E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.03

Research Article

Correlation between Sleep Duration, Body Mass Index and Gender in Medical Students

Dr. Masarat Nazeer[1], Dr. Kousar Benazir[2], Dr. Mahrukh Malik[3*], Dr. Mohammad Zakiuddin[4]
[1]Assistant Professor KMC, Srinagar.
[2]Associate Professor KMC, Srinagar J&K, India.
[3*]Senior Resident, GMC Anantnag, J & K, India.
[4]Professor and Head Department of Physiology MMC Madhubani, Bihar.
Corresponding Author: Dr. Mahrukh Malik
Email: [3]Malikmahrukh6@gmail.com
Received: 06.05.26, Revised: 04.06.26, Accepted: 01.07.26

ABSTRACT
Background: People suffering from sleep disorders do not get adequate or restorative sleep, and sleep deprivation is associated with a number of both physical and emotional disturbances. The wide range of health and cognitive issues due to sleep loss, make it important to get an adequate night's sleep daily.
Aims and Objectives: To study the effect of sleep duration on body mass index (BMI) in male and female medical students.
Material and Methods: The present study was done in the Postgraduate Department of Physiology, Government Medical College Srinagar and Associated Hospitals. This study was done on 500 subjects and it was an Observational, Cross sectional study.
Results: Out of 500(100%) subjects, 4.4 % of short sleepers were underweight, 61.3 % were normal weight and 34.4% were overweight/obese. Thus the prevalence of overweight/obese among short sleepers was quite high at 34.4 % as compared to 11.7 % and 15.2 % among normal sleepers and long sleepers respectively. This increase in the percentage of overweight/obese among short sleepers was in significant relationship with CHI square of 36.28 with a P value <0.001. (Statistically significant). On gender analysis, the mean BMI in subjects with short sleep was found to be 23.75 in males and 22.64 in females. The association was found in both the sexes with the relation stronger in females *(P-value<0.001)* as compared to males *(P-value of 0.032)*. The relationship between sleep duration and BMI shows a U shaped curvilinear pattern, where BMI increases in subjects with sleep duration below 6 hours and above 8 hours, however the association in our study was stronger for short sleep duration in comparison with longer sleep durations.
Conclusion: Our study suggests a clear association between short sleep duration and overweight/obesity. This association was found in both the sexes with the relationship stronger in females as compared to males. Increasing sleep time might be a novel approach to obesity prevention and should become the target of public health policy.

Keywords: Obesity, Body Mass Index (BMI), Sleep Duration, Short Sleepers.

INTRODUCTION

Approximately one-third of an individual's time is spent in sleep and therefore it is important to understand the role that sleep may contribute to an individual's weight and overall health. People suffering from sleep disorders do not get adequate or restorative sleep, and sleep deprivation is associated with a number of both physical and emotional disturbances.[1] Feeling tired or drowsy at any time during the day is one symptom of not having enough sleep. Being able to fall asleep within 5 minutes of lying down in the evening also may be a sign a person may be suffering from sleep deprivation. People who suffer from sleep deprivation often experience so-called "microsleeps," which are short bursts of sleep in an otherwise awake person.[2]

Lack of sleep is a risk factor for obesity since it affects glucose metabolism and up regulates appetite (Knutson et al. 2007a). Young men limited to 4 hours of sleep a night for 6 days had a 40% decrease in the rate of glucose clearance and a 30% decrease in insulin response (Spiegel et al. 1999). This diabetic-like response to sleep deprivation is one possible mechanism linking sleep to obesity (Knutson et al. 2007a). A meta-analysis by Cappucio et al. (2010) found that not only quantity but also quality of sleep significantly predicts the risk of developing type 2 diabetes. All of these changes in insulin, leptin, ghrelin, and thyroid stimulating hormone could

increase obesity due to decreased satiety, increased appetite, and decreased energy utilization. More studies that assess both appetite hormones and food consumption are needed to better understand this relationship.[3] Epidemiological and experimental evidence shows that sleep debt both increases appetite and enhances actual food intake. The association between insufficient sleep and higher body mass index is also driven by changes in satiety and hunger hormones.[4] For instance, insufficient sleep leads to an increase in blood pressure and blood cortisol, sympathicotonia, higher circulating levels of the hunger stimulating hormone like ghrelin and decreased levels of the satiety hormone like leptin. Furthermore, Zheng et al. implies that the hedonic component of food intake (e.g. liking or pleasure) triggers energy consumption and causes an additional increase in sensitivity of the reward system to food. These vicious cycles may contribute to the pathophysiology of obesity due to lack of sleep. Recent studies have shown that levels of circulating endocannabinoids, which are known to be involved in the hedonic control of food intake increase with, sleep restriction while sleep extension decreases appetite for rewarding food (e.g. sweet and salty foods).

In the present study, we examined the relationship of self-reported usual sleep duration with measured BMI in young adults.

MATERIAL AND METHODS

The present study was done in the Department of Physiology, Madhubani Medical College, Madhubani, and the subjects were taken from OPD's of the Medical college and its associated hospitals. This study was done on 500 subjects and it was an Observational, Cross sectional study.

Inclusion Criteria: All apparently healthy adults attending OPD, who consented for study.

Exclusion Criteria: Known sleep disorders, medicines that might affect sleep, mild or severe insomnia, mood disorders, unstable cardiopulmonary disease, and airway cancers. Pregnancy, chronic conditions or diseases (Hypertension/Diabetes/Coronary Heart Disease/Cancer/Kidney Disease/ Stroke/MI), hyperthyroidism and hypothyroidism alcohol intake. Subjects who did not give consent to the study.

Details of the Procedure

Detailed informed consent was taken from subjects and relevant information regarding name, age, gender, marital status, education, sleeping habits and medical history were collected on a structured proforma. Sample size was calculated using software open epi with power of 90 and permissible error 2%. The participants answered structured questions (taken from various studies) with detailed information on sleep habits. Sleep durations during the weekdays and during weekends were analyzed separately and the mean was taken as habitual sleep duration. Habitual sleep duration was coded as short sleep (< 6 hrs / Night), long sleep (> 8 hrs / night), with reference to 6 -8 hours' sleep as healthy sleep.

BMI, a well-established measure of obesity was calculated as weight in kilograms divided by the square of height in meters. BMI was categorized according to the WHO criteria into underweight (BMI< 18.5), normal weight (BMI 18.5-< 25), overweight (BMI 25-< 30) and obese (BMI $\geq$30) to assess clinically applicable cut points.[5]

Ethical Clearance: The study was approved by the Institutional Ethical Committee, Government Medical College, and Srinagar.

RESULTS

Table 1a: Distribution of Study Population as Per Sleep Duration

Sleep Duration	No.	%age
Short Sleepers (<6 Hours)	160	32.0
Normal Sleepers (6-8 Hours)	274	54.8
Long Sleepers(>8Hours)	66	13.2
Total	500	100

Table 1b: Distribution of Study Population as Per BMI

BMI	No.	%age
Underweight (< 18.5)	43	8.6
Normal Weight (18.5-24.9)	360	72.0
Over Weight (25-29.9)	87	17.4

Obese (≥ 30)	10	2.0
Total	500	100

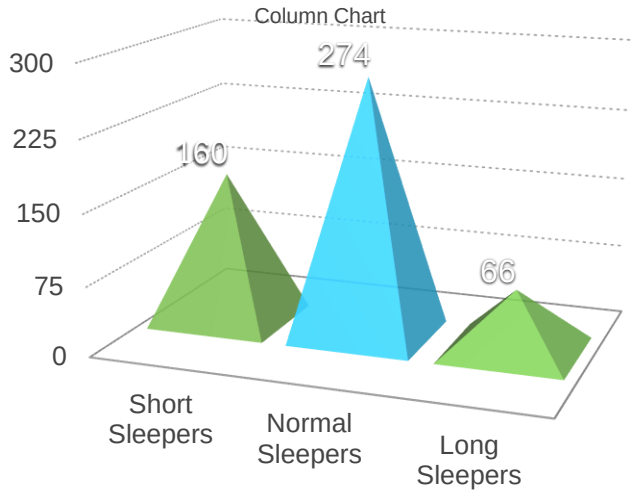

Fig 1a. Distribution of Study Population as Per Sleep Duration

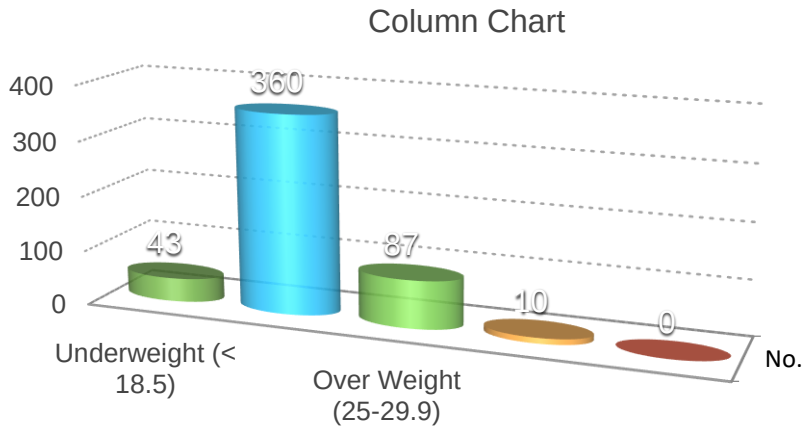

Fig 1b. Distribution of Study Population as Per BMI

Table 2: Gender Distribution of Study Population		
Gender	**No.**	**%age**
Male	188	37.6
Female	312	62.4
Total	500	100

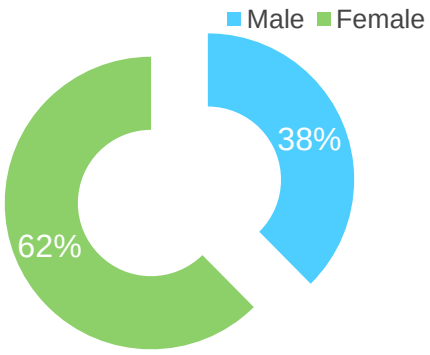

Fig 2. Gender Distribution of Study Population

Table 3: Showing Association of Sleep Duration with BMI in Study Population						
BMI	**Short Sleepers**		**Normal Sleepers**		**Long Sleepers**	
	No.	**%age**	**No.**	**%age**	**No.**	**%age**
Underweight	7	4.4	29	10.6	7	10.6
Normal Weight	98	61.3	213	77.7	49	74.2
Overweight/ Obese	55	34.4	32	11.7	10	15.2
Total	160	100	274	100	66	100
Chi-square=36.28; P-value<0.001(Statistically Significant)						

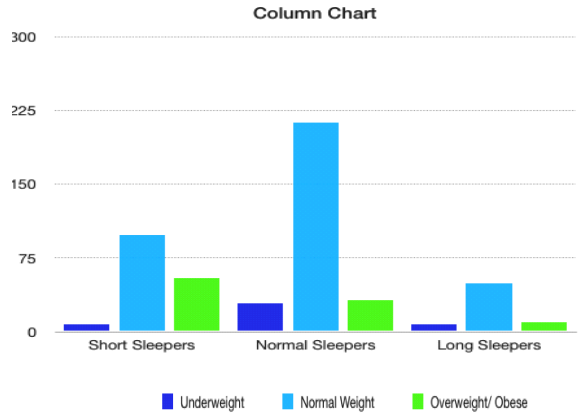

Fig 3. Association of Sleep Duration with BMI in Study Population

Association between sleep duration and BMI demonstrated that - 4.4 % of short sleepers were underweight, 61.3% were normal weight and 34.4 % were overweight/obese. Among normal sleepers 10.6 % were underweight, 77.6 % were normal weight and 11.7 % were overweight/obese. Among long sleepers 10.6 were underweight, 74.2 % were normal weight, and 15.2 % were overweight/obese.

Table 4: Showing Association of Sleep Duration with BMI in Study Males						
BMI	**Short Sleepers**		**Normal Sleepers**		**Long Sleepers**	
	No.	**%age**	**No.**	**%age**	**No.**	**%age**
Underweight	4	6.3	9	9.7	3	9.7
Normal Weight	42	65.6	76	81.7	22	71.0
Overweight/ Obese	18	28.1	8	8.6	6	19.4
Total	64	100	93	100	31	100
Chi-square=10.57; P-value=0.032 (Statistically Significant)						

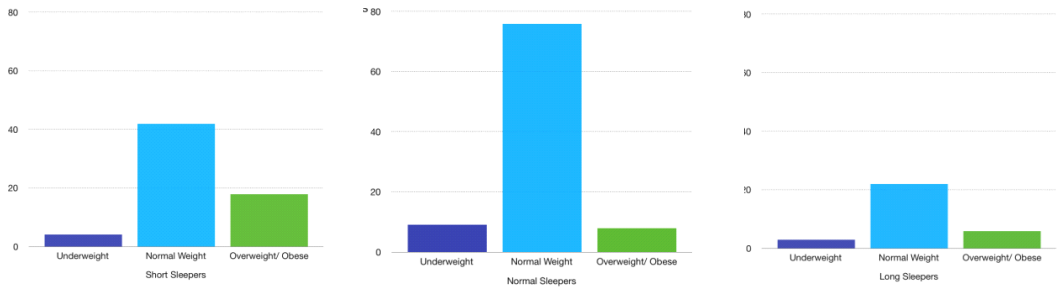

Fig 4. Association of Sleep Duration with BMI in Study Males

Among short sleepers males- 6.3 % were underweight, 65.5 % were normal weight and 28.1 % were overweight/ obese. Among normal sleeper males- 9.7 % were underweight, 81.7 % were normal weight and 8.6 % were overweight/ obese. Among long sleeper males -9.7 % were underweight, 71.0% were normal weight and 19.4 % were

overweight/ obese. There was a statistically significant increase in the percentage of overweight / obese people among some short sleepers with a Chi-square of 10.57 and P-value of 0.032

Table 5: Showing Association of Sleep Duration with BMI in Study Females						
BMI	**Short Sleepers**		**Normal Sleepers**		**Long Sleepers**	
	No.	**%age**	**No.**	**%age**	**No.**	**%age**
Underweight	3	3.1	20	11.0	4	11.4
Normal Weight	56	58.3	137	75.7	27	77.1
Overweight/ Obese	37	38.5	24	13.3	4	11.4
Total	96	100	181	100	35	100
Chi-square=28.748; P-value<0.001 (Statistically Significant)						

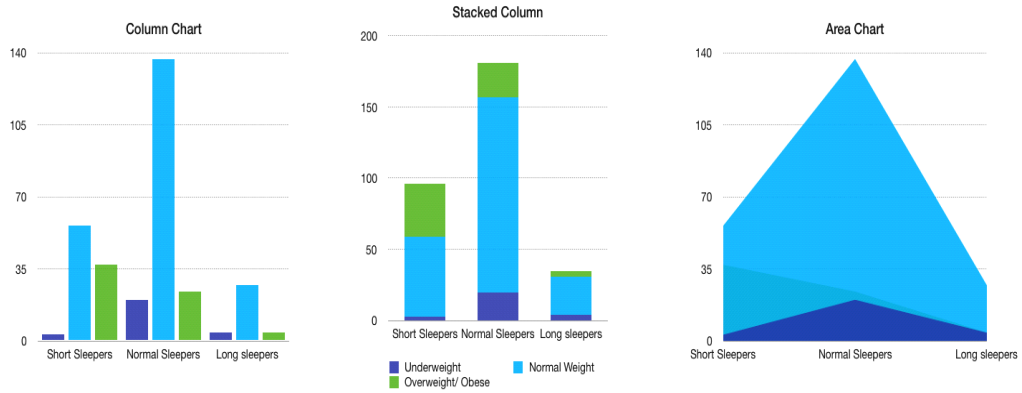

Fig 5. Association of Sleep Duration with BMI in Study Females

Among short sleeper females- 3.1% were underweight, 58.3% were normal weight and 38.5 % were overweight/ obese. Among normal sleeper females- 11.0 % were underweight, 75.7% were normal weight and 13.3 % were overweight/ obese. Among long sleeper females- 11.4 % were underweight, 77.1% were normal weight and 11.4 % were overweight/ obese. There was a statistically significant increase in the percentage of overweight / obese people among some short sleeper females with Chi-square of28.748 and P-value<0.001

Table 6: Comparison Based on Body Mass Index (BMI) as Per Duration of Sleep In Study Population						
BMI	**Mean**	**SD**	**95% Confidence Interval for Mean**		**Comparison**	**P-value**
Short Sleeper	23.30	3.70	22.73	23.88	SS vs NS	<0.001 *
Normal Sleeper	21.82	2.67	21.50	22.13	NS vs LS	0.569
Long Sleeper	22.06	3.28	21.25	22.87	LS vs SS	0.007*

**Statistically Significant Difference (P-value<0.05)*

The BMI in short sleeper, normal sleepers and long sleepers was 23.30, 21.82 and 22.06 respectively. There was a statistically significant increase in the BMI in short sleeper and long sleepers P-value<0.001 and 0.007 respectively.

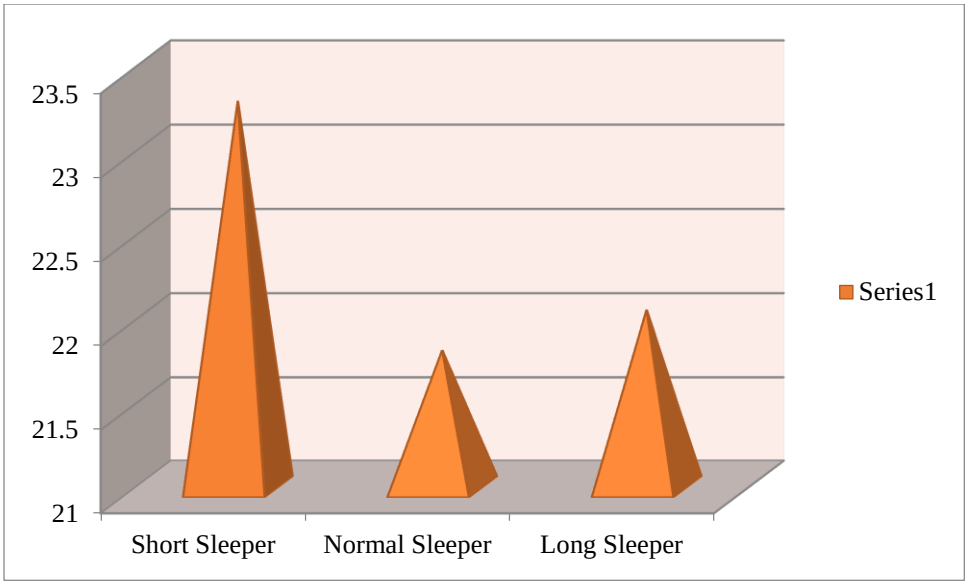

Fig 6. Body Mass Index (BMI) As Per Duration of Sleep in Study Population

Table 7: Comparison Based on Body Mass Index (BMI) as Per Duration of Sleep in Study Males						
BMI	**Mean**	**SD**	**95% Confidence Interval for Mean**		**Comparison**	**P-value**
Short Sleeper	22.64	3.62	21.74	23.54	SS vs NS	0.021*
Normal Sleeper	21.49	2.49	20.97	22.00	NS vs LS	0.522
Long Sleeper	21.89	3.14	20.73	23.04	LS vs SS	0.257

**Statistically Significant Difference (P-value<0.05)*

The BMI in short sleeper, normal sleeper and long sleeper males was 22.64, 21.49 and 21.89 respectively. There was a statistically significant increase in the BMI in short sleeper males P-value 0.021

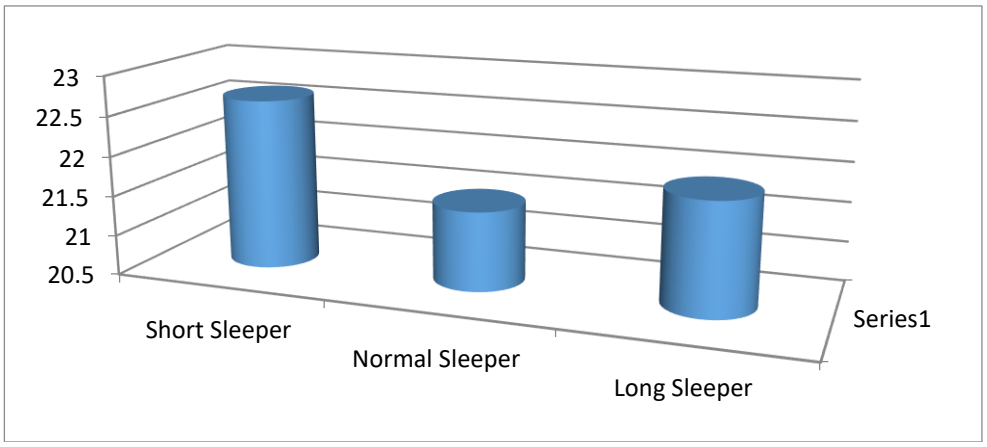

Fig 7. Body Mass Index (BMI) as Per Duration of Sleep in Study Males

Table 8: Comparison Based on Body Mass Index (BMI) as Per Duration of Sleep in Study Females						
BMI	**Mean**	**SD**	**95% Confidence Interval for Mean**		**Comparison**	**P-value**
Short Sleeper	23.75	3.70	23.00	24.50	SS vs NS	<0.001*
Normal Sleeper	21.99	2.75	21.58	22.39	NS vs LS	0.697
Long Sleeper	22.21	3.43	21.03	23.39	LS vs SS	0.014*

**Statistically Significant Difference (P-value<0.05)*

The BMI in short sleeper, normal sleeper and long sleeper females was 23.75, 21.99 and 22.21 respectively. There was a statistically significant increase in the BMI in short sleeper and long sleeper females *P-value<0.001 and 0.014*

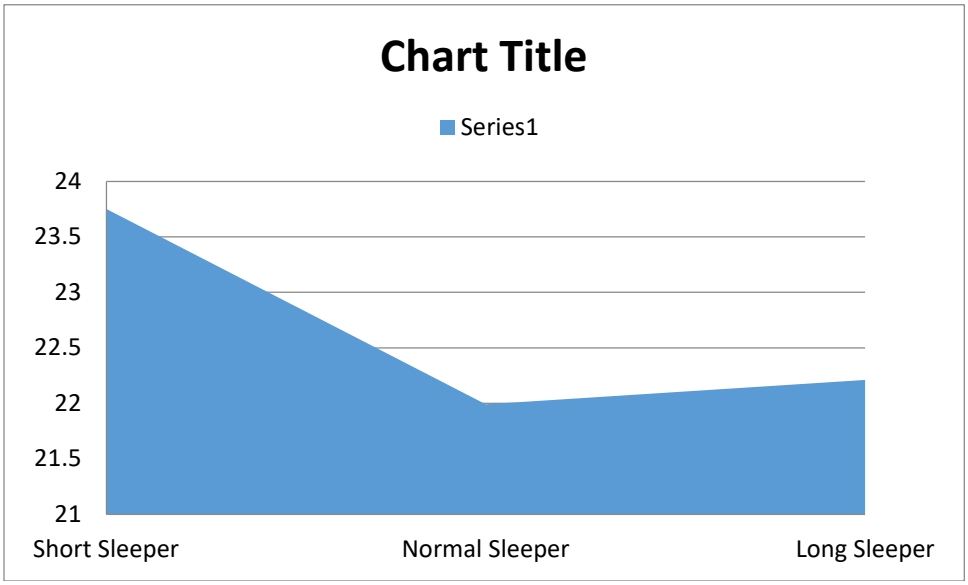

Fig 8. Body Mass Index (BMI) as Per Duration of Sleep in Study Females

DISCUSSION

The internal circadian clock promotes sleep daily at night. The diverse purposes and mechanisms of sleep are the subject of substantial ongoing research.[6] Sleep deprivation means duration of sleep less than what the individual needs to get full relaxation. It can be either acute or chronic. A chronic sleep-restricted state can cause fatigue, daytime sleepiness, clumsiness and weight loss or weight gain.[7]

In our study with sample size of 500 subjects comprising of 312 (62.4%) females and 188 (37.6%) males in the age group of 18-30 years. Self-reported sleep duration and measured Blood pressure, height and weight were used in the study. Sleep duration was characterized as short sleep (sleep duration < 6hours), normal sleep (sleep duration 6-8 hours) and long sleep (sleep duration >8 hours). Subjects were also divided on the basis of BMI into normal weight (18.5 < BMI < 25), overweight (25<= BMI < 30) and obese (BMI>= 30). The average night time sleep duration in the study cohort was 6.94 hours. Among the participants there was variation in the duration of sleep. 160 (32 %) participants were short sleepers with a sleep duration < 6 Hours. 274 (54. 8%) participants were normal sleepers with sleep duration of 6-8 Hours. 66 (13.2 %) participants were long sleepers with sleep duration > 8 hours. The weight of participants was determined by body mass index (BMI). Out of total 500 participants, 43 (8.6 %) were underweight with a BMI of < 18.5, 360 (72 %) were normal weight with BMI of 18.5-24.9, 87 (17.4 %) were overweight with a BMI of 25-29.9 and 10 (2 %) of participants were obese with a BMI of $\geq$ 30.

Normal sleep duration of 6-8 hours was reported by only about half (54.8%) of the study subjects. The average sleep duration in 24 hours among our subjects was 7.48 hours which is almost equal to the worldwide average in the age group of 17-30 years (7.49 hours).[8]About three fourth (72 %) subjects were normal weight; however, good proportions (17.4 %) of subjects were overweight. Almost one tenth of subjects (8.6%) were underweight and small proportions (2%) of subjects were obese.

Our study shows that the correlation between sleep duration and prevalence of overweight/obese among short sleepers was quite high at 34.4 % as compared to 11.7 % and 15.2 % among normal sleepers and long sleepers respectively. This increase in the presence of overweight/obese among short sleepers was significant relationship with CHI square of 36.28 with a P. value <0.001. (Statistically significant) This data is in accordance with the results from several previous studies (cross sectional, longitudinal and experimental) carried in different age groups. Spiegel K et .al (1999) [9] conducted a study to assess carbohydrate metabolism,

thyrotrophic function, activity of the hypothalamo-pituitary-adrenal axis, and sympathovagal balance in young men whose sleep was restricted to 4 h per night for 6 nights and observed that sleep restricted to 4 h per night for 1 week led to endocrine and metabolic changes associated with diabetes (insulin resistance) and weight gain. Short sleep duration, or chronic sleep debt, is associated with increased hunger and appetite, especially for calorie-dense foods with high carbohydrate content. Hanlon EC et al (2016)[10] conducted a study on healthy non-obese men and women between the ages of 18 to 30 years. The current randomized crossover study of sleep restriction versus normal sleep examined the hypothesis that increases in hunger, appetite, and food intake, in a state of sleep debt, are associated with increased activity of the eCB system. Similar study was conducted by Carmen Sayón-Orea et.al (2013)[11] on participants without chronic disease or obesity at baseline for analyzing the association between the incidence of obesity and nocturnal sleep duration or having siesta. It was found that sleeping less than 5 h at night was associated with a higher risk of becoming obese compared to sleeping between 7 and <8 h after adjusting for potential confounders.

On gender analysis, in male participants short sleepers males- 6.3 % were underweight, 65.5 % were normal weight and 28.1 % were overweight/ obese. Among normal sleeper males- 9.7 % were underweight, 81.7 % were normal weight and 8.6 % were overweight/ obese. Among long sleeper males -9.7 % were underweight, 71.0% were normal weight and 19.4 % were overweight/ obese. There was a statistically significant increase in the percentage of overweight / obese people among short sleepers with a *Chi-square of 10.57 and P-value of 0.032*

In female participants, among short sleeper females- 3.1% were underweight, 58.3% were normal weight and 38.5 % were overweight/ obese. Among normal sleeper females- 11.0 % were underweight, 75.7% were normal weight and 13.3 % were overweight/ obese. Among long sleeper females- 11.4 % were underweight, 77.1% were normal weight and 11.4 % were overweight/ obese. There was a statistically significant increase in the percentage of overweight / obese people among a short sleeper female with *Chi-square of28.748 and P-value<0.001.* The association was found in both the sexes with the relation stronger in females (*P-value<0.001)* as compared to males *(P-value of 0.032).* The mean BMI in subjects with short sleep was found to be 23.75 in males and 22.64 in females.

Some studies [12, 13] demonstrated that the association between short sleep and increased BMI existed only in women. However, in our study the association was found in both the sexes with the relationship stronger in females as compared to males. Still a few studies observed an inverse relation between short sleep and BMI. The effect of short sleep as a risk factor for higher BMI has been a matter of much interest, given the public health concerns associated with it. Several large population studies have identified significant relationship between short sleep duration and metabolic disturbances across all age groups and in several ethnic groups.[14,15,16] Because of the rapidly accelerating prevalence of sleep deprivation, any causal association between short sleep durations and obesity would have substantial importance from a public health standpoint.

CONCLUSION

The prevalence of overweight/obese among short sleepers was quite high at 34.4 % as compared to 11.7 % and 15.2 % among normal sleepers and long sleepers respectively. This increase in the presence of overweight/obese among short sleepers was significant relationship with CHI square of 36.28 with a P. value <0.001. (Statistically significant). Increasing sleep time might be a novel approach to obesity prevention and should become the target of public health policy.

Conflicts: No conflict of interests.
Interventions: None.
Funding: No funding source

REFRENCES

1. "Sleep-wake cycle: its physiology and impact on health" (PDF). National Sleep Foundation. 2006. Retrieved 24 May 2017.
2. Kushida, Clete Anthony, Sleep deprivation. Informa Health Care. pp. 1–2. (2005). ISBN 0-8247-5949-4.
3. Shiny Parsai, Examining the relationship between sleep and obesity using subjective and Objective methods, 2011, P1.
4. Katsunuma R, Oba K, Kitamura S, Motomura Y, Terasawa

Y[1,2,4], Nakazaki K[1], Hida A[1], Moriguchi Y[1], Mishima K[1], Unrecognized sleep loss accumulated in daily life can promote brain hyperreactivity to food cue. sleep,2017 oct 1;40(10).

5. Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, et al Concensus Group.Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management J Assoc Physicians India. 2009; 57:163–70
6. Bingham, Roger; Sejnowski, Terrence; Siegel, Jerry; Dyken, Mark Eric; Czeisler, Charles (February 2007). "Waking Up To Sleep" (Several conference videos). The Science Network. Retrieved 25 January 2008.
7. Taheri S, Lin L, Austin D, Young T, Mignot E; Lin; Austin; Young; Mignot (December 2004). "Short Sleep Duration Is Associated with Reduced Leptin, Elevated Ghrelin, and Increased Body Mass Index"). PLoS Med 2004 Dec;1(3) e62. doi: 10.1371/journal.pmed.0010062. Epub 2004 Dec 7.
8. National Sleep Foundation, The Sleep-Wake Cycle: Its Physiology and Impact on Health, Arlington: NSF, 2006
9. Spiegel, K1., Leproult, R., Van Cauter, E. Impact of sleep debt on metabolic and endocrine function. Lancet. 1999 Oct 23;354(9188):1435-9.
10. Erin C. Hanlon, Esra Tasali, Rachel Leproult, Kara L. Stuhr, Elizabeth Doncheck, Harriet de Wit, Cecilia J. Hillard, and Eve Van Cauter. Sleep Restriction Enhances the Daily Rhythm of Circulating Levels of Endocannabinoid 2-Arachidonoylglycerol. Sleep. 2016 Mar 1; 39(3): 653–664. Published online 2016 Mar 1.
11. Sayón-Orea C1, Bes-Rastrollo M, Carlos S, Beunza JJ, Basterra-Gortari FJ, Martínez-González MA. Association between sleeping hours and siesta and the risk of obesity: the SUN Mediterranean Cohort. bes Facts. 2013;6(4):337-47. doi: 10.1159/000354746.
12. Epub 2013 Aug 1 12. Jamshid Najafian , Noushin Mohammadifard, Zahra Dana Siadat , Gholamhosein Sadri , Majid Ramazani , Fatemeh Nouri,. Association between Sleep Duration and Body Mass Index and Waist Circumference. IJMS Vol 35, No 2, June 2010
13. Lyytikäinen P1, Rahkonen O, Lahelma E, Lallukka T. Association of sleep duration with weight and weight gain: a prospective follow-up study. J Sleep Res. 2011 Jun;20(2):298-302.
14. "Brain Basics: Understanding Sleep". Office of Communications and Public Liaison, National Institute of Neurological Disorders and Stroke, US National Institutes of Health, Bethesda, MD. 2017.
15. Hobson JA, Pace-Schott EF. The cognitive neuroscience of sleep: neuronal systems, consciousness and learning. Nat Rev Neurosci. 2002 Sep;3(9):679-93.
16. Pace-Schott EF, Hobson JA. The neurobiology of sleep: genetics, cellular physiology and subcortical networks. Nat Rev Neurosci. 2002 Aug;3(8):591-605.