



Original
Artículo inglés

Influence of sleep upon overweight in children and adolescents.

Influencia del sueño sobre el exceso de peso en niños y adolescentes.

Víctor Paredes Barato¹, Ismael San Mauro Martín¹, Elena Garicano Vilar¹, Esther Moraleda Ponzola¹, Sara López Oliva¹, Sara Sanz Rojo¹, Petar Petrov².

¹Research Center in Nutrition and Health. Paseo de la Habana, 43. 28036, Madrid. España.

²Researcher at Research Center in Nutrition and Health (Bulgaria-CINUSA Unit). Bulgaria.

Abstract

Introduction: Sleep restriction is an independent risk factor for weight gain and obesity and is significantly associated with the incidence and prevalence of obesity and various chronic non-communicable diseases. It leads to endocrine changes that might be associated with a higher intake of food and diurnal preference for energy-dense foods, generating a positive energy balance, leading to weight gain and increased risk of long-term obesity.

Objective: To analyze whether the decreases in the amount of night time sleep is a risk factor for weight gain and obesity development.

Methods: An anthropometric study (height, weight, BMI, waist circumference) was conducted in 549 students between 6 and 17 years. The amount of sleep was assessed by collecting hours of sleep on weekdays, naps and weekends and stating that school children should sleep 10 hours a day.

Results: Children who did not meet their recommended hours of sleep did not show statistically significant data in association with overweight or obese. The least amount of sleep was not negatively associated with BMI, or determined an increased risk for obesity.

Conclusion: Sleep factor has not been identified as involved in the epidemic of obesity in children and adolescents.

KEYWORDS

Sleep; Obesity; Healthy habits; Children; Adolescents.

Resumen

Introducción: La restricción del sueño es un factor de riesgo independiente para el aumento de peso y la obesidad y se asocia significativamente con la incidencia y la prevalencia de la obesidad y diversas enfermedades crónicas no transmisibles. Da lugar a cambios endocrinos que podrían estar asociados con una ingesta de alimentos diurna más alta y la preferencia por alimentos energéticamente densos, generando un balance energético positivo, lo que lleva al aumento de peso y un mayor riesgo de obesidad a largo plazo.

Objetivo: Analizar si la disminución de la cantidad de sueño nocturno sería un factor de riesgo para ganancia de peso y desarrollo de obesidad.

Métodos: Se realizó un estudio antropométrico (talla, peso, IMC, perímetro de cintura) a 549 escolares, entre los 6 y los 17 años. La cantidad del sueño se valoró recogiendo las horas de sueño entre semana, siesta y fin de semana y estableciendo que los niños en edad escolar deben dormir 10 horas al día.

Resultados: Los niños que no cumplieron con sus horas de sueño recomendadas no presentaban datos estadísticamente significativos en asociación con sobrepeso u obesidad. La menor cantidad de sueño no se asoció negativamente con el IMC, ni determinó un mayor riesgo para obesidad.

Conclusión: No se ha identificado el factor 'sueño' como involucrado en la epidemia de obesidad en niños y adolescentes.

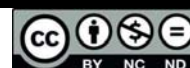
PALABRAS CLAVE

Sueño; Obesidad; Hábitos saludables; Niños; Adolescentes.

* Autor para correspondencia.

Correo electrónico: ismasmm@gmail.com (Ismael San Mauro Martín).

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Introduction:

Childhood obesity is one of the most concerning problems in the public health domain of the 21st century. According to studies published in the last twenty years, prevalence of childhood obesity is significantly rising ⁽¹⁾. Obesity is a multifactorial, chronic and complex disease which affects increasing number of people. Obesity is characterized by excessive body fat accumulation and is manifested by overweight and increased body volume. There is experimental evidence that childhood obesity positively correlates with increased risk of early-onset cardiovascular disease at adult age, which has led to a studying field of great interest ⁽¹⁾. In the majority of the cases, obesity is linked with certain lifestyle patterns ⁽²⁾ and has a genetic component ⁽³⁾. Some of these patterns, such as nutritional choices ⁽⁴⁾ and sleep ⁽⁵⁾, are essential for optimal health. It has been found that several patterns of abnormal sleep favour the onset of obesity ⁽⁶⁾. Possible hypotheses linked with this observation are based on dysregulation of energy expenditure, hormonal balance and circadian rhythm, amongst others. Sleep restriction is associated with increased concentration of leptin and ghrelin in plasma - hormones which are involved in the molecular regulation of the appetite and satiety; with an increased activity of the hypocretin/orexin system, as well as with changes in glucose metabolism and in the autonomic nervous system ⁽⁷⁾. Connections between sleep duration and energy balance are increasingly gaining attention in the scientific literature ⁽⁸⁾.

Objectives:

The objective of this study is to analyze the effect of sleep duration over lean body mass in a representative sample of children and teenagers.

Materials and methods:

Study population:

The study population consisted of 549 boys and girls (49% boys and 51% girls) aged between 6 and 17 years. All participants were provided detailed description of the study and were given an informed consent to participate in the study, which was signed by their parents. Variables subject to analysis were: sex, age, body weight, height, body mass index and its corresponding percentiles according to age and sex, waist circumference, and duration of sleep in hours.

Anthropometric study:

The anthropometric study was accomplished by previously trained nutritionists in two different zones, one for each gender. The following body measures were taken: height, body weight, body mass index (BMI) and waist circumference. Height was measured with portable height rod SECA with precision of 1mm, with the child standing on its two feet, following the established procedure by the World Health Organization ⁽⁹⁾. Body weight was measured with a digital bioimpedance scale TANITA model BP-601 with 0.1-150 kg range. The waist circumference was measured in the middle point between the last rib and the crest of the ilium ⁽⁹⁾, with an inelastic body measuring tape (range 0-150 cm). BMI was calculated from body weight and height with the Quetelet index ⁽¹⁰⁾. In order to establish overweight and obesity cut offs, the BMI values were compared with the curves and growth tables published by the Institute for Research of Growth and Development of Orbegozo Foundation ⁽¹¹⁾, which consider overweight if BMI is higher than percentile 85 and lower than percentile 97 of the population of the same age and sex and obese if BMI is higher than percentile 97. Waist circumference was measured with a metallic body measuring tape (flexible, inelastic, graduated to no more than 5 mm) in the intermediate abdominal region between the last rib and the iliac crest, in standing position, following a normal expiration.

Two measures were taken for all anthropometric measurements and their arithmetic average was used.

Sleep study

The variable "Sleep" was calculated estimating the time (in hours) spent on sleep during a whole week including *siesta*. The weekly average of sleep was compared with the recommendation presented in the Guide for clinical interventions for sleep disorders (GCI, 2011) ⁽¹²⁾, which establishes that children and adolescents in school age (6-17 years) should sleep 10 hours a day.

Results:

Following BMI calculations, it was estimated that 2.7% of the participants were obese and 32.1% were overweight, totalling to 34.8% (Table I). Regarding sleep duration, 78.6% of the participants did not follow the recommendations of (10 hours/day) ⁽¹²⁾.

Table I. Initial descriptive data			
	Girls (n=280)	Boys (n=269)	Total (n=549)
	A (SD)	A (SD)	A (SD)
Age (years)	11.8 ± 2.4	11.9 ± 2.5	11.83 ± 2.4
Height (m)	1.51 ± 0.1	1.54 ± 0.2	1.52 ± 0.1
Body weight (kg)	46.6 ± 12.1	49.8 ± 16.1	48.2 ± 14.2
BMI (kg/m ²)	20.2 ± 3.4	21.4 ± 16.3	20.8 ± 11.6
Waist circumference (cm)	68.2 ± 9.4	71.4 ± 12.3	69.8 ± 11.0
Sleep during working days (h)	8.06 ± 1.6	8.25 ± 1.8	8.15 ± 1.7
Sleep during weekend (h)	9.58 ± 1.9	9.14 ± 2.3	9.37 ± 2.1
Sleep (average hours)	8.86 ± 1.3	9 ± 1.4	8.9 ± 1.3

Summary of the initial characteristics of the participants in the study, represented as frequency (n) and average (A) ± standard deviation (SD).

There was no statistically significant correlation between BMI and sleep duration ($p > 0.05$).

Table II. Correlation between sleep hours and BMI				
	Girls (n=280)	Boys (n=269)	Total (n=549)	Chi-square ^a
	A (SD)	A (SD)	A (SD)	
<i>Hours of sleep from Monday to Friday (during the week)</i>				
				0.482
Slight underweight	8.1 ± 1.3	7.44 ± 1.5	7.87 ± 1.4	
Normal weight	8.04 ± 1.6	8.26 ± 1.9	8.13 ± 1.7	
Overweight	7.9 ± 1.6	8.29 ± 1.7	8.12 ± 1.7	
Obesity	9.6 ± 0.6	8.75 ± 0.96	9.22 ± 0.8	
<i>Hours of sleep from Saturday to Sunday(weekend)</i>				
				3.023
Slight underweight	9.67 ± 2.4	9.38 ± 2.3	9.61 ± 2.3	
Normal weight	9.62 ± 1.9	9.1 ± 2.3	9.39 ± 2.1	
Overweight	9.34 ± 2.02	9.11 ± 2.3	9.21 ± 2.2	
Obesity	11.2 ± 0.8	10 ± 0.8	10.7 ± 1.0	
<i>Hours of sleep from Monday to Sunday (average)</i>				
				0.351
Slight underweight	8.7 ± 1.1	8 ± 1.6	8.4 ± 1.3	
Normal weight	8.9 ± 1.2	9.03 ± 1.4	8.97 ± 1.3	
Overweight	8.6 ± 1.4	8.8 ± 1.4	8.8 ± 1.4	
Obesity	9.8 ± 0.7	9.4 ± 1.01	9.7 ± 0.8	

Average (A) ± Standard Deviation (SD) of the hours dedicated to sleep during working days, at weekends, and during the whole week, stratified by participants BMI and sex. ^a Kruskal-Wallis test.

Discussion:

The duration of the sleep has become a risk factor for the development of childhood obesity. Lack of sufficient sleep has been associated with increase in body weight, higher BMI values and higher probability to become overweight and obese. Children and teenagers who sleep less than recommended have approximately a two-fold higher probability to be overweight/obese compared with those who sleep more ⁽¹³⁾. This was confirmed by cross-sectional studies ⁽¹⁴⁻¹⁶⁾, longitudinal studies ⁽¹⁷⁻¹⁸⁾ and meta-analysis ⁽¹⁹⁻²⁰⁾.

To date, the underlying causal mechanisms explaining how the lack of sleep promotes obesity are not fully understood. Experimental studies in healthy adults and children have provided evidence that sleep deprivation results in several neuroendocrine and inflammatory changes: impaired glucose metabolism, decreased insulin sensitivity, and increased levels of inflammatory mediators such as interleukin-6 and tumour necrosis factor ⁽²¹⁾.

Another possible mechanism by which sleep deprivation could predispose to weight gain is by increasing caloric intake ⁽²²⁾. Additional proposed routes include choosing foods of poor nutritional quality as well as reduced levels of activity during the day related to increased fatigue or changes in thermoregulation among those who are deprived of sleep ⁽²¹⁾. Moreover, the short duration of sleep may lead to obesity due to the increased time available for eating ⁽²³⁾. The above mentioned hormonal changes may contribute to energy imbalance and could consequently lead to overweight or obesity.

Changes that occur as a consequence of sleep deprivation in hormones related to hunger and appetite are of particular interest: sleep restriction has been shown to reduce levels of leptin, a satiety-promoting hormone, and increase levels of the appetite promoting hormone ghrelin ⁽²⁴⁻²⁶⁾, which leads to an increased appetite and subsequently increased consumption of food ⁽²⁷⁾. Moreno Aznar ⁽²⁸⁾ explained: "It is known that some hormones are affected by the circadian clock. For example, growth hormone is produced only during specific phases of sleep, and although this is an anabolic hormone not necessarily related to obesity, the same could occur with other hormones. That means that a sleep disorder may mean an imbalance in the rhythms of production of hormones throughout the day. "It may also happen that little sleep brings the person to wake up with not enough time for breakfast, to feel more tired, and prime other unhealthy behaviors throughout the day.

In general, sleep duration is positively associated with lower adiposity and a better quality of life, among others. However, experimental evidence for the association between sleep duration and cardiovascular and metabolic biomarkers is limited ⁽²⁹⁾.

Despite the clear association of previous studies between short sleep duration and the obese state, the results of longitudinal studies for this association are contradictory ⁽¹³⁾. In our study sample, no relationship between sleep duration and BMI was found. Moreover, in the study of Carson et al. ⁽³⁰⁾ duration of sleep was negatively associated ($p < 0.02$) with obesity risk markers.

Conclusion:

When analyzing the influence of sleep habits on weight status, statistically significant results were not found. It is not possible to determine whether failure to comply with current recommendations for duration of the sleep in children is the cause or the result of overweight in the population studied since the study is based on self-report of sleep duration of each subject.

Limitations:

Information on sleep duration was self-reported by the participants in the study. This method has limitations to assess sleep duration, since it often does not allow differentiating between sleep time and the time spent in bed without sleeping and, in addition, it cannot precisely establish the number and duration of *siestas*.

Conflict of interests:

Authors declare no conflicts of interest.

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