African Journal of Biological Sciences

Research Paper Open Access

Sleep Efficiency and Latency as Indicators of Sleep Quality by Bmi: Multicentric Study

Valladares-Vega M[1*], Crovetto M[2], Obregón AM[3], Espinoza V[4], Mena F[5], Oñate G[6], Fernández M[6], Durán-Agüero S[7]

1. Centro Integrativo de Biología y Química Aplicada (CIBQA), Universidad Bernardo O´Higgins, Santiago, Chile.

2. Departamento Salud, Promoción y Gestión, Facultad de Ciencias de la Salud, Universidad de Playa Ancha Valparaíso Chile.

3. Escuela de Nutrición y Dietética, Facultad de Ciencias para el Cuidado de la Salud, Universidad San Sebastián, Concepción, Chile.

4. Departamento de Procesos Diagnósticos y Evaluación, Facultad de Ciencias de la Salud, Universidad Católica de Temuco, Temuco, Chile.

5. Departamento de Ciencias de los Alimentos y Nutrición, FACSA, Universidad de Antofagasta, Antofagasta, Chile.

6. Carrera Nutrición y Dietética, Facultad de Ciencias de la Salud, Universidad Autónoma de Chile, Santiago, Chile.

7. Escuela de Nutrición y Dietética. Facultad de Ciencias Para el Cuidado de la Salud, Universidad San Sebastián, sede Los leones, Chile.

Corresponding author (*): Macarena Valladares
Email: mvalladaresvega@gmail.com

Article Info

Volume 6, Issue 8, April 2024
Received: 04 Feb 2024
Accepted: 12 March 2024
Published: 07 April 2024

Abstract

The circadian rhythm plays a crucial role in regulating various physiological and behavioral processes, including sleep. Sleep quality is a construct that encompasses different aspects of sleep experience, such as difficulty initiating or maintaining sleep. Dysregulations of circadian cycles are prevalent in modern societies, leading to alterations in sleep patterns and potentially impacting overall health. Altered sleep patterns have been associated with an increased risk of overweight and obesity, particularly among university students who often exhibit poor dietary habits and sleep disturbances. While previous studies have focused on quantitative aspects of sleep, there is limited information regarding the association between qualitative elements of sleep and nutritional status in university students. Therefore, this cross-sectional study aimed to evaluate sleep quality by nutritional status among university students in Chile.

Key words: Circadian rhythm, Sleep quality, Nutritional status

Introduction

The circadian rhythm is a regular pattern of fluctuation in the physiology of behavior that is usually associated with the light-dark cycle lasting 24 h (Tahara and Shibata 2013). One of the processes regulated by the circadian rhythm is sleep, a temporary loss of consciousness that is reversible and involves a significant change in the regulation of various body functions (Buysse 2014). The circadian clock promotes wakefulness during the period of light and sleep during the period of dark (Tahara and Shibata et al. 2013). In this way, it is considered that the absence of sleep induces behavioral and physiological alterations that are associated with a chronic debt and an accumulated sleep deficit.

In relation to the sleep study, the term “sleep quality” has been established as a construct that is determined by measuring different sleep patterns such as: difficulty of initiating or maintaining sleep, and may manifest as difficulty sleeping (early insomnia), waking up frequently during the night or waking up early in the morning ahead of schedule (terminal insomnia) (Jiang 2015). In this respect, the term “quality” is not used to refer to the amount or distribution of sleep and wakefulness but rather to variations in the experience of sleep itself (Jiménez-Genchi et al. 2008). Dysregulations of circadian cycles have now been reported in the general population, this is a characteristic of postmodern societies globally and where habits and social practices with repercussions on sleep patterns and promotion of a style of life with poor hygiene and quality of sleep is present (Ogilvie and Patel 2017).

Scientific background shows that altered sleep patterns are associated with a higher risk of developing overweight and obesity (Fatima et al. 2016). It is important to consider that the sleeping experience requires that both, quantitative aspects such as sleep hours and qualitative elements, are optimal. Therefore, it is necessary when it is determining the association with sleep quality, which is the parameter (within this concept) that is effectively generating that association. When considering the association between sleep parameters and nutritional status, the university population is particularly relevant, since it is considered as a vulnerable group of students, where their habits are characterized by frequently skipped meals, between-meal snacking, fast-food preference and frequent alcohol intake (Owens 2014; Sánchez-Ojeda and De Luna-Bertos 2015). Additionally, university students have sleep disturbances; this can be due to the high stress they are subjected to or to a high exposure to television or computer screens, which results in later bedtimes, exposed to social interactions with peers, thus altering the sleep-wake rhythm [Jiang et al. 2015; Owens 2014].

In the past few years, some reports have shown an association between disruptions of circadian rhythms and nutritional status in university students (Valladares et al. 2016; Durán-Aguero et al. 2016, Durán-Aguero et al. 2017), although those studies have been focused on considering quantitative aspects, mainly in the number of hours of sleep. However, there is not enough information in relation to the association of qualitative elements of sleep and nutritional status, particularly in the university population, Thus, considering the relevance that both variables exert in other body functions such as cognitive, physical, mental pathologies, among others, it is important to address them. Therefore, the aim of this study was to evaluate sleep quality by nutritional status in a university student population.

Materials and Methods

Participants and Study Design

This was a cross-sectional study with voluntary participation. University students (n=1131; 222 men and 909 women) from the northern, central, and southern areas of Chile were invited to participate in this study. Informed signed written consent was obtained from all individual participants included in the study.

Sleep Quality

To evaluate the quality of sleep, we applied the Pittsburgh Sleep Quality Index (PSQI) (Mollayeva et al. 2016). This Questionnaire counts with 19 self-assessment questions, organized into 7 components, such as: subjective quality of sleep, latency, duration, efficiency, sleep disturbances, use of sleep medication, dysfunction daytime. Each component is scored on a scale of 0 to 3, where a higher score indicates a lower quality of sleep in general or for each component.

Anthropometric measurements

All subjects were weighed and measured, and body mass index (BMI, kg/m^2) was calculated to categorize nutritional status according to the WHO criteria (https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy lifestyle/body-mass-index-bmi).

Data collection and statistical analysis

Data were analyzed according to frequency and percentage distribution. The $\chi 2$ test was applied to evaluate an association between the BMI and the level of sleep quality. Additionally, each of the 7 components of the questionnaire was analyzed separately according to their BMI.

The Kruskal Wallis test (kwallis2 command in the Stata version 14) was applied to establish whether there are significant differences between the different groups according to BMI in terms of each sleep component. In those cases where a significant difference was found, Kruskal Wallis test was applied with adjustment of p value, considering as a control group the data obtained from the subjects who presented a normal BMI. In all the statistical analyzes, we worked with a 95% confidence and with an $\alpha = 0.05$.

All procedures were performed in accordance with the ethical standards of the Institution and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Results and Discussion

The general characteristics of the volunteers based in their nutritional status are shown in Table 1. The global scores of sleep quality are significantly higher in the overweight (10.8) and obesity type I group (11.3) compared with under (6.3) and normal weight (5.8) ($p < 0.001$). The overall scores between underweight and normal weight are not statistically significant, the same for the overweight and obesity groups (Table 1).

Table 1. General characteristics of the studied sample by nutritional status

	Under weight (n=41) (3.6%)	Normal weight (n=398) (35.2%)	Overweight (n=473) (42%)	Obesity type I (n=219) (19.4)	P value
Age (years)	24.5 ± 2.1	22.3 ± 3.2	23.2 ± 2.7	21.6 ± 2.6	0.4
Total sleep quality scores	6.3 ± 3.8[a, b]	5.8 ± 2.6[c, d]	10.8 ± 2.1	11. 3 ± 3.2	P < 0.001

Statistically significant p<0.001 differences were analyzed with the Kruskal-Wallis test

[a] significant difference between underweight and overweight

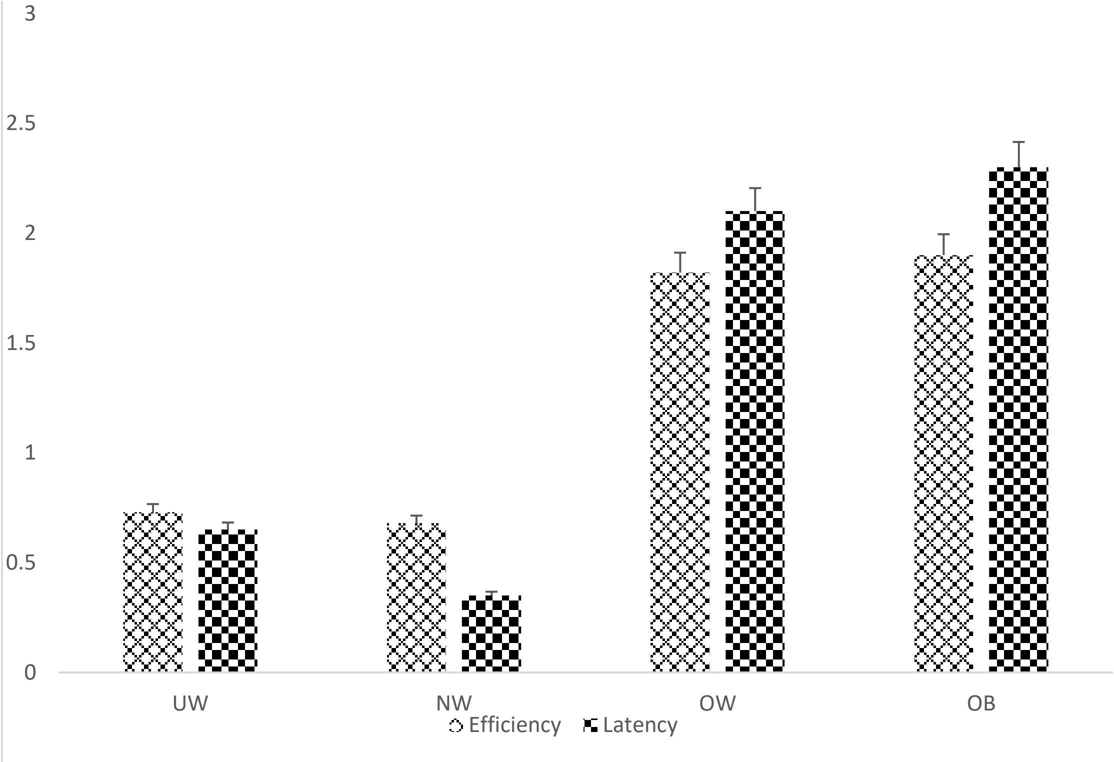
[b] significant difference between underweight and obese type I

[c] significant difference between normal weight and overweight

[d] significant difference between normal weight and obese type I

Since there were differences in the global score by nutritional status, the individual scores of each component of the sleep quality questionnaire were also compared by their nutritional status (Figure 1). Statistically significant differences were found in the components of efficiency and sleep latency according to nutritional status, where overweight (scores of 2.1) and people with obesity (scores of 2.3) had higher scores than those underweight (scores of 0.65) and normal weight (scores of 0.35). These data show that participants with overweight and people with obesity take 30-60 minutes to fall asleep after they have gone to bed, whereas, underweight and normal weight population take less than 15 minutes to fall asleep.

Figure 1. Efficiency and Latency scores by nutritional status



Scores of efficiencies and latency component through the PSQI. UW: underweight; NW: normal weight; OW: overweight; OB: obesity type I.

In the other components of sleep quality measured with PSQI such as, subjective quality of sleep, duration, sleep disturbances, use of sleep medication and dysfunction daytime, no significant differences were found according to nutritional status.

Discussion

As far as we know, this study is one of the few to undertake an analysis of sleep quality in Chilean college students, considering that Hispanic population is generally underrepresented in sleep studies. The most relevant and novel result found in our study is the poorer sleep quality in the groups with overweight and obesity as a global parameter. Furthermore, when analyzing the seven components individually that structure the quality of sleep measured with PSQI, we found that significant differences, according to their nutritional status, were observed in the latency and sleep efficiency scores and not in the other 5 components.

In relation to latency and considering the length of time the lights are turned off when the person tries to sleep at night (Shrivastava et al. 2014), our results are in agreement with other reports where frequent high latencies in adolescents' students (more than 30 minutes) were found (Saxvig et al. 2012; Albqoor and Shaheen 2020).

The specific mechanisms underlying the association between nutritional status and sleep latency specifically have not been described. However, there is accumulating and consistent evidence showing that short sleep duration, generate high levels of ghrelin and also decreased leptin levels and together increases hunger and appetite (Taheri et al. 2004, Spiegel et al. 1999, Chaput et al. 2007). We did not find a significant association with the duration of sleep component and BMI; this fact reflects how inaccurate and incomplete it can be to evaluate only one component of sleep, like number of hours of sleep. No knowledge is available regarding hormonal changes related to altered levels of efficiency or sleep latency. Therefore, it would be relevant to address physiological variables that may be influencing the association observed in this study as hormone levels, depression, stress among others. knowing the individual causes of poor quality of sleep, would allow to generate prevention and a more effective management.

Respect to sleep efficiency, which is the ratio between the time actually spent asleep and the time spent in bed, this parameter of sleep would demonstrate in a better way how sleep is structured, since it includes all the variables of sleep continuity (Berry et al. 2012). The regulation of the light-dark cycles is controlled at the level of the hypothalamus, as are the feeding processes (Adamantidis and De Lecea 2008; Vanitallie 2006). Therefore, changes in processes that occur at the level of the hypothalamus, as observed during adolescence, could explain in part the association between sleep latency and efficiency observed in this study.

Conclusion

We did not find differences according to gender in any of the variables measured. The university stage is characterized by a transition process, from adolescence to an adult age, which leads to an increase in independence, autonomy and responsibility and is directly related to aspects of behaviors affecting health (VanKim et al. 2012). Therefore, it is crucial to establish behaviors and lifelong health habits, associated with eating behavior and sleep patterns.

Disclosure of interest

The authors report no conflict of interest

References

Adamantidis A, De Lecea L. 2008. Sleep and metabolism: shared circuits, new connections. Trends Endocrinol Metab. 19: 362–370.

Albqoor A, Shaheen A. 2020. Sleep quality, sleep latency, and sleep duration: a national comparative study of university students in Jordan. Sleep and Breathing 25:1147–1154.

Berry RB, Brooks R, Gamaldo CE. 2012. The AASM manual for the scoring of sleep and associated events. Darien, IL: American Academy of Sleep Medicine. https://learn.aasm.org/Public/Catalog/Details. Accessed 2019 December 4.

Buysse DJ. 2004. Sleep health: can we define it? Does it matter? Sleep. 37: 9-17.

Chaput JP, Després JP, Bouchard C, Tremblay A. 2007. Association of sleep duration with type 2 diabetes and impaired glucose tolerance. Diabetología. 50 (11): 2298-2304.

Durán-Aguero S, Crovetto M, Espinoza V. 2017. Lifestyles, body mass index and sleep patterns among university students. Rev Med Chile. 145: 1403-1411.

Durán-Aguero S, Fernández-Godoy E, Fehrmann-Rosas P. 2016. Fewer hours of sleep associated with increased body weight in chilean university nutrition students. Rev Peru Med Exp Salud Pública. 33 (2): 264-268.

Fatima Y, Doi SA, Mamun AA. 2016. Sleep quality and obesity in young subjects: a meta-analysis. Obes Rev. 17 (11):1154-1166.

Jiang XL, Zheng XY, Yang J, Ye CP, Chen YY, Zhang ZG. 2015. A systematic review of studies on the prevalence of insomnia in university students. Public Health. 29(12): 1579-1584.

Jiang X, Hardy LL, Baur LA, Ding D, Wang L, Shi H. 2015. Sleep duration, schedule and quality among urban Chinese children and adolescents: associations with routine after-school activities. Pols One. 10 (1): 1-12.

Jiménez-Genchi A, Monteverde-Maldonado E, Nenclares-Portocarrero A. 2008. Reliability and factorial analysis of the Spanish version of the Pittsburg Sleep Quality Index among psychiatric patients. Gac Méd Méx 144 (6): 401-496.

Mollayeva T, Thurairajah P, Burton K, Mollayeva S, Shapiro CM, Colantonio A. 2016. The Pittsburgh sleep quality index as a screening tool for sleep dysfunction in clinical and non-clinical samples: A systematic review and meta-analysis. Sleep Med Rev.25:52-73.

Owens J. 2014. Insufficient sleep in adolescents and young adults: an update on causes and consequences. Pediatrics. 134 (3):921-932.

Ogilvie RP, Patel SR. 2017. The epidemiology of sleep and obesity. Sleep Health. 3: 383-388.

Sánchez-Ojeda MA, De Luna-Bertos E. 2015. Healthy lifestyles of the university population. Nutr Hosp. 131(5): 1910-1919.

Saxvig IW, Pallesen S, Wilhelmsen-Langeland A, Molde H, Bjorvatn B. 2012. Prevalence and correlates of delayed sleep phase in high school students. Sleep Med 13(2):193–199.

Shrivastava D, Jung S, Saadat M, Sirohi R, CrewsonK. 2014. How to interpret the results of a sleep study. J Community Hosp Intern Med Perspect 4(5):24983

Spiegel K, Leproult R, Van Cauter E. 1999. Impact of sleep debt on metabolic and endocrine function. Lancet. 354 (9188):1435-1439.

Tahara Y, Shibata, S. 2013. Chronobiology and nutrition. Neuroscience. 253: 78–88.

Taheri L, Lin L, Austin D, Young T, Mignot E. (2004). Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index. Plos med. 1 (3): 210-217.

Valladares M, Campos B, Zapata C. 2016. Association between chronotype and obesity in young people. Nutr Hosp. 33:1336-1339.

VanKim NA, Larson N, Laska MN. 2012. Emerging adulthood: a critical age for preventing excess weight gain? Adolesc Med State Art Rev. 23 (3): 571-588.

Vanitallie TB. (2006). Sleep and energy balance: interactive homeostatic systems. Metabolism. 55(Suppl. 2): S30–S35.