THE RELATIONSHIP BETWEEN SLEEP DURATION AND BODY COMPOSITION OF CHILDREN AND ADOLESCENTS IN TURKEY*

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ABSTRACT

It remains unclear how many hours of sleep are associated with obesity in children and adolescents in Turkey. The main purpose of this study was to determine the association between sleep and body mass index (BMI), body fat ratio (BFR), waist circumference (WC) in children and adolescents. Data were collected from a nationally representative samples of 1723 male and female people whose ages are between 7-18 years. The relationship between sleep duration and body composition values were analyzed by "Pearson Correlation" analysis. In the total samples, there was a correlation of sleep duration categories (5-6, 7-8, 9-10) on BMI, BFR, WC. As a result, it was determined that there was a negative correlation between sleep duration and BMI (r= -.006), BFR (r= -.017), WC (r = -.021). In conclusion, in children and adolescents reduced sleep durations are strongly associated with greater adiposity.

Keywords: Sleep duration, body mass index, body fat ratio, waist circumference

INTRODUCTION

The prevalence and frequency of obesity in children and adolescents have increased worldwide over the past decades (Nam et al., 2017). Although the cause of obesity is simply characterized by imbalance of energy expenditure and energy intake, there are a lot of environmental factors together with these two main factors that lead to a positive energy balance like physical activity and diet (Eisenmann et al., 2006). Obesity in childhood is caused by an increased cardio metabolic risk which is accompanied by obesity-related disorders that affect child health. Besides, increased body weight is associated with psychosocial problems, low self-esteem, increased cardiovascular morbidity and type 2 diabetes mellitus (Moraes et al., 2013). National obesity in childhood affects child health and may lead to long-term outcomes in later stages of life such as cardiovascular disease, hypertension, type 2 diabetes mellitus and metabolic syndrome in adults (Weber et al., 2014). For these reasons, from a public health perspective, obesity is a major problem in childhood. Simple anthropometric measurements have been used to determine obesity and have practical value both in clinical practice and in large-scale epidemiological studies (Dalton et al., 2003).

Body mass index (BMI), which is associated with weight and height, is a commonly used simple measure and is often used to estimate the prevalence of obesity in a population (Colditz et al., 1995). However, BMI does not account for differences in body fat distribution and abdominal fat mass. (WHO, 2000). Excess intra-abdominal fat is associated with greater risk of obesity (Visscher et al., 2002). For this reason, waist circumference and waist-to-hip ratio (WHR) measurements have been identified as an alternative to BMI and are regularly used both in clinical and research settings. The waist circumference has been shown to be the simplest measure of intra-abdominal fat mass and total fat (Visscher et al., 2002; Han et al., 1997).

Sleep has an important role on obesity in children's mental and physical development, with short sleep duration or irregular sleep schedules associated with subsequent overweight and obesity in childhood and short sleep duration in children has been reported to have negative effects on physical and mental health and, moreover, it has often been used as an indicator of unhealthy lifestyle and poor health status (Owens, 2014). Mechanisms maintain their uncertainty, but researchers indicate that short sleep duration is linked to increased hunger through irregular hormonal mechanisms including reduced leptin and increased levels of ghrelin (Spiegel et al.,

2004). Studies have tried to figure out the mechanisms between obesity and sleep, but have been limited to clinical studies among adults in controlled environments (Martinez et al., 2017). Adulthood research has also found out that less than 7 hours sleep and more than 9-10 hours sleep can increase the risk of obesity, type 2 diabetes, heart disease, stroke and depression (Furuncuoglu et al, 2016; Sakamoto et al., 2017).

The importance of this study is that this was the only study that includes Turkish children and adolescents as a sample in these parameters. The aim of this study was to find out the relationship between sleep duration and body composition, body fat ratio and waist circumference.

MATERIAL AND METHOD

Participants and Study Design

A total of 1723 people whose ages are between 5-18 voluntarily participated in this study (height: 164±3 cm; body mass: 71.2±17.6 kg, body fat: 24.9±10 % and body mass index: 25.9±5.7 kg/m^2, waist circumference: 83.1±14.3 cm). Sleep duration, BMI, BFR and waist circumference (WC) values of the volunteers were measured in this study. A questionnaire developed by researchers was used to determine sleep duration. Anthropometric measurements such as height, body weight, body mass index and body fat percentages were determined by methods used to measure general body composition. Height was measured to the nearest 0·1 cm without shoes with a stadiometer (Seca, Hamburg, Germany). BMI, BFR and weight were measured with empty pockets and without shoes and sweaters to the nearest 0·1 kg on a digital scale (Seca, Hamburg, Germany). WC was measured on a horizontal plane at the mid-point between the lowest border of the ribcage and the iliac crest with the subject in a standing position at the end of normal expiration.

Statistical Analyses

Statistical analyses of the obtained data were determined by SPSS (23.0 IBM) package program. First, homogeneity analysis was applied using "Kolmogorov Smirnov", and then information about the research data was obtained using "Descriptive Statistics". As the data showed normal distribution, the relationship between sleep duration and body composition values

were analyzed by "Pearson Correlation" analysis. Significance level in this study was accepted as p <0.01.

RESULTS

Table 1. *The data of SD, BMI, BFR, WC*

SD	Weight (kg)	Height (cm)	BMI (kg/m^2)	BFR (%)	WC (cm)
9-10 h	69.8±22.4	164.2±17.5	25.1±5.5	23.2±9.1	82.1±17.4
7-8 h	69.7±18.9	163±13	25.5±6	24±10	82.4±15.2
5-6 h	72.1±16.6	165.1±14.4	26.1±5.4	25.1±9.9	83.4±13.7

(SD: Sleep duration; BMI: Body mass index; BFR: Body fat ratio; WC: Waist circumference)

The sample was divided into three groups as 9-10 h sleep, 7-8 h sleep, 5-6 h sleep. Participant's values (weight, height, body mass, body fat ratio and waist circumference) were showed in Table 1 as mean ± SD.

Table 2. *Correlation of participants' BMI, SD, BFR, WC*

	SD	BMI	BFR	WC
SD (h)	1			
BMI (kg/m^2)	r = -.006* p = .796	1		
BFR (%)	r = -.017* p = .479	r =.633* p = .000	1	
WC (cm)	r = -.021* p = .374	r =.667* p = .000	r= .450* p = .000	1

(SD: Sleep duration; BMI: Body mass index; BFR: Body fat ratio; WC: Waist circumference; r= Pearson's correlation coefficient; Correlation is significance at p<0.001*)

The correlation between SD and body composition measurements for participants was presented in Table 2. When we examined these results totally, there was a negative correlation between BMI and SD (r= -.006*), BFR and SD (r = -.017*), WC and SD (r = -.021*).

DISCUSSION

The main purpose of this study was to determine the association between the sleep duration and body mass index (BMI), body fat ratio (BFR), waist circumference (WC) in children and adolescents. These parameters were selected because there have not been any researches about this topic with Turkish volunteers.

There are lots of studies about the relationship between obesity and some parameters. Cappuccio et al., (2011) found that short duration of sleep was associated with a greater risk of developing or dying of coronary heart disease (CHD), short duration of sleep was associated with a greater risk of developing or dying of stroke, short duration of sleep was weak and not significantly associated with a greater risk of developing or dying of total cardiovascular disease (CVD). Sakamoto et al., (2017) found that shorter sleep duration leads to greater risk of obesity. A similar yet independent association emerged among children at higher risk for sleep disordered breathing (SDB), based on a validated questionnaire-based index. Martinez et al., (2017) thought that short sleep duration in childhood could be a risk factor for obesity yet the mechanism was unclear, but high carbohydrate food could be the cause of the risk, and also they studied the relationship between estimated sleep duration and the amount of macronutrient intake as a percentage of total energy in the 9-11 age group of Mexican nationals. They found that sleeping for a short time could be a risk factor for food intake with high carbohydrate content and heart-healthy dietary fat which could increase the risk of obesity among children. Nam et al., (2017) aimed to investigate the association of sleep duration with various parameters of obesity among South Korean adolescents. In this study, sleep duration was based on a self-reported questionnaire. BMI, WC, waist-to-height ratio (WHtR), BFR and skeletal muscle index (SMI) were assessed as parameters of obesity. They found that proportions of the highest quartile of BMI, WC, WHtR, BFP and the lowest quartile of SMI increased significantly with increased sleep duration only in boys. Also, in boys, decreased sleep duration was associated significantly with the increased risk of the highest quartile of BMI, WC, WHtR and BFP and the lowest

quartile of SMI, even after adjusting for confounding factors. Our results were comparable with Nam et al., (2017) who found a similar result to ours, we found that shorter sleep duration can increase BMI, BFR, WC. Arora et al., (2016) found that sleep quality, not sleep duration, plays an important role in insulin resistance in newly diagnosed type 2 diabetes mellitus patients. BMI may mediate the relationship between indicators of sleep quality and insulin resistance. Shan et al., (2015) found that their dose response meta-analysis of prospective studies showed a U-shaped relationship between sleep duration and risk of type 2 diabetes, with the lowest type 2 diabetes risk at 7–8 h per day of sleep duration. Both short and long sleep duration are associated with a significantly increased risk of type 2 diabetes, underscoring the importance of appropriate sleep duration in the delay or prevention of type 2 diabetes.

Fatima et al., (2015) studied meta-analysis of 11 longitudinal studies, comprising 24,821 participants and revealed that subjects sleeping for short duration had twice the risk of being overweight/obese, compared with subjects sleeping for long duration (odds ratio 2.15; 95% confidence interval:1.64–2.81). This study provides evidence that short sleep duration in young subjects is significantly associated with future overweight/obesity. Padez et al (2009) found an inverse relationship between long sleep duration and obesity prevalence as well as with body fat, and these findings are important because sleep duration is a potentially modifiable risk factor that could be important to consider in the prevention and treatment of childhood obesity. In addition, studies in adults have shown that sleep less than 7 hours and more than 9-10 hours of sleep may increase the risk of obesity, type 2 diabetes, heart disease, stroke and depression (Shan et al., 2015).

Various mechanisms explain the associations between sleep duration and anthropometric measures. The underlying mechanisms for a higher consumption of energy dense foods among children with short sleep durations or with large variability in sleep duration are unclear, and may include behavioral as well as reward related aspects of food consumption. Subjects' sleep duration, their bed time and habit of eating somethings before sleeping is a key factor in becoming fatter. These eating and sleeping habits dysregulated hormonal mechanisms that involve decreased leptin and increased ghrelin levels (Spiegel et al., 2004).

CONCLUSIONS

As a result, it was determined that there was a negative correlation between SD and BMI, BFR, WC. According to our study, it was observed that the decrease of sleep duration (less than 6-hour) lead to increase in BMI, BFR and WC. In terms of obesity and health, it is recommended to pay attention to sleep duration.

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