTS

Of the 100 1st year medical students in the present study, 47% (47) were male and 53% (53) were female.

Table 1 shows that as the duration of sleep decreases, the BMI increases, i.e., obesity.

It was found that the percentage of students with sleep duration ≤5 hrs of BMI <18.4 is nil, BMI 18.5-24.9 was 7%, BMI 25-29.9 was 2%, BMI 30-34.9 was 6%, BMI 35-39.9 was 10%, and BMI >40 was 1%.

The percentage of students with sleep duration 6 hrs of BMI <18.4 was 1%, BMI 18.5-24.9 was 31%, BMI 25-29.9 was 13%, BMI 30-34.9 was 1%, and BMI 35-39.9 was >40 was nil.

The percentage of students with sleep duration ≥7 hrs of BMI <18.4 is nil, BMI 18.5-24.9 was 7%, BMI 25-29.9 was 2%, BMI 30-34.9 was 6%, BMI 35-39.9 was 10%, and BMI >40 was 1%.

Table 2 shows that there is a high significant association between short sleep duration and high BMI (obesity) with p<0.001 (ANOVA test).

Table 1: Relationship between sleep duration and BMI

BMI (kg/m²)	Sleep duration		
	<5 hrs n=26 (%)	6 hrs n=28 (%)	>7 hrs (n=28) (%)
<18.4 (underweight)	-	-	1 (1)
18.5-24.9 (normal)	7 (7)	21 (21)	31 (31)
25-29.9 (overweight)	2 (2)	7 (7)	13 (13)
30-34.9 (obese class I)	6 (6)	-	1 (1)
35-39.9 (obese class II)	10 (10)	-	-
>40 (Obese class III)	1 (1)	-	-

BMI: Body mass index

Table 2: Association between short sleep duration and obesity

Variables	Sleep duration		
	<5 hrs	6 hrs	>7 hrs
Number of students (n)	26	28	46
Mean BMI	30.81	22.21	22.76
SD	6.49	2.90	3.21

F = 36.65, P < 0.001 (highly significant). BMI: Body mass index, SD: Standard deviation

Table 3: Relationship between WC and sleep duration

Variables	Sleep duration		
	≤5 hrs	6 hrs	>7 hrs
Number of students (n)	26	28	46
Mean (WC)	96.77	82.50	80.08
SD	15.50	11.37	13.77

F = 13.17, P < 0.001 (p < 0.05 is significant). WC: Waist circumference

Table 3 shows that with decrease in sleep duration, there is an increase in WC, which shows that there is a high significant association between short sleep duration and WC (p<0.001) (ANOVA test).

Figure 1 shows that as the duration of sleep decreases, the BMI increases.

Figure 2 shows that sleep deprivation might predispose to weight gain by increasing caloric intake which leads to hyperphagia. These changes correspond with elevation of serum ghrelin and reduction in serum leptin suggesting sleep deprivation will increase hunger and feeling of fatigue. Sleep deprivation also leads to altered thermoregulation. These changes lead to obesity.

DISCUSSION

The World Health Organization has recognized the obesity epidemic as one of the top 10 global health problems [17]. A healthy lifestyle includes among other things a good sleeping pattern. Human beings spend almost one-third of their lifetimes in sleeping, and adequate sleep is essential to human health and well-being [18,19].

The main findings of this study indicate that adolescents do not obtain enough daily sleep. In addition, adolescents in IMS and SUM Hospital are overweight or obese are more likely to have inadequate daily sleep.

This study shows that there is a high significant association between short sleep duration and obesity which corroborates with Patel and Hu (2008) [20] and Marshall *et al.* (2008) [21].

In the current study, we did not observe any significant difference in sleep duration between males and females. Such finding is similar to those reported by previous research for adolescents from Australia [22], Switzerland [23], and Germany [24].
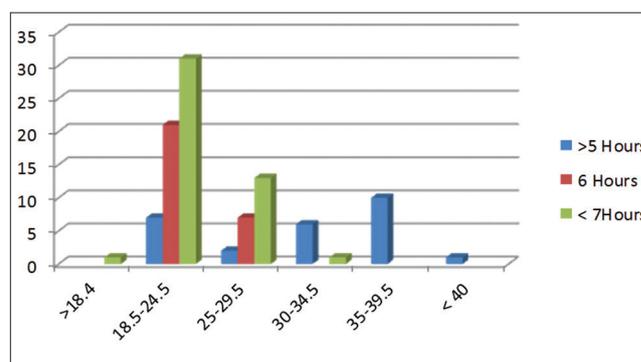

Fig. 1: The relationship between fewer hours of sleep per day and the incidence of high body mass index (obesity)
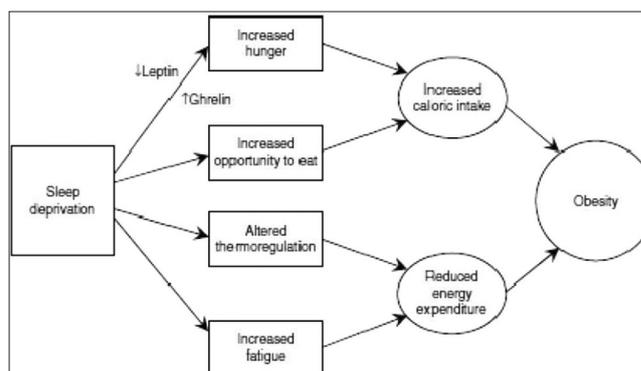

Fig. 2: Potential mechanisms by which sleep duration may predispose obesity (Patel and Hu) [20]

Yu *et al.* found the association between short sleep duration and higher BMI, which is most likely mediated by factors mediated by factors associated with total and central adiposity (which was measured by using dual- energy X- ray absorptiometry [DEXA]) which corroborates with the present study [25].

CONCLUSION

The present study observed a high prevalence of short sleep duration that short sleep duration was significantly associated with increased risk of overweight and obesity. For the prevention of adolescent obesity, sleep duration must be an important risk factor to be considered. We should further investigate that adults adopting a healthy lifestyle with short sleep duration would improve their sleeping habits or not. Since short sleep duration is a modifiable risk factor, increasing sleep duration may be clinically implicated for prevention and treatment of obesity. To improve the health, we should promote a healthy diet, physical activity, and adequate sleep [26].

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