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ASSOCIATION OF SLEEP DURATION WITH BLOOD GLUCOSE LEVEL OF GUJARATI INDIAN ADOLESCENTS

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Abstract : Recently studies conducted in various parts of the world indicate short sleep duration as a novel risk factor for development of type 2 diabetes. However, ethnic differences exist in the etiopathogenesis of diseases, the current study was undertaken to study the effect of sleep duration on the blood glucose level of Gujarati Indian adolescents. A randomized, non-experimental, cross-sectional study was done on the voluntary participants n=332 Gujarati adolescent boys and girls of age group 13-20 years studying at the schools and colleges in the Anand district. The participants were assessed for their sleep duration, body composition and blood glucose level. The sleep duration was reported by the subjects as the number of hours they slept on most of the nights in a week over the last one-year. The observations of the study were then analyzed after grouping them into: 1) Adequate sleep duration at night, ASDN (≥7 hrs) and 2) Inadequate sleep duration at night, ISDN (<7 hrs) groups. One-way ANOVA and post hoc Tuky-Krammer test were used for finding significant differences ($P<0.05$) between groups. No significant difference was found in all parameters of body composition and fasting blood glucose level between the ASDN group and ISDN group in both boys and girls. However, gender difference exists in the body composition and blood glucose level. The current study indicates that inadequate sleep duration at night (<7 hrs) does not affect the blood glucose level of the Gujarati Indian adolescents of age group 13-20 years.

Key words : sleep duration blood glucose level Gujarati Indian adolescents

INTRODUCTION

Type 2 diabetes poses a major health problem globally, especially in many developing countries. In India, type 2 diabetes is reaching epidemic proportions. Diabetes develops at a younger age in Indians, i.e., at least a decade or two earlier than in the Western population (1). The study has reported a high prevalence of maturity-onset diabetes of the young (MODY) in Indian population (2). However, studies

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conducted in various parts of the world indicate short sleep duration as a novel risk factor for development of type 2 diabetes amongst adults (3, 4).

Sleep deprivation studies suggest that habitually short sleep results in a reduction in insulin sensitivity, and therefore, could be a risk factor for the later development of diabetes. Various mechanisms have been delineated that link short sleep duration with the development of diabetes. First, short sleep may lead to diabetes due to weight gain, as a high body mass index (BMI) may worsen sleep quality by creating a prediabetic state with increasing urination. Second, sleep restriction may directly lead to the development of diabetes through its effects on weight. Hypothesis behind this is that, if chronic self-imposed sleep restriction occurs that leads to reductions in leptin, so appetite and weight gain may be increased. This could thus represent a physiologic mechanism whereby sleep restriction may predispose to weight gain and subsequently contribute to the development of diabetes (5).

In our previous study we have found that short sleep durations have been associated with adiposity in Gujarati Indian adolescents (6). However, there are scant reports available from Indian adolescents, which indicate the influence of sleep on the blood glucose level of Indians and the fact that aetiopathogenesis differs across ethnicity, it is essential to determine the role of sleep quantity and sleep quality in the pathogenesis of type 2 diabetes in the Indian adolescents. The current study was therefore undertaken to assess the effect of sleep duration on blood glucose level of the Gujarati Indian adolescents. The study was framed keeping the hypothesis that short sleep duration may affect the blood glucose level by affecting the body composition of the adolescents.

MATERIALS AND METHODS

A randomized, non-experimental, cross-sectional study was done on the voluntary participants n=332 Gujarati adolescent boys and girls of age group 13-20 years studying at the schools and colleges in the Anand district. The study was conducted after the approval of the Human Research Ethic's Committee (HREC) of H. M. Patel centre for Medical Care and Education and after obtaining the informed consent from the participants (Age ≥18 yrs) or the guardian (Age <18 yrs).

Sleep duration at night: 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 subjects reported the sleeping hours from the time of going to bed to the time they woke up in the morning. Sleep duration of more than or equal to 7 hours per night was considered as Adequate Sleep Duration at Night (ASDN) and sleep duration of less than seven hours was considered as Inadequate Sleep Duration at Night (ISDN) (7).

Assessment of body composition

The body composition was assessed in a standardized state of clothing. The body weight (Wt) was recorded bare footed to the nearest 0.5 kg using a calibrated weighing machine. The height was measured using meter scale without footwear to the nearest 1cm. BMI was calculated by as the weight (kg) divided by the square of height (m^2).

Waist circumference (WC) was measured at the mid point between the lower costal margin and the iliac crest to the nearest 0.5 cm at the end of normal expiration (8, 9). Hip circumference (HC) was measured at the highest point of the buttocks (10). Waist – Hip Ratio (WHR) was calculated as the waist circumference divided by the Hip circumference. Body fat percentage (BF %) and Total body fat mass (FM) were assessed by bioelectrical impedance technique using Omron Body Fat Monitor HBF -302 (11). Fat Free Mass (FFM) was calculated by subtracting FM from total body wt. Fat Mass Index (FMI) was calculated as the FM (kg) divided by the square of height in meters (m^2) and Fat Free Mass Index (FFMI) was calculated as the FFM (kg) divided by the square of height in meters (m^2) (12).

Assessment of blood glucose level

The blood glucose level was measured in the fasting state, where the subjects were asked NOT to eat or drink for eight-hour, using the capillary blood (13) and assessed by the glucometer Accu-check Active (14) whose accuracy is 0.989 and SD is 2.7 mg/dl.

Statistical analysis

Statistical analysis was done using Microsoft Excel and SPSS (Statistical package for social sciences). One-way ANOVA (Analysis of variance) and post hoc Tuky-Krammer test were used for finding significant differences between groups. P-values <0.05 were considered as significant.

RESULTS

Table I indicate that in both boys and girls, respectively wt., BMI, BF%, FM, FMI, FFM, FFMI, WC, HC, WHR and fasting blood glucose level did not differ significantly between adolescents having adequate sleep duration at night and those who slept inadequately at night. However, boys with adequate sleep duration at night (ASDN) did have a significantly higher weight, FFM, WC, WHR in comparison to girls with ASDN and Girls with ASDN did have significantly higher BF % and FBS in comparison to those boys who slept adequately at night.

TABLE I: Body composition and fasting blood glucose level in Gujarati Indian Adolescents with Adequate and Inadequate Sleep Duration at Night.

Study variable	*Girls with ASDN (≥7 hours) (N=90)*	*Girls with ISDN (<7 hours) (N=5)*	*Boys with ASDN (≥7 hours) (N=204)*	*Boys with ISDN (<7 hours)(N=33)*	*P values*
Weight	43.4±8.5	43.9±10.0	48.9±13.7**	53.3±11.8#	0.00
BMI	18.9±3.6	19.3±4.4	18.5±3.9	19.7±3.4	0.30
BF%	22.6±7.3	23.9±9.1	17.9±5.8**	19.4±6.0	0.00
FM	10.4±5.3	11.2±6.0	9.6±7.2	10.7±5.3	0.68
FMI	4.5±2.3	4.9±2.8	3.6±2.8	4.0±1.9	0.06
FFM	33.0±3.8	32.6±4.1	39.3±10.8**	42.6±7.9#, †	0.00
FFMI	14.4±1.5	14.4±1.5	14.8±3.1	15.7±1.7	0.11
WC	61.4±5.8	47.7±23.3	64.9±9.6**	66.0±9.1#	0.00
HC	78.5±6.3	77.6±7.3	79.3±9.4	82.3±7.9	0.17
WHR	0.78±0.03	0.62±0.3	0.81±0.05**	0.79±0.05	0.00
FBS	87.3±8.1	86.4±8.5	84.2±7.3**	84.4±7.4	0.01

*depicts significant difference between Females with ASDN and Males with ASDN **P<0.01, *P<0.05,
#depicts significant difference between Females with ASDN and Males with ISDN #P<0.05,
†depicts significant difference between Females with ISDN and Males with ISDN †P<0.01.

DISCUSSION

Current study shows that sleep duration does not have significant effect on the body composition and fasting blood glucose level in the Gujarati Indian adolescents. This is, however, contradictory to the findings of research conducted in the other part of world, which, shows that a consistent increased risk of obesity amongst short sleepers in children and adults (15). As the obesity increases it leads to diabetes in short sleepers via multiple pathways. Chronic partial sleep loss is associated with impairments in glucose metabolism and with alterations in the circulating levels of the hormones leptin and ghrelin. Leptin and ghrelin are involved in appetite regulation and energy expenditure. Leptin inhibits appetite and increases energy expenditure, while ghrelin has the opposite affects. Sleep restriction is associated with lower leptin and higher ghrelin levels and is thus likely to increase hunger and appetite. Thus sleep loss may increase the risk of obesity and diabetes (5). In the current study as the body composition is not affected which probably explain that the glucose level is not influenced by short sleep duration in adolescents. The second important observation in the current study is that the lean body mass and central distribution of fat is significantly higher in boys having adequate sleep duration at night as compared girls who slept adequately and girls have significantly higher body fat as compared to boys who slept adequately at night.

There are large differences in body composition in boys and girls, with boys having more lean body mass and girls having more body fat. Fat distribution also differs with gender, with boys having a relatively more central distribution of fat. These differences begin early in life and become more apparent in puberty due to changes in sex hormone levels. In both, boys and girls, waist and waist-to-hip ratio increase with age. A large portion of this increase is driven by gains in body weight (16). The present study is in line with the previous studies which observed that girls have more body fat and less lean body mass and central distribution of fat as compared to boys.

Conclusion

The current study indicates that inadequate sleep duration at night (< 7 hrs) does not affect the blood glucose level of the Gujarati Indian adolescents of age group 13-20 years. This is probably because inadequate sleep does not affect the body composition. However, gender difference exists in the body composition and blood glucose level.

Limitations and future perspectives

A major limitation of the study is that, it is a cross sectional study and that the sleep duration has been assessed subjectively. Therefore longitudinal and/or experimental studies involving more objective measures and biochemical parameters are required to assess the actual casual relationship between sleep duration and blood glucose level.

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