

## Impact of sleep quality on anthropometric profile in school-age children from a sports academy

Impacto de la calidad del sueño en el perfil antropométrico de los niños en edad escolar de una academia deportiva

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**Abstract.** Sleep quality is crucial during school age as it directly impacts children's development; however, understanding its influence on anthropometric profile during this vulnerable stage is essential. To determine the association between sleep quality and anthropometric profile in school-aged children from a sports academy in the city of Trujillo, Peru. Data were obtained through a non-experimental cross-sectional study involving 117 boys and girls aged 9 to 12 years. Sleep quality was measured using a survey technique, with the instrument being a sleep quality questionnaire developed by the researchers. Additionally, anthropometric profile was assessed using observational techniques, with the instrument being an anthropometric measurement record form. The *p*-values for body mass index (BMI), height for age (H/A), waist-to-height ratio and skinfold thickness were all greater than 0.05 (0.360; 0.661; 0.696; 0.312). There is no association between sleep quality and anthropometric profile, sleep quality had no impact on anthropometric profile.

**Keywords:** academy, sleep, anthropometric profile, football, children, sport.

**Resumen.** La calidad del sueño es crucial durante la edad escolar ya que impacta directamente en el desarrollo de los niños; Sin embargo, comprender su influencia en el perfil antropométrico durante esta etapa vulnerable es fundamental. Determinar la asociación entre la calidad del sueño y el perfil antropométrico en niños en edad escolar de una academia deportiva de la ciudad de Trujillo, Perú. Los datos se obtuvieron a través de un estudio transversal no experimental en el que participaron 117 niños y niñas de 9 a 12 años. La calidad del sueño se midió mediante una técnica de encuesta, siendo el instrumento un cuestionario de calidad del sueño desarrollado por los investigadores. Además, se evaluó el perfil antropométrico mediante técnicas de observación, siendo el instrumento un formulario de registro de medidas antropométricas. Los valores de *p* para el índice de masa corporal (IMC), la altura para la edad (H/A), el indicador cintura-altura y el grosor de los pliegues cutáneos fueron todos superiores a 0,05 (0,360; 0,661; 0,696; 0,312). No existe asociación entre la calidad del sueño y el perfil antropométrico, la calidad del sueño no tuvo impacto en el perfil antropométrico.

**Palabras clave:** academia, sueño, perfil antropométrico, niños, fútbol, deporte.

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### Introduction

In recent decades, there have been significant changes, including technological advancements, cultural shifts, dietary habits, and changes in economic conditions of families. All of these factors have contributed to alterations in sleep quality, subsequently impacting nutritional status, particularly affecting a vulnerable stage, childhood (Grandner, 2017).

In particular, sleep quality refers to a subjective perception of the degree of satisfaction and recovery experienced during nighttime rest, beyond merely analyzing sleep duration. It is crucial for physiological and psychological functioning, as it enables cellular regeneration, emotional balance, and the optimization of cognitive processes (Santa et al., 2024). Sleep quality is evaluated through parameters such as circadian rhythm, sleep latency, sleep efficiency (the proportion of total sleep time relative to time spent in bed), sleep fragmentation (interruptions during sleep), and wakefulness frequency. Furthermore, regular physical activity has been shown to significantly improve sleep quality (Claudino et al., 2019).

With the emergence of the coronavirus disease and subsequent social isolation, technology has become a prevalent entertainment tool, leading to reduced sleep duration and quality, a problem that persists to this day (Carmenate & Marín, 2021).

Sleep is a vital physiological process crucial for the development and growth of infants and adolescents. It not only plays a restorative role but also regulates metabolism,

influencing appetite control (Van der Heijden et al., 2018; Zarpellón et al., 2022).

The World Health Organization (WHO) reported that approximately 390 million children aged 5 to 19 were overweight or obese, with 19% of girls and 21% of boys being overweight, and 8% of children having obesity (Who, 2024). This situation negatively impacts the anthropometric profile of the pediatric population.

Regarding anthropometric profile, it refers to the detailed assessment of body dimensions, such as weight and height, using standardized procedures that are essential for obtaining accurate data on body composition. Therefore, anthropometric analysis is crucial for monitoring health and well-being, particularly in pediatric populations, where growth patterns and the family environment play a key role in relation to physical activity and BMI (Rao et al., 2023).

Furthermore, Fernández et al., (2021) conducted a study in Lima titled "Sleep Quality and Body Fat Percentage in Nutrition University Students", aiming to determine the association between sleep quality and body fat percentage. The study, based on a cross-sectional design with a correlational approach, involved 155 students, measuring body fat percentage using bioimpedance and sleep quality using the Pittsburgh Sleep Quality Index. The results showed that 59% had poor sleep quality, and 47% of university students had markedly inappropriate body fat percentages, with no observed association between body fat percentage (%BF) and sleep quality ( $p=0.466$ ). The conclusions highlighted students' poor sleep-related habits and inappropriate %BF, threatening their quality of life.

Additionally, a study in Mexico found an association between overweight/obesity and poor sleep quality ( $p < 0.0001$ ), particularly among male university students who had higher percentages of overweight/obesity directly linked to poor sleep quality (Hermes et al., 2022).

Considering the aforementioned points and the limited literature on the impact of sleep quality on anthropometric profile in school-aged children, a critical age for developing sleep patterns and eating habits that influence their anthropometric profile and future quality of life, our objective in this study is to determine the association between sleep quality and anthropometric profile measured in school-aged children from a sports academy.

## Material and Methods

### Study design

The present study follows a non-experimental, simple descriptive, cross-sectional, and prospective design, conducted at a youth football academy between February and March 2024 in Trujillo city, La Libertad region, Peru.

A questionnaire adapted from Alfonso et al. (2019) was administered to the children after obtaining informed consent from their guardians, who were informed about the study's purpose and procedures. The questionnaire had undergone prior validation by expert judgment and was approved by the research ethics committee of the Nutrition School with project code: PI-CEI-NUT. EST. 2023-0035.

### Study population

A simple random probabilistic sampling method was used for the study to ensure a representative sample of the total population. The study population comprised 166 children of both sexes, aged between 9 and 12 years. Using the known population formula with a 95% confidence level, a sample of 117 boys and girls was selected. Informed consent was obtained from legal guardians to administer the sleep quality questionnaire and take anthropometric measurements. The study included children who had been engaged in sports for 6 to 12 months. Children with sporadic sports practice, those older than 13 or younger than 8 years, and those without parental or guardian consent were excluded from the study.

### Data collection

#### Sleep quality

To assess sleep quality, a survey technique was employed using a specific questionnaire based on the well-known Children's Sleep Habits Questionnaire (CSHQ) by Alfonso et al. (2019), adapted for children aged 9 to 12 years. The information collected corresponded to the previous week prior to the administration of the questionnaire. Before implementation, the questionnaire was validated by a panel of experts to ensure its suitability and reliability in measuring sleep quality. It consisted of 26 questions divided into three dimensions: sleep hygiene, sleep disorders, and daytime fatigue and sleepiness. Responses were classified

on a 5-point scale: 5 for "always," 4 for "almost always," 3 for "sometimes," 2 for "almost never," and 1 for "never." A score of  $\leq 3$  indicated good sleep quality, while a score of  $\geq 4$  indicated poor sleep quality. The reliability of our instrument was evaluated through a pilot test, resulting in a Cronbach's alpha of 0.933, indicating high reliability of the instrument.

#### Anthropometric profile

Observation technique was utilized for assessing nutritional status, using an anthropometric measurement form. Weight was measured using digital body scale Huawei AH100, height with stadiometer Seca, waist circumference with measuring tape Ava Nutri, and skinfold thickness (triceps and subscapular) with caliper Ava Nutri. Criteria established by the Ministry of Health (MINSa) for classifying various anthropometric variables were applied. BMI categories included underweight ( $< -3$  SD), overweight ( $< 3$  SD) and obesity ( $< 3$  SD). Height-for-age (H/A) was categorized as low ( $< -3$  SD) or high ( $> 3$  SD). Abdominal perimeter used indicators for with or without abdominal obesity by waist-height ratio (WH). Body fat percentage categories were low (6% to 9.9%), adequate (10% to 19.9%), moderately high (20% to 24.9%), high (25% to 30.9%), and very high (31% and above) by skinfold thickness (ST).

#### Statistical analysis

Specific statistical tests were applied to analyze the distribution of the study's samples. Given the sample size exceeding 30 participants, the Kolmogorov-Smirnov test was used to assess whether the data followed a normal distribution. Additionally, due to the non-parametric nature of the sample, the chi-square ( $\chi^2$ ) test was employed to explore possible relationships between study variables. This test is suitable for analyzing categorical or frequency data when conditions for parametric tests are not met. All statistical analyses were performed using software SPSS version 25, known for its robust data analysis tools and widespread use in scientific research.

## Results

In this study, we investigated the relationship between sleep quality and anthropometric profile in school-aged children (Table 1). It was observed that the  $p$ -values for body mass index (BMI), height-for-age (H/A), waist-to-height ratio (WH), and skinfold thickness (ST) were all greater than 0.05 ( $0.360 > 0.05$ ;  $0.661 > 0.05$ ;  $0.696 > 0.05$ ;  $0.312 > 0.05$ ), indicating that there is no significant relationship between sleep quality and anthropometric status in school-aged children. It was evident that the majority of school-aged children (71.8%) exhibited positive sleep quality, including its various dimensions: sleep hygiene (73.5%), sleep disorders (70.1%), and daytime fatigue and sleepiness (74.4%). However, a notable percentage (28.25%) of surveyed children showed poor sleep quality, reflected in their dimensions at (26.5%), (29.9%) and

(25.6%) respectively (Figure 1).

Table 1.  
Relationship between sleep quality and anthropometric profile in school-aged children

Nutritional status	Indicator	Sleep quality				Chi-square ( <i>p</i> )*	
		Good		Poor			Total
		n	%	n	%	n	%
BMI	Normal	52	44.4	25	21.4	77	65.8
	Overweight	19	16.2	5	4.3	24	20.5
	Obesity	13	11.1	3	2.6	16	13.7
H/A	Short stature	2	1.7	0	0	2	1.7
	Normal	79	67.5	32	27.4	111	94.9
	Tall stature	3	2.6	1	0.9	4	3.4
WH	With obesity	18	15.4	6	5.1	24	20.5
	Without obesity	66	56.4	27	23.1	93	79.5
	Low fat	11	9.4	1	0.9	12	10.3
ST	Adequate	50	42.7	23	19.7	73	62.4
	Moderately high	21	17.9	9	7.7	30	25.6
	High	2	1.7	0	0	2	1.7

BMI: Body Mass Index, T/E: Height for Age, WH: Waist-to-Height ratio, ST: Skinfolds Thickness.

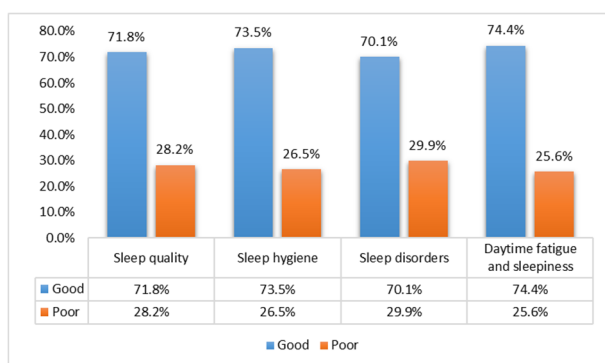


Figure 1. Percentage of sleep quality based on three dimensions in school-aged children

Table 2.  
Anthropometric profile in school-aged children by gender

	Indicator	Gender				Total	
		Male		Female		n	%
		n	%	n	%	n	%
BMI	Normal	34	29.1	43	36.8	77	65.8
	Overweight	9	7.7	15	12.8	24	20.5
	Obesity	10	8.5	6	5.1	16	13.7
T/E	Short stature	0	0	2	1.7	2	1.7
	Normal	50	42.7	61	52.1	111	94.9
	Tall stature	3	2.6	1	0.9	4	3.4
WH	With obesity	10	8.5	14	12.0	24	20.5
	Without obesity	43	36.8	50	42.7	93	79.5
	Low fat	7	6.0	5	4.3	12	10.3
ST	Adequate	32	27.4	41	35.0	73	62.4
	Moderately high	14	12.0	16	13.7	30	25.6
	High	0	0	2	1.7	2	1.7
Total		53	45.3	64	54.7	117	100

BMI: Body Mass Index, T/E: Height for Age, WH: Waist-to-Height ratio, ST: Skinfolds Thickness.

The anthropometric profile of participating school-aged children in the study is presented. Regarding body mass index (BMI), 65.8% of children have a normal weight, while 20.5% are overweight, and 13.7% are obese. Concerning height-for-age (H/A), the majority of children (94.9%) have a normal height, with a small percentage having low (1.7%) or high (3.4%) stature. Regarding waist-to-height ratio (WH), 20.5% of children show abdominal obesity. Lastly, concerning skinfold thickness (ST), the majority (62.4%) have an appropriate amount of subcutaneous fat,

while a smaller percentage show moderately high (25.6%) or low (10.3%) levels (Table 2).

## Discussion

The main objective of the research was to determine the potential association between sleep quality and anthropometric profile in school-aged children from a sports academy. The data from Table 1 were analyzed for this purpose. However, a significant correlation between these variables was not observed. In this regard, Hermes et al. (2022) in their findings, highlight that sleep duration is related to the risk of developing overweight and obesity. They suggested that insufficient sleep duration, i.e., less than 9-10 hours per night, is associated with a higher risk of overweight or obesity in children (Fernandez et al., 2021). However, in our research, a significant connection between these variables was not found. This lack of association could be attributed to the high level of physical activity maintained by the participating children, thanks to the variety of sports they practice, along with control over caloric intake (Chales-Aoun & Merino, 2019).

In the analysis of anthropometric profile in children aged 9 to 12 years, it was observed that there is no significant association between BMI and sleep quality ( $p$ -value = 0.360), in contrast to the study conducted by Ortiz et al. (2019), in their research on the relationship between sleep deficiency and overweight or obesity in new-generation medical students in Mexico, an association between poor sleep quality and excess weight ( $p < 0.0001$ ) was found. However, in our study, a significant association between sleep quality and BMI was not found. This disparity could be explained by the high physical activity experienced by the children compared to the sample studied. Consequently, it is suggested that the influence of the significant link between sleep quality and BMI is highly conditioned by the specific characteristics of the examined population, which represents a significant difference from the research (Silva et al., 2020).

Likewise, it has been observed that there is no significant association between height-for-age (H/A) and sleep quality ( $p$ -value = 0.661). Calcaterra et al. (2023) in their study, concluded that height is not significantly related to sleep quality. Furthermore, they highlighted that 25% of subjects with normal height also had optimal sleep quality. Comparing these findings with the results obtained, a significant similarity can be observed. On the other hand, Favela et al. (2024) found that 34.7% of the athletes reported having sleep disorders and 65.6% had poor sleep quality. This could be explained by the fact that children with normal height often participate frequently in recreational activities, which may contribute to their overall well-being. On the other hand, a frequent use of mobile devices was observed among participants. Considering the contrast, García-Real & Losada-Puente (2022) indicate that excessive technology use in certain children (47%) could have a negative impact on

sleep quality, even if they maintain adequate levels of physical activity.

It was also observed that sleep quality in children aged 9 to 12 years is not significantly related to waist-to-height ratio ( $p$ -value = 0.696). In a study by Ruiz et al. (2014) on nighttime sleep duration, weight, height, and waist-to-height ratio were measured, where adolescents with a high waist-to-height ratio and obesity showed a significant association with the average hours of sleep from Sunday to Thursday ( $p < 0.05$ ). This study details a connection between waist-to-height ratio and sleep. However, our findings did not yield the same conclusion, possibly due to differences in the age of the subjects in the samples, which is a crucial factor in the sleep quality of each child (Muñoz & Bianchi, 2017).

It is determined that there is no significant association between sleep quality and skinfold thickness ( $p$ -value = 0.312), in contrast to the findings by Hernández et al. (2021) whose research revealed that skinfold thickness was correlated with total body fat percentage (%BF), concluding that they lacked significance regarding sleep quality ( $p < 0.05$ ). This result coincides with the findings of the study, where a lack of significance was also observed. This could be attributed to the fact that sleep quality is influenced by a variety of factors, such as the rest environment, emotional state, sleep habits, and overall health, so skinfold thickness may not be directly related to any of these factors. However, there is a disparity between the results obtained in this study and the previous one, mainly due to differences in the populations analyzed and the methodologies used to assess both nutritional status and sleep quality (Herrera et al., 2021).

This study was to identify sleep quality in children aged 9 to 12 years. Figure 1 shows a comparison of the results, indicating that the majority of children in this age group have positive sleep quality, with 71.8% experiencing good quality sleep. This information is related to the study conducted by Meltzer et al. (2021) who emphasized the importance of sleep quality in children. Their research highlighted how factors such as sleep duration and consistency affect overall well-being and daytime performance of children. The findings support the idea that a significant proportion of children aged 9 to 12 years enjoy positive sleep quality, which is crucial for their development and daily functioning.

Furthermore, 73.5% exhibited satisfactory sleep hygiene. In supporting this finding, Nikles observed that a high number of examined children maintained healthy sleep habits and adequate sleep hygiene, which correlated positively with better rest (Nikles et al., 2020). These findings support the relevance of promoting sleep hygiene, which is also cost-effective, and underline the importance of focusing on the regularity of children's daily routines and activities, which likely brings benefits beyond the sleep realm (García & Navarro, 2017). Additionally, positive results are observed regarding nutritional status and the sensation of daytime fatigue and sleepiness, reaching 70.1% and 74.4%,

respectively. According to Tenezhay et al. (2021) sleep disorders can exacerbate daytime drowsiness and increase fatigue by up to 50%, resulting in 55.94% of the surveyed individuals experiencing excessive sleepiness. These findings support our assertion that alterations in eating habits, such as decreased appetite or increased consumption of unhealthy foods, are common in individuals with depression and can impact energy levels, thereby contributing to fatigue (Ramón et al., 2019).

However, it is of utmost importance to address the 28.2% of children experiencing poor sleep quality, especially among those with more than 25.6% exhibiting negative aspects such as daytime fatigue and sleepiness.

Regarding the anthropometric profile, it was determined in children aged 9 to 12 years. According to the data presented in Table 2, 65.8% of the children have a weight considered normal according to BMI, while 20.5% are overweight and 13.7% are obese. A study conducted by Dávila-Morán & Agüero (2024) reports that the body mass index showed a higher prevalence of overweight, grade I obesity, and grade II obesity in women, with 23.6%, 2.1%, and 1.8% respectively.

Regarding height-for-age (H/A), the vast majority (94.9%) exhibit a height within normal parameters, although a small percentage shows low (1.7%) or high (3.4%) height. This finding aligns with the results obtained by Moreno (2024) who also observed that the majority of children of this age have a height appropriate for their age, with a minimal proportion of cases of low or high height. As for waist-to-height ratio, it was found that 20.5% of the children have abdominal obesity, a figure similar to that obtained by Pajuelo et al., (2019) who also identified a similar percentage of children (33.6%) with this issue in their study on child population. It is important to improve nutritional status through nutritional knowledge as well as the diet of the students (Irab et al., 2024) as this would help control weight gain and reduce the rates of overweight and obesity.

It was discovered that 12% of girls have abdominal obesity, a figure that aligns with the finding of Rönnecke et al. (2019) who determined that girls have a waist-to-hip ratio of 22.5%. This phenomenon is attributed to the increase in hip circumference and waist development during puberty, which is also influenced by bone structure, such as pelvis width, and muscle mass. Regarding skinfold thickness, the majority (62.4%) have an adequate amount of subcutaneous fat, which agrees with the findings by Patiño (2022) who found that most children of this age maintained adequate levels of subcutaneous fat in their research on child nutritional health. This discrepancy in results can be attributed to the different characteristics of the populations studied; it is relevant to note that children with higher physical activity exhibit a lower obesity rate. Furthermore, it is important to point out that our study focuses on children, which establishes a significant distinction from the population studied. Consequently, pediatric obesity due to increased caloric intake is likely related to

sleep deprivation (Morrison et al., 2023).

### Conclusions

In conclusion, although the findings do not suggest a close relationship between sleep quality and anthropometric profile, sleep deprivation and/or poor sleep quality are considered significant contributing factors affecting nutritional status. Furthermore, this study evidenced that a significant percentage of children were overweight, had abdominal obesity, and had a moderately high body fat percentage. Therefore, this link underscores the importance of addressing both dietary habits and sleep patterns in the prevention and management of childhood malnutrition. Adopting strategies that promote a healthy lifestyle, including a balanced diet and adequate sleep, could be crucial in combating this growing public health concern. However, further research is needed to fully understand the underlying mechanisms and to develop effective interventions in this area.

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### Conflict of interest

The authors report no financial or any other conflicts of interest in this work.

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### Data availability

All data generated and analyzed during this study are included in this research article.

### Ethical approval

The study received ethical approval from the Research Ethics Committee of the School of Nutrition of César Vallejo University (Approval Number: PI-CEI-NUT. EST. 2023-0035, dated: November, 2023).

### Abbreviations

SQ (Sleep quality), BMI (body mass index) H/A (height-for-age), CSHQ (Child's Sleep Habits Questionnaire), WH (Waist-to-height ratio), ST (Skinfolds Thickness)

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