The delay in the start time of classes significantly increases adolescent performance, a reflection for Public Health in Ecuador: a narrative review

Fabricio González-Andrade[1,2], Carolina Ocaña-Terán[1], Gabriela Aguinaga-Romero[1]

[1] *Universidad Central del Ecuador, Facultad de Ciencias Médicas, Unidad de Medicina Traslacional, Iquique N14-121 y Sodiro-Itchimbía, 170403, Quito, Ecuador.*
[2] *Universidad San Francisco de Quito USFQ, Colegio Ciencias de la Salud, calle Diego de Robles s/n y Pampite, 170901, Quito, Ecuador.*

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Corresponding author: *Fabricio González-Andrade, MD, PhD*
ORCID ID: 0000-0002-2091-9095. jfgonzalez@uce.edu.ec; fabriciogonzaleza@gmail.co; Phone: +593-9-984536414

Resumen

Contexto: en el Ecuador no existen estudios publicados sobre las horas de sueño por grupos de edad u horarios de inicio de clases enfocados al rendimiento académico de la población, en especial adolescentes.

Discusión: al recopilar los datos de estudios realizados en niños y adolescentes, se demuestra que los adolescentes necesitan dormir lo suficiente para funcionar bien a diario y mejorar los efectos cognitivos que se presentan por la falta de sueño. Considerando solo el 14% al 27% de los adolescentes duermen más de 9 horas en las noches escolares, y peor aún, hasta el 25% duermen menos de 6 horas, no es sorprendente que la mayoría de los adolescentes se despierten sintiéndose cansados. Se recomienda planificar las horas de sueño con los padres, horario de tareas en casa y horarios de actividad física, para entrenar la mente y tener una buena higiene del sueño

Conclusión: el retraso de la hora de inicio de clases aumenta notablemente el desempeño en los adolescentes, por lo cual se debe cambiar las políticas públicas para permitir que la hora de ingreso a clases sea pasada las 9:00 horas.

Descriptores DeCS: privación del sueño; salud del adolescente; Ecuador, Salud Pública; desempeño académico

Abstract

Context: In Ecuador, there are no published studies on the hours of sleep by age groups, or start times of classes focused on the academic performance of the population, especially adolescents.

Discussion: When collecting data from studies conducted in children and adolescents, adolescents need enough sleep to function well daily, and improve the cognitive effects that occur due to lack of sleep. Considering that only 14% to 27% of adolescents sleep more than 9 hours on school nights, and worse, up to 25% sleep less than 6 hours, it is not surprising that most adolescents wake up feeling tired. It recommends to plan the sleep hours with parents, homework schedule, and physical activity schedules, to train the mind and have good sleep hygiene

Conclusion: **The delay of the start time of classes significantly increases the performance in adolescents, so public policies have be changed to allow the time of entry to classes to be past 9 am.**
Keywords: sleep deprivation; adolescent health; Ecuador, Public Health; academic performance

Introduction

In Ecuador, there are no published studies on the hours of sleep by age groups, or start times of classes focused on the academic performance of the population, especially adolescents. However, worldwide this topic has been widely discussed and it shows that both the quantity and quality of sleep hours directly influence the performance of an individual, especially the youngest, and therefore they require changes in public policy aimed at the full search for the welfare of the population (1). This individual well-being will translate into social development (2).

It defines quality of sleep by the number of hours an individual sleeps and its relationship with performance in the waking state, which determines good health, therefore, it needs adequate sleep to achieve optimal mental state and physical alertness, daytime functioning and ability to learn in young people, qualities that are of particular importance in the school environment (3). The average distribution of hours necessary for an adult to function well during the day is seven to eight hours, depending on the energy expenditure during this day. Sleeping less than six hours leads to an accumulation of non-sleeping hours that will never recover (4). This poor quality of sleep is manifested mainly with a state of drowsiness and fatigue, and when deprivation is chronic or constant, it can generate alterations in behavior, attention, memory, thinking and, in the worst case, be the cause of accidents in general (5).

An average of eight hours of sleep are needed three or four decades ago, today it reaches an average of six to seven, at most, depending on the age of the individual. At older age fewer hours of sleep (6). In a survey conducted by the National Institute of Statistics and Censuses it was estimated that Ecuadorians spend an average of 55.3 hours a week to sleep, that is, almost eight hours per day. Despite this, the periodicity and sleep schedules vary considerably among the population, which unquestionably affects the quality of sleep. In the urban area, you sleep 54.8 hours and in the rural area 56.6 hours. In the mountains and Galapagos there is an average sleep of 54.2 hours, in the Amazon 55.3 hours and on the coast 56.2 hours a week with an average of 7 hours a day (INEC, 2015), that is that in the mountains and the urban area is where Ecuadorians sleep less. University students in general have poor sleep quality, which is directly related to the workload of their studies (7).

Indeed, considering that the working hours of Ecuadorians are eight hours, and that the time of entry to work in most institutions is at 8 am, parents are forced to send their children to school at least one hour before, this is 7 am, and getting them out of bed an hour before too, this is 6 am. In addition, if physiological neuronal activity is considered to begin at 9 am (8), there is regular sleep deprivation of at least three hours. There is, therefore, less hours for adequate rest in our population, particularly adolescents.

The National Sleep Association of the USA recommends that, for healthy people with normal sleep, adequate sleep duration for newborns is between 14 and 17 hours, younger infants between 12 and 15 hours, older infants between 11 and 14 hours, preschool children between 10 and 13 hours and school-age children between 9 and 11 hours. For adolescents, it was considered appropriate from 8 to 10 hours, for young adults and adults from 7 to 9 hours, and from 7 to 8 hours of sleep for older adults (9). Despite this, individual variability in sleep patterns needs throughout the life cycle implies that there is no magic number for the ideal duration of sleep. However, it is important to promote sleep health for everyone.

Sleep is not a waste of time and it should receive the same level of attention as nutrition and exercise in activities to achieve good health. Similarly, the Canadian Movement Guidelines for 24 hours for children and youth recommend 8 to 10 hours of sleep for adolescents (10). In contrast, excessive sleep duration or prolonged sleep may be indicative of poor sleep efficiency, that is, spending a lot of time in bed with poor quality sleep may also be indicative of problems in sleep quality (eleven).

The purpose of this narrative review is to discuss the effects of chronic sleep deprivation in adolescents and to establish criteria to define new public policies in this field.

Discussion

It is important to recognize that insufficient sleep is a key Public Health problem and relevant to pediatric practice (12). The problem of sleepy teenagers has been around for a long time. However, it is only since the end of the 80s that this pro-

blem has taken social interest, from the anecdotes of the teachers about students who fall asleep in class and the parents' complaints of the daily struggle to keep their children out of bed, even scientific research on the causes and consequences of lack of sleep (13).

Studies in the last four decades show that getting to have adequate sleep and maintaining a sleep schedule that is consistent with the physiological circadian rhythm is vital for normal growth and development during childhood and adolescence. Adequate sleep is needed, that is, a quality dream, to achieve an optimal mental state and physical alertness, daytime functioning and learning capacity in young people and children, qualities that are of particular importance in the psychosocial environment, school environment, family environment, and biological environment (14).

The American Academy of Pediatrics recognizes the lack of sleep in adolescents as a major public health problem that significantly affects health and safety, as well as the academic success of middle and high school students. The evidence strongly implies that starting early in school hours, that is, before 8:30 a.m., as a key and modifiable contributor in performance, as well as the interruption of the circadian rhythm. From a biological perspective, approximately at the time of the onset of puberty, most adolescents begin to experience a sleep-wakefulness phase delay, that is, later onset of sleep and wakefulness times, which manifests as a change of up to two hours in the relationship, sleep-wake cycles (15).

It attributes sleep restriction often to extrinsic factors, such as artificial light, caffeine use, lack of physical activity, lack of bedtime rules at home, and the increased availability of information and communication technologies. In adolescence, it attributes insufficient sleep to intrinsic factors such as pubertal hormonal changes, which is associated with a shift towards a nocturnal chronotype, which can also lead to asynchrony between the biological clock, characterized by a phase delay, and the social clock (16). In adolescents, this delay of the biological phase combined with the social clock, for which the main synchronizer is the fixed and early school start time, contributes to the sleep deficits observed in this population.

The conflict between intrinsic and extrinsic factors, biological time and social time, it is greater during adolescence than at any other time in our lives (17). Despite some overlap between the factors that could explain the lack of sleep, between adolescents and adults, are exposure to artificial light at night, lack of physical activity, caffeine consumption and lack of sleep hygiene. Other factors could be specifically related to lack of sleep in adults include, among others, work demands, lifestyle habits, the urban environment focused on the search for social recognition; such as gangs and urban tribes, health problems and/or emotional and family dynamics altered, for example, parents who work excessively (18).

It consider sleep deprivation event that happens worldwide, in children, adolescents and adults. In America, Europe and Oceania there are studies that provide us with extensive information on the causes, consequences, and effects presented by sleep deprivation, and scarce information in Latin American countries.

In northern Taiwan, Germany, and India, the average sleep duration diminished to less than 8 hours for high school students. In 2005, it reported an average sleep duration of 4.9 to 6 hours in more than 1400 Korean adolescents. In general, studies have shown that the hours of sleep on the weekend are similar in these countries, but the duration of sleep during the week tends to vary greatly. In contrast, teenagers from Australia, from 17 years of age and older, had an average sleep duration between 8.5 and 9.1 hours. Interestingly, although it did not report data on the start times of classes in Australia, the average waking time on school days was at 7:00 a.m. or later, suggesting that the school start time of these schools did not begin before 8:00 am (12).

Sleep disorders continue to prevail in Latin America, which implies a risk to public health due to its effects on quality of life, cardiac and vascular complications, health expenses and decreased productivity. The researchers call on the population about the need to understand the conditions that generate these disorders, to know the appropriate measures for their prevention and the importance of looking for timely diagnoses and treatment (19).

In addition, it shows that 75% of people have sleep disorders. In fact, "Better Dream, Better Health", a study carried out in the framework of World Sleep Day, by a leading company in health technologies in Spain, analyzed the characteristics and consequences of sleep in 13 countries, including Argentina, Brazil, Mexico and Colombia. In the report, sleep is a habit of greater impact on general health and well-being in Brazil (68%) and Argentina (54%) and considered among the main factors in Colombia (61%) and Mexico (74%), along with the exercise

and financial security. Despite this, only 41% of respondents have established sleeping schedules, while the rest say they have difficulty establishing an adequate schedule (20).

Important definitions

Sleep deprivation: a phenomenon that occurs when inadequate or poor quality sleep leads to a decrease in individual performance, inadequate alertness and deterioration of health. A night of sleep deprivation, followed by a night of "sleeping well" clearly affects neurobehavioral function. These subjective impressions are supported by studies of endocrine function and metabolism, as well as investigations of sleep deprivation effects on cognitive and neural function (21,22).

Chronic sleep deprivation: loss of sleep that results as a sleep debt, that is, it cannot be recover. It is equivalent to an average of 5.6 hours of sleep over a 24-hour period. Chronic sleep deprivation and sleepiness associated with daytime deficiencies in adolescence are a serious threat to academic success. In addition, chronic sleep deprivation is capable of inducing different biological effects, such as changes in autonomic neural control, increased oxidative stress, inflammatory and coagulatory responses in a pathological manner and accelerated atherosclerosis (23,24).

Cognitive behavior: insufficient sleep can contribute to aberrant behavior. Subjects with chronic sleep restriction may show greater behavior focused on risk taking, or subjectively may show deficiencies in reasoning to seek premature conclusions without considering all aspects of a problem. This type of impulsivity can also manifest itself as an increased but inadvertent search for risks (25). Insufficient sleep that occurs in preschool and early children is associated with poor neurobehavioral processes, reported by the mother and teacher, which manifest themselves particularly in mid-childhood (26).

Hours of sleep required: the requirement varies from person to person, on average, 7 to 8 hours of sleep per night are needed, even if a person sleeps more than 8 hours every night, sleep deprivation can still occur if the Quality of this dream is poor (27).

Sleep and sleepiness: Sleep is essential for learning, children's memory, school performance and general well-being. Sleep deprivation and sleep fragmentation is the main mechanism that leads to daytime sleepiness in children (28). Chronic loss of sleep, also called insufficient sleep, or inadequate sleep, is the main one, although not only the cause of daytime sleepiness. In addition, the transition from childhood to adulthood is accompanied by many biological changes in the adolescent, and the clock is no exception (29).

Circadian rhythm: The circadian rhythm depends on an internal clock, a central clock, or cerebral pacemaker, located in the supra-chiasmatic nucleus (SCN) of the anterior hypothalamus. On the one hand, the SCN serves as a central clock, synchronizing other clocks in peripheral tissues (for example, liver, kidney, heart, retina and others). The SCN generates circadian rhythms through a feedback loop during DNA transcription and translation. This molecular mechanism of the clock is present in every cell of the body. One of the first changes associated with puberty is the alteration of a child's circadian rhythms, causing adolescents to be more alert in the afternoons and evenings and require sleeping in the morning (30).

Sleep hygiene: It involves implementing changes in lifestyle that can improve the quality of nighttime sleep and promote alertness during the day. We could name some changes in lifestyle, which are closely related to parental action; create an environment that promotes sleep (activities at home after school), and a bedtime routine in childhood and throughout childhood, creating a habit. Therefore, advising families about sleep requires an understanding of sleep regulation, physiology, developmental patterns, recommendations for optimal sleep duration and the many factors that influence sleep and sleep hygiene. (31, 32).

Quality of sleep is define as the number of hours an individual sleeps, latency of the onset of sleep, maintenance of sleep and its relationship with performance in the waking state (33).

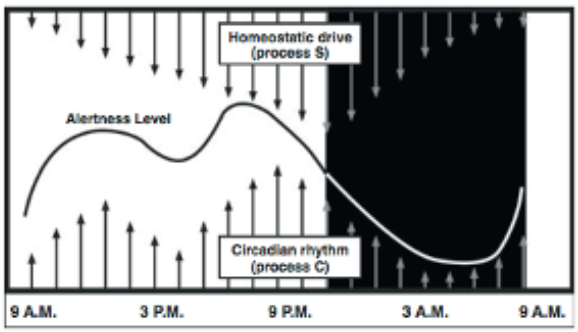
Pathophysiology of sleep deprivation: Indeed, during a normal 24-hour day, that is, daily activities and more than 8 hours of rest at night, the alertness and wakefulness of a healthy and rested person is maintain. Fluctuations in alertness, for example, post-lunch immersion, during normal wakefulness are difficult to detect in tests. However, when the waking state goes beyond roughly 16 hours, most people begin to show a substantial deceleration of the reaction time to stimuli and worsening of psychomotor surveillance, which continue to get worse as the vigil remains throughout the night until the early hours (34).

The circadian rhythm of adolescents is different from that of adults. Changes in sleep regulation associated with puberty, including late secretion of melatonin and impaired sleep impulse, commonly leads to difficulties falling asleep at bedtime early and taking more time to fall asleep.

Their watches are prepared to prefer the onset of sleep hours later (35).

Two biological changes occur in the regulation of sleep. One factor is the delay in the time of nocturnal secretion of melatonin through adolescence, which parallels a change in the preference of the circadian phase, from more "morning" to more "late" type, which consequently results in difficulty falling asleep before bedtime. The second biological factor is an altered sleep impulse in adolescence, in which the pressure to fall asleep builds up more slowly (36).

However, it described the sleep/wake cycle as a dual process regulated by the circadian rhythm (process C) and the impulse of homeostatic sleep (process S). The S process represents the natural impulse of sleep. When we wake up, sleep pressure is minimal, but it increases the longer we stay awake for the entire time of the day. The sleep pressure increases until we fall asleep, at which point it begins to recede. Process C represents our internal momentum as a state of alert and it maintains by our circadian rhythm. Starting at the morning hours, our alert levels increase constantly, until noon. The increase in melatonin production causes process C, this is our state of alertness, to submerge, which induces drowsiness. Process C begins to rise again and peaks early at night, and falls within hours before bedtime (37).



Adapted from:
Badin E, Haddad C, Shatkin JP. Insomnia: the Sleeping Giant of Pediatric Public Health. Curr Psychiatry Rep. 2016; 18 (5): 47. doi: 10.1007 / s11920-016-0687-0 (36)

Factors that influence sleep deprivation in adolescents

Lack of sleep on school nights is a phenomenon that crosses borders. In some studies, there is a benefit in the delay of bedtime of adolescents during development. Although bedtime is later, unfortunately, the early hours of school start remain constant, resulting in insufficient sleep duration during the school week (38).

On the other hand, sleep and technology are relevant factors as well. Teenagers who comprise more than three 3 billion-technology users are spending excessive amounts of time online with health benefits and risks related to internet addiction, also called internet-gambling disorder. Among the devices most used by teenagers we have; televisions (57%), music players, (90%), video game consoles (43%), computers (28%) and telephones (64%). Not surprisingly, several studies in adolescents have shown that electronic exposure at night potentially interrupts sleep (36).

Effects of sleep deprivation on health

Health promotion is essential in public health, and sleep plays a fundamental role in health promotion. Several investigations have documented that sleep disturbance has a strong influence on the risk of increase infectious diseases, the onset and progression of cardiovascular diseases, cancer, and increase in the incidence of depression. Increasingly, the field has focused on identifying the biological and those mechanisms underlying these effects (39).

Biological effects

One of the main effects is the impact on safety and physical health, which increases the risk of obesity, as some studies cite (40). Metabolic dysfunction (hypercholesterolemia, type 2 diabetes mellitus); the risk of developing type 2 diabetes mellitus associated with insufficient sleep was comparable to that of traditional risk factors, such as excess weight, family history of diabetes and physical inactivity, therefore, there is a greater recognition that sleep should considered in clinical guidelines for type 2 diabetes mellitus (41).

Metabolic disorders lead to the development of diseases and the increase in morbidity, such as cardiovascular diseases and their effects, such as hypertension, and an increased risk of stroke. There is a growing interest regarding the impact of sleep and its disorders on the regulation of inflammatory processes and morbidities of terminal organs, particularly in the context of metabolic and cardiovascular diseases (CVD) and their complications (42). There is a decrease or loss of wakefulness, due to deficiency in the quality of sleep, or less hours of sleep at night. It is difficult to stay awake in daily activities, therefore, an increase in the rates of car accidents, known as drowsy driving; there is consistent evidence for an association between the late start times of classes and the decrease in car accident rates (43).

Furthermore, it knows that adenosine, a neuromodulator, plays an important role in the regulation of sleep pressure. On the other hand, caffeine, is the most consumed stimulant in the world, and

blocks adenosine receptors, resulting in the lack of sleep, disturbances in vigilance and attention (44).

Psychological effects

If sleep is affected by bad habits or external as well as internal factors, mental health will also affects. Adolescence is a period in which people are at a greater risk of deprivation of sleep largely due to a late change in the circadian rhythm around puberty, combined with early school start times. This combination can lead to adolescents having a higher risk of mental health problems, and especially in behavior related to high degrees of stress. The high prevalence of stress is one of the most important problems in the cognitive sphere of the human being; studies define stress as a sensation of wear that the body experiences when it adjusts to the pressure or a threatening situation, and therefore behavior problems and relationships of the human being. (45, 46).

Psychosocial effects

Restful sleep has beneficial fruits in the brain, but if the sleep is not of quality, there is a cognitive deficit that translates into a marked decrease in academic and school performance, and all this leads to the adolescent's relationship with his school environment, family and social, with the result of not attending school and there could even be an increase in dropout rates. This cognitive deficit is especially related to more complex tasks, deficiencies in executive function, such as work-memory, organization, time management, sustained effort, deficiencies in attention and memory, deficits in abstract thinking, verbal creativity, decline of efficiency and performance. By relating memory to sleep, it is found that sleep promotes different stages of memory processing, including coding, consolidation, recovery or even further processing, such as re-consolidation and integration into existing memory networks (47).

Identifying solutions

A study conducted in adolescents gives us information about their criteria on the subject of hours and sleep hygiene. In the study, adolescents indicate that not getting enough sleep gives them the feeling of being tired during the day (93.7%), having difficulty paying attention (83.6%), lower grades (60.8%), increased stress (59.0%), and have difficulty relating to others (57.7%). The majority (73.3%) of teenagers believed that high school students should sleep between 8 and 9 hours each night. In addition, the adolescents were asked what the recommended time for the beginning of classes would be for them, understanding, if the school started later, it would end later in the day.

The majority (31.6%) of respondents indicated that the school should start at 8:00 a.m. and almost a quarter (24.5%) wanted school to start before 8:00 a.m. Other school start times desired by students were 08:30 am (16.7%), 9:00 am (17.5%) and 9:30 am (9.4%). If adolescents, who are affected by lack of sleep due to fewer hours in bed, the quality of sleep related to the hygiene of the same, early start of classes, are those that incline us to solutions for changing these habits, we it would be necessary to implement them (48).

When collecting data from studies conducted in children and adolescents, it is shown that adolescents need enough sleep to function well daily, and improve the cognitive effects that occur due to lack of sleep. Considering only 14% to 27% of adolescents sleep more than 9 hours on school nights, and worse, up to 25% sleep less than 6 hours, it is not surprising that most adolescents wake up feeling tired. It is recommended to plan sleep hours with parents, homework schedule, and physical activity schedules, to train the mind and have good sleep hygiene (49).

Public policies in health and education for adolescents in Ecuador

It is recognized that sleep is a critical component of healthy development and overall health. Healthy sleep comprises many dimensions, including the right duration, good quality, the right time and the absence of sleep disorders. Not getting enough sleep at night is usually associated with daytime sleepiness, daytime fatigue, depressed mood, daytime malfunction and other health and safety problems. Chronic insufficient sleep has become a concern in many countries, given its association with morbidity and mortality. For example, the usual short duration of sleep has been associated with adverse health outcomes, including obesity, type 2 diabetes, hypertension, cardiovascular disease, depression, and increased mortality. It is of public interest to find ways to improve people's sleep patterns, being a fundamental problem in Public Health, as well as nutrition and activity.

Conclusion

The delay of the start time of classes significantly increases the performance in adolescents, so public policies must be changed to allow the time of entry to classes to be past 9 am.

Authors' contribution

The research protocol and its design, data collection, critical analysis, discussion, writing and approval of the final manuscript were made by all authors who contributed equally to the entire process. The corresponding author represents the group of authors.

Availability of data and materials

The data that support this manuscript are available upon request to the corresponding author.

Consent for publication

The institutions cited in this document gave their consent to use your information.

Interest conflict

The authors declare no conflict of interest.

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References

1. Chaput JP, Dutil C, Sampasa-Kanyinga H. Sleeping hours: what is the ideal number and how does age impact this?. Nat Sci Sleep. 2018;10:421–430. Published 2018 Nov 27. doi:10.2147/NSS.S163071
2. de Lima TR, Silva DAS. Association of sleep quality with sociodemographic factors and lifestyle in adolescents from southern Brazil. World J Pediatr. 2018;14(4):383–391. doi:10.1007/s12519-018-0136-8
3. Minges KE, Redeker NS. Delayed school start times and adolescent sleep: A systematic review of the experimental evidence. Sleep Med Rev. 2016;28:86–95. doi:10.1016/j.smrv.2015.06.002.
4. Alsaggaf MA, Wali SO, Merdad RA, Merdad LA. Sleep quantity, quality, and insomnia symptoms of medical students during clinical years. Relationship with stress and academic performance. Saudi Med J. 2016;37(2):173–182. doi:10.15537/smj.2016.2.14288
5. Wheaton AG, Chapman DP, Croft JB. School Start Times, Sleep, Behavioral, Health, and Academic Outcomes: A Review of the Literature. J Sch Health. 2016;86(5):363–381. doi:10.1111/josh.12388
6. Chaput JP, Dutil C, Sampasa-Kanyinga H. Sleeping hours: what is the ideal number and how does age impact this?. Nat Sci Sleep. 2018;10:421–430. Published 2018 Nov 27. doi:10.2147/NSS.S163071
7. Instituto Nacional de Estadísticas y Censos. Compendio de Resultados - Encuesta Condiciones de Vida ECV- Sexta Ronda, 2015. Disponible en: http://www.ecuadorencifras.gob.ec/documentos/webinec/ECV/ECV_2015/documentos/ECV%20COMPENDIO%20LIBRO.pdf
8. Krueger JM, Nguyen JT, Dykstra-Aiello CJ, Taishi P. Local sleep. Sleep Med Rev. 2019;43:14–21. doi:10.1016/j.smrv.2018.10.001
9. Hirshkowitz M, Whiton K, Albert SM, et al. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep Health. 2015;1(1):40–43. doi:10.1016/j.sleh.2014.12.010
10. Tremblay MS, Carson V, Chaput JP, et al. Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep. Appl Physiol Nutr Metab. 2016;41(6 Suppl 3):S311–S327. doi:10.1139/apnm-2016-0151
11. Boyko Y, Jennum P, Toft P. Sleep quality and circadian rhythm disruption in the intensive care unit: a review. Nat Sci Sleep. 2017;9:277–284. Published 2017 Nov 10. doi:10.2147/NSS.S151525
12. Owens J; Adolescent Sleep Working Group; Committee on Adolescence. Insufficient sleep in adolescents and young adults: an update on causes and consequences. Pediatrics. 2014;134(3):e921–e932. doi:10.1542/peds.2014-1696
13. Wheaton AG, Chapman DP, Croft JB. School Start Times, Sleep, Behavioral, Health, and Academic Outcomes: A Review of the Literature. J Sch Health. 2016;86(5):363–381. doi:10.1111/josh.12388.
14. Minges KE, Redeker NS. Delayed school start times and adolescent sleep: A systematic review of the experimental evidence. Sleep Med Rev. 2016;28:86–95. doi:10.1016/j.smrv.2015.06.002.
15. Adolescent Sleep Working Group; Committee on Adolescence; Council on School Health. School start times for adolescents. Pediatrics. 2014;134(3):642–649. doi:10.1542/peds.2014-1697.
16. Guerrero MD, Barnes JD, Chaput JP, Tremblay MS. Screen time and problem behaviors in children: exploring the mediating role of sleep duration. Int J Behav Nutr Phys Act. 2019;16(1):105. Published 2019 Nov 14. doi:10.1186/s12966-019-0862-x
17. Bartel KA, Gradisar M, Williamson P. Protective and risk factors for adolescent sleep: a meta-analytic review. Sleep Med Rev. 2015;21:72–85. doi:10.1016/j.smrv.2014.08.002
18. Al-Hazzaa HM, Alhussain MH, Alhowikan AM, Obeid OA. Insufficient Sleep Duration And Its As-

sociation With Breakfast Intake, Overweight/Obesity, Socio-Demographics And Selected Lifestyle Behaviors Among Saudi School Children. Nat Sci Sleep. 2019;11:253–263. Published 2019 Oct 25. doi:10.2147/NSS.S225883
19. Irwin MR. Why sleep is important for health: a psychoneuroimmunology perspective. Annu Rev Psychol. 2015;66:143–172. doi:10.1146/annurev-psych-010213-115205
20. Royal Philips (NYSE: PHG, AEX: PHIA) empresa líder en tecnología de la salud, enfocada en mejorar la salud de las personas. Disponible en: https://www.philips.com.ar/aw/about/news/archive/standard/news/press/2018/20180611-encuesta-latinoamericana-sobre-el-sueno.html
21. Abrams RM. Sleep Deprivation. Obstet Gynecol Clin North Am. 2015;42(3):493–506. doi:10.1016/j.ogc.2015.05.013.
22. McEwen BS, Karatsoreos IN. Sleep Deprivation and Circadian Disruption: Stress, Allostasis, and Allostatic Load. Sleep Med Clin. 2015;10(1):1–10. doi:10.1016/j.jsmc.2014.11.007
23. McHill, A. W., Hull, J. T., Wang, W., Czeisler, C. A., & Klerman, E. B. (2018). Chronic sleep curtailment, even without extended (>16-h) wakefulness, degrades human vigilance performance. Proceedings of the National Academy of Sciences, 115(23), 6070–6075. doi:10.1073/pnas.1706694115 .
24. Tobaldini E, Costantino G, Solbiati M, et al. Sleep, sleep deprivation, autonomic nervous system and cardiovascular diseases. Neurosci Biobehav Rev. 2017;74(Pt B):321–329. doi:10.1016/j.neubiorev.2016.07.004
25. Maric A, Montvai E, Werth E, et al. Insufficient sleep: Enhanced risk-seeking relates to low local sleep intensity. Ann Neurol. 2017;82(3):409–418. doi:10.1002/ana.25023
26. Taveras EM, Rifas-Shiman SL, Bub KL, Gillman MW, Oken E. Prospective Study of Insufficient Sleep and Neurobehavioral Functioning Among School-Age Children. Acad Pediatr. 2017;17(6):625–632. doi:10.1016/j.acap.2017.02.001
27. Tremblay MS, Chaput JP, Adamo KB, et al. Canadian 24-Hour Movement Guidelines for the Early Years (0-4 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep. BMC Public Health. 2017;17(Suppl 5):874. Published 2017 Nov 20. doi:10.1186/s12889-017-4859-6
28. Taveras EM, Rifas-Shiman SL, Bub KL, Gillman MW, Oken E. Prospective Study of Insufficient Sleep and Neurobehavioral Functioning Among School-Age Children. Acad Pediatr. 2017;17(6):625–632. doi:10.1016/j.acap.2017.02.001
29. Moreira GA, Pradella-Hallinan M. Sleepiness in Children: An Update. Sleep Med Clin. 2017;12(3):407–413. doi:10.1016/j.jsmc.2017.03.013
30. Touitou Y, Touitou D, Reinberg A. Disruption of adolescents' circadian clock: The vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. J Physiol Paris. 2016;110(4 Pt B):467–479. doi:10.1016/j.jphysparis.2017.05.001.
31. Badin E, Haddad C, Shatkin JP. Insomnia: the Sleeping Giant of Pediatric Public Health. Curr Psychiatry Rep. 2016;18(5):47. doi:10.1007/s11920-016-0687-0
32. Bathory E, Tomopoulos S. Sleep Regulation, Physiology and Development, Sleep Duration and Patterns, and Sleep Hygiene in Infants, Toddlers, and Preschool-Age Children. Curr Probl Pediatr Adolesc Health Care. 2017;47(2):29–42. doi:10.1016/j.cppeds.2016.12.001
33. Knufinke M, Nieuwenhuys A, Geurts SAE, Coenen AML, Kompier MAJ. Self-reported sleep quantity, quality and sleep hygiene in elite athletes. J Sleep Res. 2018;27(1):78–85. doi:10.1111/jsr.12509
34. Killgore WD. Effects of sleep deprivation on cognition. Prog Brain Res. 2010;185:105–129. doi:10.1016/B978-0-444-53702-7.00007-5
35. Morgenthaler TI, Hashmi S, Croft JB, Dort L, Heald JL, Mullington J. High School Start Times and the Impact on High School Students: What We Know, and What We Hope to Learn. J Clin Sleep Med. 2016;12(12):1681–1689. Published 2016 Dec 15. doi:10.5664/jcsm.6358.
36. Touitou Y, Reinberg A, Touitou D. Association between light at night, melatonin secretion, sleep deprivation, and the internal clock: Health impacts and mechanisms of circadian disruption. Life Sci. 2017;173:94–106. doi:10.1016/j.lfs.2017.02.008
37. Badin E, Haddad C, Shatkin JP. Insomnia: the Sleeping Giant of Pediatric Public Health. Curr Psychiatry Rep. 2016;18(5):47. doi:10.1007/s11920-016-0687-0
38. Bartel KA, Gradisar M, Williamson P. Protective and risk factors for adolescent sleep: a meta-analytic review. Sleep Med Rev. 2015;21:72–85. doi:10.1016/j.smrv.2014.08.002
39. Irwin MR. Why sleep is important for health: a psychoneuroimmunology perspective. Annu Rev

Psychol. 2015;66:143–172. doi:10.1146/annurev-psych-010213-115205
40. Fatima Y, Doi SA, Mamun AA. Sleep quality and obesity in young subjects: a meta-analysis. Obes Rev. 2016;17(11):1154–1166. doi:10.1111/obr.12444
41. Dutil C, Chaput JP. Inadequate sleep as a contributor to type 2 diabetes in children and adolescents. Nutr Diabetes. 2017;7(5):e266. Published 2017 May 8. doi:10.1038/nutd.2017.19
42. Kim J, Hakim F, Kheirandish-Gozal L, Gozal D. Inflammatory pathways in children with insufficient or disordered sleep. Respir Physiol Neurobiol. 2011;178(3):465–474. doi:10.1016/j.resp.2011.04.024
43. Shekari Soleimanloo S, White MJ, Garcia-Hansen V, Smith SS. The effects of sleep loss on young drivers' performance: A systematic review. PLoS One. 2017;12(8):e0184002. Published 2017 Aug 31. doi:10.1371/journal.pone.0184002
44. Urry E, Landolt HP. Adenosine, caffeine, and performance: from cognitive neuroscience of sleep to sleep pharmacogenetics. Curr Top Behav Neurosci. 2015;25:331–366. doi:10.1007/7854_2014_274
45. Jamieson D, Broadhouse KM, Lagopoulos J, Hermens DF. Investigating the links between adolescent sleep deprivation, fronto-limbic connectivity and the Onset of Mental Disorders: a review of the literature [published online ahead of print, 2019 Aug 29]. Sleep Med. 2019;66:61–67. doi:10.1016/j.sleep.2019.08.013
46. Almojali AI, Almalki SA, Alothman AS, Masuadi EM, Alaqeel MK. The prevalence and association of stress with sleep quality among medical students. J Epidemiol Glob Health. 2017;7(3):169–174. doi:10.1016/j.jegh.2017.04.005
47. Kopasz M, Loessl B, Hornyak M, et al. Sleep and memory in healthy children and adolescents - a critical review. Sleep Med Rev. 2010;14(3):167–177. doi:10.1016/j.smrv.2009.10.006
48. Noland H, Price JH, Dake J, Telljohann SK. Adolescents' sleep behaviors and perceptions of sleep. J Sch Health. 2009;79(5):224–230. doi:10.1111/j.1746-1561.2009.00402.x
49. Bartel KA, Gradisar M, Williamson P. Protective and risk factors for adolescent sleep: a meta-analytic review. Sleep Med Rev. 2015;21:72–85. doi:10.1016/j.smrv.2014.08.002