Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2020, 9(10): 8-14

Association between Obesity and Sleep Duration in Young Adult Saudis: A Cross-Sectional Study

Abdelmarouf H. Mohieldein

Department of Medical Laboratories, College of Applied Medical Sciences, Qassim University, Buraidah, Saudi Arabia

**Corresponding e-mail: mabdelmarauf@hotmail.com*

ABSTRACT

Objective: *The study aimed to assess the relationship between nightly sleep duration and obesity in young adult Saudi citizens.* ***Methods:*** *A cross-sectional study in which eighty-one healthy young adults were enrolled. Self-reported sleep duration per night was recorded from each participant. Sleep hours were categorized into three groups: normal (7-8 h), short (≤ 6 h), and long (>8 h). Weight, height, and waist circumference were measured for all participants. Body mass index was computed and WHO guidelines was used to estimate obesity. Venous blood samples were collected at fasting and 2-h after breakfast. Blood glucose and glycated hemoglobin were assayed by standard laboratory procedures. SPSS was used to analyze data.* ***Results:*** *69.6% of overweight/obese subjects reported sleeping less than 6 hours per night while 37.1% of normal weight subject did (p=0.008). 66.7% of all participants spent over three hours per day in front of screen i.e. spent watching TV, using computer, playing video games. Data analysis revealed an inverse significant correlation between duration of sleep per night and body mass index (r=-0.246, p=0.027).* ***Conclusion:*** *Our findings collectively highlight the importance of having an adequate amount of sleep per night (7-8 hours) which could help in minimizing the epidemic of obesity and its associated co-morbidities. We should encourage young adults to create a positive behavioral change and improve their lifestyle choices by changing their delay in the timing of sleep onset.*

Keywords: Overweight, Obesity, Sleep hours per night, Young adults, Risk factors

INTRODUCTION

Obesity is a condition of excessive fat accumulation in adipose tissue that adversely affect human health [1,2]. It is a public health concern worldwide with increased mortality and morbidity because of obesity associated co-morbidities like metabolic syndrome, type 2 diabetes, hypertension, cardiovascular disorders, some cancers [3,4]. The global economic impact of obesity in 2014 was 2.8% of the global gross domestic product which equivalents to US $2.0 trillion [5]. The prevalence of overweight and obesity has increased significantly in Arab Gulf Countries due to economic shifts toward greater gross domestic product [2]. A recent cross-sectional study in Southwestern Saudi Arabia reported that the overall prevalence of overweight and obesity was 38.3% and 27.6% respectively [6].

Researchers attribute body adiposity to multifactorial interactions including genetic, environmental, behavioral, and psychosocial factors [7,8]. These factors promote the intake of energy-dense food, sedentary lifestyle, and increasing urbanization [9]. Besides traditional lifestyle factors, sleep duration has been suggested to have a role in the obesity epidemic [10]. In our hectic modern society, sleep duration and patterns have been changed in both children and adults [11]. Television viewing, video gaming, computer and cellular phones use are associated with a reduction in sleep duration [12,13]. The prevalence of young adults who reported nightly sleep of ≤ 6 hours has significantly increased in recent decades [14,15].

To the best of our knowledge, no previous study has examined the association between sleep duration per night and obesity in a young adult Saudi population. Short sleep duration could be an additional risk factor to exaggerate obesity prevalence in the country. The aim of the study was to test the hypothesis of an inverse relationship between decreased

sleep duration per night and increased Body mass index (BMI) in young adult Saudis. Also, we interested to examine the relationship between duration of using mobile phones and BMI.

MATERIALS AND METHODS

Study Design and Participants

This was a cross-sectional study in which eighty-one apparently healthy subjects, aged between 18 to 46 years, were enrolled in this study. The inclusion criteria were: both sexes, Saudi citizen, BMI≥18.5 Kg/m^2, fasting plasma glucose <100 mg/dl, 2-h plasma glucose<140 mg/dl. The exclusion criteria were: none Saudi, BMI<18.5 Kg/m^2, fasting plasma glucose ≥ 100 mg/dl, 2-h plasma glucose ≥ 140 mg/dl, have diabetes or any chronic diseases. Data regarding each participant's socio-demographic, physical activity, duration of sleep per night, screen time, duration talking in mobile were recorded by a questionnaire.

Sleep Duration

Self-reported sleep duration per night was recorded from each participant by the open-ended question, "How many hours of sleep do you get per night?" Based on sleeping 7-8 h per night is the optimal sleep duration for young [4,8,16], sleep hours were further categorized into three groups: 7-8 h (normal), ≤ 6 h (short), and>8 hours (long).

Assessment of Anthropometric Measures

Research assistants carried out anthropometric measurements including weight, height, and waist circumference for all participants. Weight and height were measured using electronic scales. We calculated Body mass index (BMI) as body weight (kilogram) divided by height (meter) squared. The WHO guidelines for BMI was used to estimate obesity: underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 (kg/m^2) and obese (≥ 30.0 kg/m^2) [17]. Waist circumference (WC) was measured using an anthropo-metric tape at a level midway between the lower rib margin and iliac crest with the tape all around the body in a horizontal position.

Biochemical Analyses

Venous blood samples were drawn at fasting and 2-h after breakfast (postprandial) from each participant into heparinized tubes, centrifuged, separated to prepare plasma. Glucose was measured by glucose oxidase-glucose peroxidase method; glycated hemoglobin (HbA1c) was estimated from whole blood by fast ion-exchange separation method. Analyses were done using available commercial kits supplied by Human Diagnostics (Wiesbaden, Germany).

Statistics

Descriptive statistics were computed for all variables. All analyses were conducted using the SPSS software version 23.0 (SPSS Inc., IL, USA) for Windows, and a P value of<0.05 was used to indicate statistical significance. Results were reported as the mean (confidence interval) or number (%) where appropriate. Differences between normal weight group and overweight/obese group were tested for significance by a Student's t-test (for continuous data) or chi-square test (for categorical data). Pearson's correlation was conducted between the BMI, WC and sleep duration hours per night.

Ethical Consideration

Oral consent was obtained from all participants after a thorough explanation of the goals of the study. The protocol of this study conformed to the Declaration of Helsinki and all data were provided anonymously.

RESULTS

Characteristics of Participants

Eighty-one healthy participants enrolled in this study were divided into two groups based on their BMI: normal weight group and overweight/obese group. There was no significant difference in the gender, height, 2-hour postprandial blood glucose, glycosylated hemoglobin. More than half of the participants (54.3%) were students and 72.8% of participants had university or higher education. Participants with normal weight were younger than overweight or obese subjects (p=0.031). Compared to overweight/obese subjects, more participants with normal weight significantly used

to do physical exercise at least 30 minutes/day (p=0.01). Although the values within normal ranges, overweight/obese participants had higher fasting blood glucose and 2-hour postprandial blood glucose when compared to normal weight subjects (Table 1).

Table 1 Comparison of socio-demographic and biochemical characteristics between overweight/obese and normal weight participants

Characteristic	Overweight/Obesity (BMI ≥ 25 Kg/m^2)	Normal weight (BMI=18.5-24.9 Kg/m^2)	p-value
	n=46	n=35	
Gender, Male	31 (67.4%)	28 (80.0%)	0.206
Age, Years	28.59 (25.65-31.53)	24.83 (24.07-25.59)	0.031
BW, Kg	86.3 (82.5-90.1)	65.6 (63.2-68.0)	0.000
Height, cm	164.7 (161.4-167.9)	168.4 (165.7-171.0)	0.087
BMI, Kg/m^2	32.1 (30.3-33.9)	22.6 (22.2-23.1)	0.000
WC, cm	96.2 (90.3-102.2)	76.1 (73.9-78.3)	0.000
Education, University or higher	31 (67.4%)	28 (80.0%)	0.164
Occupation, Students	29 (63.0%)	15 (42.9%)	0.036
Doing physical exercise at least 30 min per day, Yes	05 (10.9%)	13 (37.1%)	0.010
FPG, mg/dl	84.7 (82.9-86.4)	82.2 (80.7-83.6)	0.036
2hr-PP, mg/dl	117.5 (114.6-120.4)	114.8 (111.5-118.1)	0.217
HbA1c, %	5.6 (5.2-6.0)	5.7 (5.4-6.0)	0.7

Values were expressed as mean (95% CI) or n (%) where appropriate; BW: Body Weight; BMI: Body Mass Index; WC: Waist Circumference; FPG: Fasting Plasma Glucose; 2hr-PP: 2 hours Post Prandial; HbA1c: Glycosylated hemoglobin; CI: Confidence Interval

Duration of Sleep/Night in Study Participants

Over two-third of subjects in the overweight/obese group reported sleeping less than 6 hours/night while around one-third of normal weight subjects did. Out of all participants, 66.7% spent more than three hours per day in front of screen i.e. spent watching TV, using computer, playing video games. 61.7% of participants reported talking less than one hour per day in mobile phones (Table 2).

Table 2 Duration of sleep per night and habitual activities of participants

Characteristic		Overweight/Obesity (BMI ≥ 25 Kg/m^2)	Normal weight (BMI=18.5-24.9 Kg/m^2)	p-value
		n=46	n=35	
Screen time, hours	<1 h/day	00 (00%)	01 (02.9%)	0.463
	1-3 h/day	14 (30.4%)	12 (34.3%)	
	>3 h/day	32 (69.6%)	22 (62.9%)	
Talking on mobile	<60 min/day	33 (71.7%)	17 (48.6%)	0.102
	60-120 min/day	07 (15.2%)	09 (25.7%)	
	>120 minutes/day	06 (13.0%)	09 (25.7%)	
Duration of sleep per night, hours	≤ 6 hours	32 (69.6%)	13 (37.1%)	0.008
	7-8 hours	14 (30.4%)	20 (57.1%)	
	>8 hours	00 (00%)	02 (5.7%)	
Values were expressed as n (%) where appropriate				

Correlation between Duration of Sleep/Night and BMI and WC

Data analysis revealed an inverse significant relationship between duration of sleep per night and body mass index (r=-0.246, p=0.027). However, there was no significant correlation between waist circumference and duration of sleep per night (r=-0.155, p=0.166) (Table 3).

Table 3 Correlation between duration of sleep per night and Body mass index (BMI), Waist circumference (WC) in all participants

Duration of sleep per night	
BMI	r=-0.246
	p=0.027
WC	r=-0.155
	p=0.166
BMI: Body Mass Index; WC: Waist Circumference	

DISCUSSION

Sleep is a restorative physiological process crucial for metabolic and endocrine homeostasis [9,18]. Sleep insufficiency is associated with chronic diseases, fatigue and hyperactivity, irritability and poor emotional regulation, poor academic performance, impaired immune function, and obesity [19,20].

The main finding of the current study was a higher percentage of overweight or obese participants who reported short sleep duration (less than 6 hours/night) as compared to normal weight subjects (69.6% vs. 37.1%, p=0.008). Our result is consistent with previous cross-sectional and longitudinal cohort studies. In a cross-sectional study conducted among suburban students, short sleep duration was associated with overweight. Authors confirmed a high prevalence of short sleep among suburban high school students [21]. In a prospective 10-year follow-up 'Sleep and Health in women' study (SHE study) to evaluate the consequences of sleep disturbances to obesity. Authors reported that younger women (aged<40 years) with short sleep duration (<6 h/night) had a higher prevalence of general obesity (BMI ≥ 30 kg/m^2) and central obesity (waist circumference ≥ 88 cm) when compared with habitual normal sleepers (6-9 h/night). They concluded that a short sleep duration was a risk factor for obesity [22].

Our study showed an inverse significant correlation between duration of sleep per night and BMI (r=-0.246, p= 0.027). In agreement with our finding, Xiao, et al. [23], in a cohort longitudinal study over 7.5 years, observed an inverse association between sleep duration per night and weight gain in a sample of 83,377 US men and women aged 51-72 years. Weight gain was associated with subjects of short sleep (<5 hours or 5-6 hours) when compared with those 7-8 hours of sleep. The odd ratio for developing obesity was almost twice in participants with short sleep than those who reported 7-8 hours of sleep [23]. In line with these findings, a meta-analysis included 17 cross-sectional studies in adults from around the world (Spain, Japan, USA, France, Switzerland, Sweden, Brazil, Finland, Norway, Canada, Hong Kong, and United Kingdom) showed a consistent and significant negative association between hours of sleep and BMI. The authors suggested that a reduction in one hour of sleep per day would be associated with a 0.35 kg/m^2 increase in BMI [24]. Another longitudinal prospective study over a 6-year follow-up period confirmed the association between short sleep duration (<6 hours of sleep/night) and increased abdominal adiposity in adults when compared to those who sleep on average ≥ 7 hours/night, over a 6-year follow-up period [25].

It is noteworthy that in this era most of young adults are engaged with electronic media which has its negative impact on other activities including sleep hours per night [26]. This study showed that two-third of participants spent more than three hours per day in front of screen engaged with late night activities such television, computer games, and the internet use. However, around the same percentage of participants reported talking less than one hour per day in mobile phones. This might point to the wide usage of mobile phones in social media applications rather than talking. We could expect study participants to use mobile phones during night since more than half of the participants were students who expected to have their daytime in schools or universities. Beside communication, mobile phones in recent

years provide ubiquitous usage like interaction, searching for information, and passing time [27]. One study reported an association between the use of mobile phones after lights out and sleep disturbances including short sleep duration among Japanese adolescents [28].

The mechanism by which sleep curtailment leads to weight gain and obesity is thought to be related to hormonal alterations that control hunger and appetite. Short sleep duration alongside with greater awake time increase the opportunity to eat and then get more fatigue which leads to decease physical activity and basal metabolic rate; ultimately leads to significant weight gain [15]. Decreased sleep time creates alterations in levels of hormones that regulate appetite i.e., alteration of leptin (an appetite-inhibiting hormone) and ghrelin (an appetite-stimulating peptide) [29]. Taheri, et al. [30], confirmed an association of short sleep with low serum leptin and high serum ghrelin. The authors concluded that the differences in level of two hormones (leptin and ghrelin) could provide a powerful dual stimulus to food intake, which explain the increased weight gain for persons with short sleep duration.

CONCLUSION

The present study showed that subjects with short sleep duration per night were more overweight or obese than those with normal sleep duration. In this study, we found an inverse correlation between sleep duration per night and body weight (BMI). Our findings collectively highlight the importance of having an adequate amount of sleep per night (7-8 hours) which could help in minimizing the epidemic of obesity and its associated co-morbidities. We should encourage young adults to create a positive behavioral change and improve their lifestyle choices by changing their delay in the timing of sleep onset.

Limitations

The limitation of this study came from the limited number of sample size as well as the cross-sectional design in which we could not establish short sleep duration per night is a cause for body weight and obesity. However, person`s correlation showed the inverse relationship between sleep hours and body weight.

DECLARATIONS

Acknowledgement

The author is thankful for the help provided by Mr. Sami Al-Mushawwah for samples collection.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Fassio, Angelo, et al. "The obesity paradox and osteoporosis." *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity,* Vol. 23, No. 3, 2018, pp. 293-302.

[2] DeNicola, Erica, et al. "Obesity and public health in the Kingdom of Saudi Arabia." *Reviews on Environmental Health,* Vol. 30, No. 3, 2015, pp. 191-205.

[3] Horne, Jim. "Short sleep is a questionable risk factor for obesity and related disorders: Statistical versus clinical significance." *Biological Psychology,* Vol. 77, No. 3, 2008, pp. 266-76.

[4] Kohatsu, Neal D., et al. "Sleep duration and body mass index in a rural population." *Archives of Internal Medicine,* Vol. 166, No. 16, 2006, pp. 1701-05.

[5] Tremmel, Maximilian, et al. "Economic burden of obesity: A systematic literature review." *International Journal of Environmental Research and Public Health,* Vol. 14, No. 4, 2017, p. 435.

[6] Al-Qahtani, Awad Mohammed. "Prevalence and predictors of obesity and overweight among adults visiting primary care settings in the Southwestern region, Saudi Arabia." *BioMed Research International,* 2019, p. 8073057.

[7] Lin, Chia-Ling, et al. "The association between sleep duration and overweight or obesity in Taiwanese adults: A cross-sectional study." *Obesity Research and Clinical Practice,* Vol. 12, No. 4, 2018, pp. 384-88.

[8] Penev, Plamen D. "Update on energy homeostasis and insufficient sleep." *The Journal of Clinical Endocrinology and Metabolism,* Vol. 97, No. 6, 2012, pp. 1792-801.

[9] Bayon, Virginie, et al. "Sleep debt and obesity." *Annals of Medicine,* Vol. 46, No. 5, 2014, pp. 264-72.

[10] Van Cauter, Eve, and Kristen L. Knutson. "Sleep and the epidemic of obesity in children and adults." *European Journal of Endocrinology,* Vol. 159, No. 1, 2008, pp. S59-66.

[11] Nam, Ga Eun, et al. "Sleep duration is associated with body fat and muscle mass and waist-to-height ratio beyond conventional obesity parameters in Korean adolescent boys." *Journal of Sleep Research,* Vol. 26, No. 4, 2017, pp. 444-52.

[12] Arora, Teresa, et al. "Associations between specific technologies and adolescent sleep quantity, sleep quality, and parasomnias." *Sleep Medicine,* Vol. 15, No. 2, 2014, pp. 240-7.

[13] Linaker, Catherine H., et al. "Body mass index (BMI) and work ability in older workers: Results from the Health and employment after fifty (HEAF) prospective cohort study." *International Journal of Environmental Research and Public Health,* Vol. 17, No. 5, 2020, p. 1647.

[14] Spaeth, Andrea M., David F. Dinges, and Namni Goel. "Effects of experimental sleep restriction on weight gain, caloric intake, and meal timing in healthy adults." *Sleep,* Vol. 36, No. 7, 2013, pp. 981-90.

[15] Zimberg, Ioná Zalcman, et al. "Short sleep duration and obesity: Mechanisms and future perspectives." *Cell Biochemistry and Function,* Vol. 30, No. 6, 2012, pp. 524-9.

[16] Patel, Sanjay R., et al. "Association between reduced sleep and weight gain in women." *American Journal of Epidemiology,* Vol. 164, No. 10, 2006, pp. 947-54.

[17] World Health Organization. *Obesity: Preventing and managing the global epidemic,* World Health Organization, 2000.

[18] Beccuti, Guglielmo, and Silvana Pannain. "Sleep and obesity." *Current Opinion in Clinical Nutrition and Metabolic Care,* Vol. 14, No. 4, 2011, p. 402.

[19] Adenekan, Bosede, et al. "Sleep in America: Role of racial/ethnic differences." *Sleep Medicine Reviews,* Vol. 17, No. 4, 2013, pp. 255-62.

[20] Khan, Mohammad KA, et al. "Is it nutrients, food items, diet quality or eating behaviours that are responsible for the association of children's diet with sleep?" *Journal of Sleep Research,* Vol. 26, No. 4, 2017, pp. 468-76.

[21] Seicean, Andreea, et al. "Association between short sleeping hours and overweight in adolescents: Results from a US Suburban High School survey." *Sleep and Breathing,* Vol. 11, No. 4, 2007, pp. 285-93.

[22] Theorell-Haglöw, Jenny, et al. "Both habitual short sleepers and long sleepers are at greater risk of obesity: A population-based 10-year follow-up in women." *Sleep Medicine,* Vol. 15, No. 10, 2014): 1204-11.

[23] Xiao, Qian, et al. "A large prospective investigation of sleep duration, weight change, and obesity in the NIH-AARP Diet and Health Study cohort." *American Journal of Epidemiology,* Vol. 178, No. 11, 2013, pp. 1600-10.

[24] Cappuccio, Francesco P., et al. "Meta-analysis of short sleep duration and obesity in children and adults." *Sleep,* Vol. 31, No. 5, 2008, pp. 619-26.

[25] McNeil, Jessica, Éric Doucet, and Jean-Philippe Chaput. "Inadequate sleep as a contributor to obesity and type 2 diabetes." *Canadian Journal of Diabetes,* Vol. 37, No. 2, 2013, pp. 103-8.

[26] Exelmans, Liese, and Jan Van den Bulck. "Bedtime, shuteye time and electronic media: Sleep displacement is a two-step process." *Journal of Sleep Research,* Vol. 26, No. 3, 2017, pp. 364-70.

[27] Thomée, Sara. "Mobile phone use and mental health. A review of the research that takes a psychological

perspective on exposure." *International Journal of Environmental Research and Public Health,* Vol. 15, No. 12, 2018, p. 2692.

[28] Munezawa, Takeshi, et al. "The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: A nationwide cross-sectional survey." *Sleep,* Vol. 34, No. 8, 2011, pp. 1013-20.

[29] Knutson, Kristen L. "Impact of sleep and sleep loss on glucose homeostasis and appetite regulation." *Sleep Medicine Clinics,* Vol. 2, No. 2, 2007, pp. 187-97.

[30] Taheri, Shahrad, et al. "Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index." *PLoS Medicine,* Vol. 1, No. 3, 2004, p. e62.