BODY MASS INDEX OF ADOLESCENTS AND ADULTS AND ITS RELATION TO SLEEP IN A WARD OF GOKARNESHWOR MUNICIPALITY

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ABSTRACT

Various studies have shown that abnormal body mass index (BMI) of an individual is linked to poor sleep. Abnormal BMI is a predisposing factor for many non- communicable diseases like cardiovascular diseases and diabetes. However, if BMI is affected by sleep, detecting sleep abnormality followed by simple corrective measures may help in making BMI normal hence preventing the risk of many such diseases. Using Asian Classification for BMI and questions from Pittsburgh Sleep Quality Index (PQSI) a survey was carried out among persons aged 15 to 60 years in a ward of Gokarneshwor Municipality. In this study, out of a total of 563 persons 4.4% were underweight, 33.9% had normal BMI, 18.5% were overweight and 43.2% were obese. Around 22% reported a reduced duration of sleep but only around 5% of the persons felt that their quality of sleep was poor. This study showed that the association between reduced sleep duration and abnormal BMI was significant even when confounding variables like tobacco or alcohol and poverty state were removed.

KEYWORDS

Body mass index, sleep, Gokarneshwor

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INTRODUCTION

Body mass index (BMI), also known as Quetelet index, is the ratio of weight in kilograms and height squared in meters.[1] The term "adolescence" has been defined as including those aged between 10 to 19.[2] It is the age that precedes adulthood. Humans spend about one-third of their lives in sleep, yet most individuals know little about sleep. Sleep is a universal need of all higher life forms including humans, absence of which has serious physiological consequences.[3] Major advances in sleep sciences have occurred since the discovery of rapid eye movement (REM) sleep in 1953 AD.[4] The importance of sleep to good health was shown by the experiments conducted in rats. With sleep deprivation the rats became hyper-metabolic and lost weight despite increasing food intake. Studies of prolonged sleep deprivation have not been performed in humans for ethical reasons. However, there are evidences that torture in humans in the form of prolonged sleep deprivation had detrimental consequences to the individual.[4]

Studies have shown that BMI is affected by sleep.[5,6] Mechanisms of sleep restriction leading to changes in weight (and BMI) are unclear but it may be due to disrupted appetite regulating hormone.[7]

Sufficient sleep duration requirements vary across the lifespan and from person to person. The recommended duration of sleep by National Sleep Foundation of U.S.A. is 8 to 10 hours for adolescents and 7 to 9 hours for adults.[8] Results from another study done in U.S.A indicated that professionals should also focus on sleep quality in addition to sleep quantity in their efforts to understand the role of sleep in daily life.[9] The Pittsburgh Sleep Quality Index (PSQI), a self-administered questionnaire that assesses sleep quality over a 1-month time interval, has been used on late adolescents.[10] This index has also been used to assess quality of sleep in adults under the age of sixty.[11] According to WHO, Asian BMI classification for adults, the suggested cut off point for underweight, overweight and obese I and obese II in kg/m^2 is <18.5, 23.0 to 24.5,25.0 to 29.9 and >30 respectively with normal range being 18.5 to 22.9. For adolescents BMI categories vary according to age and gender as per WHO growth charts.

MATERIALS AND METHODS

After getting ethical approval from the Institutional Review Committee of Nepal Medical College (Ref. No:044-075/076) and consent from the Ward office, community based descriptive study was carried out from June 2019 to November 2019 in ward 1 of Gokarneshwor Municipality which has a total of 9 wards.

A questionnaire based on that of Family Health Exercise, Community Medicine Department of Nepal Medical College and PQSI was designed to collect data required for the research. Medical undergraduates of Nepal Medical College were trained to use the questionnaire when they went on a family health visit which is a part of academic activity of Community Medicine. For this permission was taken from the Head of Community Medicine Department. Verbal consent was also taken from the head of each household.

Total number of households in Ward 1 is 1194 (as per Gokarneshwor Municipality, Policy, Program and Budget-2018/19). Two hundred and forty households constitute 20% of the total number of households in that ward. To cover 20 % of the total households in this ward, based on method of systematic random sampling, every fifth household was selected. If the members did not give consent the student went to the next household. Pre testing was done in 10 percent of the total households.

Five hundred and sixty- three subjects with age between 15 to 60 years of age from 240 households participated in this study. Anthropometric measurements were taken using a weighing machine and measuring tape. Weight was measured with a weighing scale placed on a hard, flat surface without slippers and reported in kilograms. Height was measured by placing the person against a wall and height marked by a ruler. The height was measured using a non-stretchable measuring tape on a rigid wall surface and reported in meters. This method has been used in other studies which required measurement of BMI.[12,13]

People with diagnosed psychiatric problems were not included in this study. Household members of Mulkharka of this ward were also not included in this study because of relative inaccessibility.

Adult BMI was categorized according to WHO. BMI Asia Classification and for adolescents WHO. BMI chart was used. Caste was categorized as in *Nepal Demographic and Health Survey 2006; caste, ethnic and regional identity in Nepal*. Duration of Sleep was categorized based on Standard of American Sleep Foundation of USA, i.e. 8 to 10 hours for adolescents and 7 to 9 hours for adults. Sleep quality was assessed according to a question of PSQI.

A person was considered living below poverty line if the person did not have access to at least 2 US dollars per day (Human Development Report, 2007/2008, United Nations). During the study period 1 US dollar was equivalent to NRs. 111. Social role category was based on Kuppuswamy Scale and for students, International Standard Classification of Education(UNESCO) was used.

Data was entered in SPSS 16 and descriptive statistics applied. Association between categorical variables was determined using chi square test and level of significance was set at 5 percent. Those with poor quality of sleep or abnormal BMI were given health education related to their condition or advised to go for health checkup.

RESULTS

Table 1: Socio demographic profile of the subjects (N- 563)

Gender	
1. Male	264 (46.9%)
2. Female	299 (53.1%)
Caste	
1. Brahamin/Chhetri	312 (55.4%)
2. Newar	116 (20.6%)
3. Tamang	82 (14.6%)
4. Others	53 (9.4%)
Age group	
1. Adolescence	64 (11.4%)
2. Adults	499 (88.6%)
Social role /Occupation	
1. Student (Upper Secondary level)	61 (10.8%)
2. Student(Bachelors & Masters)	43 (7.6%)
3. Homemakers	154 (27.4%)
4. Farmers	18 (3.2%)
5. Unskilled & Semi skilled work	163 (29.0%)
6. Professional	93 (16.5%)
7. Retired	15 (2.7%)
8. Unemployed	16 (2.8%)
Economic status (Living Below Poverty Line)	
1. Yes	104 (18.5%)
2. No	459 (81.5%)
Use of tobacco products or alcohol	
1. Yes	73 (13.0%)
2. No	490 (87.0%)

The socio demographic profile of the subjects has been shown in Table 1. Out of 563 subjects 53% were female and the rest were male. Around 89 % belonged to the adult age group with around 11 % belonging to adolescent age. The most common caste group was *Brahmin/Chhetri* constituting 55%, followed by *Newar* at almost 21 percent. *Tamangs* constituted almost 15% and around 9% were from other caste groups. Around 18.5% of the subjects were students, 29.0% engaged in unskilled and semiskilled work, 27.4% were homemakers and 16.5% involved in professional work. Around 82% of the subjects were living above the poverty line. Eighty-seven percent of the subjects did not consume any tobacco products or alcohol.

Table 2: BMI of the subjects according to Asian classification (N-563)

Underweight	25 (4.4%)
Normal	191 (33.9%)
Overweight	104 (18.5%)
Obese I	201 (35.7%)
Obese II	42 (7.5%)

As shown in Table 2, only 33.9% (191) had normal BMI and 66.1%(372) had abnormal BMI. Around 4% were underweight and 62% had their BMI more than the normal range, ie overweight (18.5%), obese I (35.7%) & obese II (7.5%). The range of BMI in adults was from 13.9 to 39.6 with mean value of 24.1±4.2.

Table 3: Sleep duration and sleep quality of subjects (N-563)

Sleep Duration	
Adequate	404 (71.8%)
Inadequate	159 (22.2%)
Sleep Quality (based on a question of PSQI)	
Good	533 (94.7%)
Poor	30 (5.3%)

Table 4: Sleep duration and BMI (Asian Classification) (N-563)

	Normal BMI	Abnormal BMI		P value
1. Less sleep duration	42 (7.4%)	117 (20.8%)	159 (28.2%)	
2. Adequate sleep duration	149 (26.5%)	255 (45.3%)	404 (71.8%)	0.02
	191 (33.9%)	372 (66.1%)	563 (100%)	

Table 5: Sleep duration and BMI (excluding those with underweight) (N – 538)

	Normal BMI	High BMI		P value
1. Less sleep duration	42 (7.8%)	111(20.6%)	153 (28.4%)	
2. Adequate sleep duration	149 (27.7%)	236 (43.9%)	385 (71.6%)	0.01
	191 (35.5%)	347 (64.5%)	538 (100%)	

Table 6: Sleep quality and BMI (Asian Classification)			
	Normal BMI	Abnormal BMI	Total
1. Poor quality sleep	3 (10%)	27 (90%)	30(100%)
2. Good quality sleep	188 (35%)	345 (65%)	533(100%)

Table 7: Sleep duration and BMI in subjects not consuming alcohol or tobacco products (n-90)				
	Normal BMI	Abnormal BMI		P value
1. Less sleep duration	34 (7.0%)	102 (20.8%)	136 (27.8%)	
2. Adequate sleep duration	134 (27.3%)	220 (44.9%)	354 (72.2%)	0.007
	168 (34.3%)	322 (65.7%)	490 (100%)	

Table 8: Sleep duration and BMI in subjects living above poverty line (n-459)				
	Normal BMI	Abnormal BMI		P value
1. Less sleep duration	34 (7.4%)	101 (22.0%)	135 (29.4%)	
2. Adequate sleep duration	113 (24.6%)	211 (46.0%)	324 (70.6%)	0.04
	147 (32.0%)	312 (68.0%)	459 (100%)	

As shown in Table 3, the duration of sleep hours at night ranged from 4.5 to 11 with mean of 7.5 ±1.1. Almost 72% of the subjects were getting adequate sleep and only 5% of the subjects felt that the quality of their sleep was poor. As shown by Table 4 less sleep duration was significantly associated with abnormal BMI.

As shown in Table 5, when those with underweight were excluded, significant association was seen between less sleep duration and high BMI i.e. overweight and obese state.

Ninety percent of the subjects who reported poor quality of sleep had abnormal BMI which is high compared to 65% of those with good quality sleep having abnormal BMI (Table 6).

As seen in Table 7, in subjects not consuming alcohol or tobacco products less sleep duration was significantly associated with abnormal BMI. As seen in Table 8, in subjects living above the poverty line (N-459), less sleep duration was significantly associated with abnormal BMI.

DISCUSSION

In this study, only 18.5% of the subjects were living below poverty line which is low in context to Nepal where 56% of the total population is living below 2 US dollars per day (United Nations Economic & Social Commission for Asia and Pacific. Statistical Yearbook for Asia and the Pacific 2015: Nepal profile). Less than 5% were underweight and almost 62% had BMI above the normal range with 18.5% and 43.2% falling in overweight and in obese category respectively. Back in 1995 WHO had found that the problem of overweight was more than underweight in many developing countries.[14] Studies done on Nepalese population since 2000 AD have shown prevalence of overweight ranging from 20 to 34% and prevalence of obesity from 0.4 to 10.14%.[15]

This study has shown that 22% of the subjects did not have adequate sleep. The result is similar to that of a study done on adults of Finland where the prevalence of insufficient sleep was shown to be around 20%.[16] Another study done on population of Jharkhand, India showed that 36.4% were not having adequate sleep.[17]

In this study, around 5% reported having poor quality of sleep. Studies related to sleep disturbance in Scandinavian countries have shown its prevalence varying from 3.2 to 42%.[18]

In this study it was seen that less sleep duration was significantly associated with abnormal BMI. Association between less sleep duration and high BMI was also seen. Data obtained from a study done in rural population of south eastern Iowa, USA showed that less sleep duration on weeknights was associated with higher BMI.[19] Another cross-sectional population-based study in the United States reported that short sleep duration was significantly associated with all categories of abnormal body weight including underweight, overweight, and obesity, whereas longitudinal observation in a large national cohort of Thai adults did not identify any significant association of short sleep duration with underweight.[20,21] Similarly a study done on Norwegian adolescents showed that the average weekday sleep duration among adolescents in the normal weight range

was of longer duration compared to that of underweight, overweight and obese adolescents.[22] Another study conducted in a medical college of Haryana, India in 18-25 aged subjects showed that subjects sleeping less than 7 hours in a day were found to have higher anthropometric parameters compared to those getting adequate sleep.[23]

In this study a large proportion of subjects with poor quality of sleep was shown to have abnormal BMI (90%). A study done on college students of Arizona State University, United States showed that poor quality of sleep was associated with overweight in young adults.[24] Many studies have shown that interference of normal sleep patterns leads to metabolic changes which may contribute to the development of obesity as well as cardiovascular disease and diabetes.[25]

In a study done in 66,817 adolescents in China, it was seen that optimal sleep duration of 7 to 8 hours of sleep may prevent overweight and obesity.[26] Similarly among 245 women enrolled in a 6-month weight-loss program in universities of USA, better subjective sleep quality and sleeping more than 7 hours at night increased the likelihood of successful weight loss.[27]

A study done in university students of Eastern Thailand has shown that alcohol consumption is associated with high BMI.[28] A cross sectional done in adults of Mumbai, India showed that tobacco use was linked to low BMI.[29] However another cross sectional study done in adults of UK showed that among smokers, the risk of obesity increased with the amount smoked.[30] Studies have also shown that smoking and alcohol leads to disturbed sleep.[31,32] However even in those subjects who did not consume alcohol or any forms of tobacco products less sleep duration was significantly associated with abnormal BMI (Table 7).

Finding of a meta-analysis study based on studies of USA, Canada and UK was that individuals having lower income were more likely to develop obesity.[33] Poverty has also been linked to poor sleep.[34,35] Even when those subjects living below poverty line were excluded less sleep duration was significantly associated with abnormal BMI (Table 8).

Studies show that the problem of overweight and obesity is rising in many developing countries including Nepal.[15] A lot of evidence suggests that sleeping habits should not be overlooked when prescribing a weight-reduction program.[36] Due to work pressures, time is valued so much that sleeping is often perceived as a waste of time. However as abnormal sleep features have been linked to abnormal BMI and many other non-communicable diseases we can no longer ignore the importance of sleep for our physical and mental wellbeing.[37]

Strength of the study: In this community based study 20% of the total households in a ward were covered. In context to Nepal community based studies at the simplest administrative level i.e. Ward, are scarce. Based on findings of the health related research carried out in local level, ward representatives can mobilize community health workers to improve the health status of the community. Sleep related research has only been carried out in hospital settings and that too is limited in number. As sleep has been linked to many non-communicable diseases, simple sleep related interventions at an earlier stage to prevent and control non communicable diseases may prove to be cost effective in comparison to expensive medical treatment once the disease has progressed to a chronic stage.

Weakness of the study: This study has used Asian BMI category whose application has not been widely accepted in Nepal. Also only a part of PQSI related to quality and duration of sleep has been used to assess sleep. The proportion of adolescents participating in this study is also very less compared to that of adults so the findings may not be generalized for the adolescents. Except for poverty level and consumption of alcohol and tobacco products, this study has not included many variables which may have effect on BMI and sleep.

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