

## Study of sleep deprivation and obesity among adolescents of Vadodara city



### Medical Science

**KEYWORDS :** sleep deprivation, adolescents, obesity

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### ABSTRACT

*Background and objectives:* Recent studies on various populations indicate that sleep deprivation is one of the potential risk factors predisposing Adolescents to obesity. Since there is a significant rise in obesity among Indian Adolescents and because research indicating the role of sleep in development of obesity among Indian population is scant, the current study was undertaken with the objective to assess the effect of sleep duration on obesity among urban adolescents.

*Methods:* A cross sectional study was conducted between July 2012 to December 2012 in Vadodara city. Total 1050 participants were randomly selected from 15 schools in the age group of 11 to 19 years after taking written informed consent from school authority. A pre-tested, semi structured, self administered questionnaire was used which includes demographic information, dietary information and physical activity questionnaire. Anthropometric measurements such as height, weight were done for each of the adolescents. BMI of each was calculated and Adolescents were classified as overweight and obese by the WHO Reference 2007 with respect to their age and sex.

*Results:* 45% participants were taking less than seven hours sleep per day. Obese adolescents were observed to have less sleep than non-obese adolescents ( $P < 0.0002$ ).

*Conclusion:* Inadequate sleep duration may be one of the risk factor for obesity among adolescents but further research is required to find out the mechanisms through which sleep affects obesity in this population.

### INTRODUCTION

The World Health Organization (WHO) describes overweight and obesity as one of today's most important public health problems, which is escalating as a "Global Epidemic".(1) It is also increasingly recognized as a significant problem in developing countries and countries undergoing economic transition. (2) The problem of overweight and obesity is confined not only to adults but also being reported among the children and adolescents of developed as well as developing countries. Since, adolescence is a period of transition from childhood to adulthood; it assumes critical position in the life cycle of human beings, characterized by an exceptionally rapid rate of growth.(3)

A phenomenal rise has been observed in the prevalence of overweight and obesity among Indian adolescents.(4) This has been attributed to nutritional transition in India, characterized by a shift in the diet content towards a high fat and high sugar.(5) However, recent studies conducted in various parts of the world indicate that sleep has evolved as a significant determinant of body composition besides conventional factors like physical activity status, dietary habit and genetic inheritance that determine the body composition.(6-7). These studies indicate that lack of adequate sleep predisposes the children to overweight and obesity. Sleep has been known to influence the physical and emotional well being of adolescents by causing substantial biological and psychosocial changes.(8)

The current study assesses the effect of sleep duration on obesity among the urban Gujarati adolescents. There are scant reports available on Indian population indicating the relationship of sleep and obesity among adolescents.

### MATERIALS AND METHODS

A cross sectional study was conducted between July 2012 to December 2012 among urban school going adolescents in the age group of 11 to 19 years. Studies carried out in the past have revealed that the prevalence of overweight and obesity among urban adolescents was in the range of 10-15%.(9) Assuming a current prevalence (P) of 10% overweight and obesity, with 95% confidence interval, 20% allowable error (L), sample size

estimated was 865 children. [Using formula  $n = \frac{(Z_{1-\alpha/2})^2 \times PQ}{L^2}$ ; where  $\alpha=5\%$ ,  $P=10\%$ ,  $Q=90\%$ ,  $L=2(20\% \text{ of } P)$ ](10) Estimating the non-response rate of 20%, an additional 173 subjects were included. So, total sample size came to 1038 (865+173) which was rounded to 1050.

So, total 1050 participants were randomly selected from 15 schools after taking written informed consent from school authority. A pre-tested, semi structured, self administered questionnaire was used which includes demographic information, dietary information and physical activity questionnaire.

The participants were asked to self-report the number of hours for which they slept during most of the nights, in a week, for the last one-year. The participants reported the sleeping hours from the time of going to bed to the time they woke up in the morning.

An anthropometric measurement such as height and weight of each of the adolescents was done. The height was measured using meter scale without footwear to the nearest 1 cm. Body Weight was measured without any footwear with minimal clothing (school uniform) using spring balance calibrated to 0.5 kg accuracy.

BMI was calculated by formula weight in kg divided by square of height in meter. Adolescents were classified as overweight and obese the WHO Reference 2007 with respect to their age and sex.(11)

### Data Management & Statistical methods

Data was entered in Microsoft Excel Sheet and analyzed using Epi Info<sup>TM</sup> 3.5.1. Comparison of difference in proportions of Overweight/Obese and Non-Overweight/Obese was compared using 'chi-square' test.

### Ethical Issues

Before starting the study, necessary clearances and permissions were obtained from concerned authorities including District

Education Office, School authorities, and Institutional Scientific and Ethical Review Committee.

## RESULTS

Table 1 presents the socio-demographic profile of the participants. Majority of adolescents were from early (11-13 years) and mid (14-16 years) adolescent age group. Around 10% were from late (17-19 years) adolescent age group. This is because our sample consisted of school going adolescents. There was almost equal distribution of boys and girls (Boys - 55%, Girls - 45%).

Out of 1050 participants one fourth were from English medium and the rest were from Gujarati medium schools. Majority of the participants followed Hindu religion. Almost three fourth (71.9%) participants had total number of family members less than or equal to five and one fourth with six to ten. Around one fifth (20.3%) participants have positive family history of overweight/obesity. The socio-economic status (SES) could be calculated for only one third of the participants as relevant information on family income could not be obtained from some of them. According to socio economic status, class I to IV have almost equal representation of around 20% to 25% in each class, followed by only 7% from SES class V.

The combined prevalence of obesity and overweight were found to be 10.5%. Table 2 shows that as high as around 45% participants were taking less than seven hours sleep per day. Those adolescents taking inadequate sleep ( $\leq 7$  hours per day) had a highly significant ( $P < 0.0002$ ) association with overweight and obesity.

## DISCUSSION

Sleep deprivation has been reported in the literature to be associated with obesity. Shaikh W et al. had done study on sleep deprivation and obesity among Gujarati adolescents. The results of the study reveal that sleep duration of less than seven hours is a risk factor for obesity in Gujarati adolescents.(12) Kuriyan R et al. also showed association of sleep deprivation and obesity among Indian children.(13)

Similar findings were observed in various studies. Chen X et al. had done a meta-analysis for papers published between January 1980 and May 2007, it showed the strong evidence of the association between short sleep duration and childhood obesity. (14)

Another systematic review by Patel SR et al. also suggested short sleep duration is strongly and consistently associated with concurrent and future obesity.(15)

Our study also shows association of sleep deprivation with overweight and obesity in urban adolescents from India. The cross sectional nature of our study does not allow us to comment on the temporality of the association. Yet, the previous studies on the subject have largely provided a hint towards the direction of such association. They have postulated that sleep deprivation is a potential risk factor for obesity among adolescents.

Several explanations have been offered and studied for the sleep deprivation to cause obesity. One of them suggests that chronic partial sleep deprivation causes feelings of fatigue which may lead to reduced physical activity.(16-17) Some cross-sectional studies in children have also found short sleep durations to be associated with increased television viewing and reduced participation in organized sports.(18-19)

It has also been argued that the additional time available on account of sleep deprivation may go into snacking and eating leading to higher calorie intakes in those social environments where the lifestyle is largely sedentary.(20)

The sleep deprivation link to obesity has also been studied with the help of biochemical markers. Most prominent among them are the ones on Leptin and Ghrelin also known as the 'hunger hormones'. Leptin and ghrelin are two hormones that have been

recognized to have a major influence on energy balance. Leptin is a mediator of long-term regulation of energy balance, suppressing food intake and thereby inducing weight loss. Ghrelin on the other hand is a fast-acting hormone, seemingly playing a role in meal initiation.(21)

Studies have shown that Sleep curtailment is associated with decreased Leptin levels, elevated Ghrelin levels, and increased hunger and appetite. Further, these studies have also shown a link of sleep deprivation with insulin resistance and type 2 diabetes with which obesity shares so many risk factors. Thus, the increased adiposity observed in sleep-deprived individuals is may be in part due to changes in the plasma concentrations of Leptin and Ghrelin. (22-23)

In spite of these studies the definitive effect of sleep deprivation on obesity is yet to be conclusively proven. Thus further prospective studies are warranted to understand the effect of the sleep deprivation on obesity. Moreover it would be advantageous to use more objective methods to measure the duration of sleep as compared to recall method which has been a limitation of this study.

## CONCLUSION

This study shows that sleep deprivation (night sleep duration less than seven hours) significantly affects the body composition of the urban adolescents of age group 11-19 years and may predisposes them to the risk of overweight and obesity. However, further studies are required to understand the mechanism of increase in fat mass in this population because of sleep deprivation.

**Table 1: Socio-demographic characteristics of the Participants**

CHARACTERISTICS	No. (N=1050)	%
Age Group		
Early Adolescence (11-13 years)	472	45
Mid Adolescence (14-16 years)	453	43.1
Late Adolescence (17-19 years)	125	11.9
Gender		
Boys	577	55
Girls	473	45
Medium of Instruction		
Gujarati	770	73.3
English	280	26.6
Religion		
Hindu	975	92.8
Muslim	72	6.9
Others	3	0.3
Total family members		
$\leq 5$	755	71.9
6 - 10	263	25.1
>10	32	3
Family history of overweight/Obesity		
Yes	213	20.3
No	837	79.7
<b>Socio economic class (Modified Prasad Classification)* (N=369)</b>		
Class I	78	21.1

Class II	89	24.1
Class III	86	23.3
Class IV	90	24.4
Class V	26	7

\*Modified Prasad Classification

**Table 2: Sleep duration and Obesity**

Sleep duration (per day)	Overweight & Obese N (%)	Non-Overweight & Obese N (%)	Total
≤7 hours	69 (14.4)	411 (85.6)	480
>7 hours	41 (7.2)	529 (92.8)	570
	110	940	1050
<b>Significance :</b> $\chi^2 = 13.57, p < 0.0002$			

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