

Sleep quality in university student-athletes: influence of chronotype, excessive daytime sleepiness, and stress

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Abstract

Adequate sleep is essential for the health, recovery, and performance of athletes. It is particularly important for university student-athletes, who must balance academic and athletic responsibilities, to understand the factors that influence sleep quality. This study explored the relationships between chronotype, excessive daytime sleepiness (EDS), perceived stress levels, and sleep quality in university student-athletes, comparing them to non-athletes. We performed a quantitative study involving 462 participants—249 university student-athletes and 213 non-athletes. Participants voluntarily filled out the morningness–eveningness questionnaire (MEQ), Epworth sleepiness scale (ESS), perceived stress scale (PSS), and Pittsburgh sleep quality index (PSQI). The data analysis included descriptive statistics, a chi-square test, and a t-test. The research findings indicated that 58.63% of university student-athletes preferred a morningness chronotype. Additionally, 48.59% exhibited normal levels of daytime sleepiness, while 81.53% reported moderate stress levels, and 57.83% experienced poor sleep quality. On average, participants slept for 6.84 hours per day. The components with higher scores were sleep latency and sleep disturbance, while sleep efficiency and use of sleep medication scored lower. A significant correlation was found between chronotype and perceived stress levels with sleep quality ($p < 0.05$), whereas EDS was not significantly correlated with sleep quality ($p > 0.05$) among university student-athletes. Significant differences were observed in chronotype, perceived stress levels, and sleep quality between university student-athletes and non-athletes ($p < 0.05$). However, no significant differences were found in EDS between the two groups ($p > 0.05$). More than half of university student-athletes experienced poor sleep quality, which was strongly correlated with their chronotype and stress levels. However, university student-athletes reported a greater preference for morning functioning, better sleep quality, reduced daytime sleepiness, and lower stress levels compared to non-athletes. The study suggests that a morningness chronotype and lower stress levels may contribute to improved sleep quality. It is essential to educate coaches and athletes about the impact of sleep quality on academic and athletic performance to promote healthy and effective sleep habits among university student-athletes.

Keywords: Chronotype, excessive daytime sleepiness, stress, sleep quality, sleep patterns, athletic performance

Introduction

Sleep Quality

Humans spend approximately one-third of their lives sleeping, averaging 5–10 h each night (Goel et al., 2009; Reilly & Edwards, 2007; Venter, 2012). Sleep is essential for maintaining a healthy and productive life (Goel et al., 2009). Adults need at least seven hours of sleep to support optimal health (Hirshkowitz et al., 2015; Watson et al., 2015). However, sleep quality is often more important than sleep quantity (Davenne, 2009). Sleep allows the body to function both physically and cognitively while providing recovery time. Sufficient, quality sleep is crucial for achieving peak athletic performance, physical recovery, enhanced learning, and improved cognitive function (Gaultney, 2010; Gerber et al., 2010; Hayes et al., 2010; Valdez et al., 2010).

Sleep is essential for athletes to minimize the decline in cognitive and motor skills necessary for optimal exercise performance (Pilcher & Huffcutt, 1996). However, athletes may be more likely to get less than seven hours of sleep each night compared to the general adult population (Sargent et al., 2014). Many athletes report experiencing lower sleep quality and fewer hours of sleep compared to their non-athlete counterparts (Simpson et al., 2016). Poor sleep quality is especially common for athletes during competition times, often attributed to competition-related thoughts or feelings of anxiety (Juliffa et al., 2014). Student-athletes who juggle the demands of both academics and athletics may face increased sleep difficulties owing to the additional social roles they have compared to their peers who are solely students. Research shows that the percentage of university student-athletes reporting poor sleep quality ranges from 42% (Mah et al., 2018), 44% (Carter et al., 2020), 50% (Li et al., 2018) to 60% (Lund et al., 2010).

Chronotype and Sleep Quality

Individuals can be classified into three chronotypes: morning-types (M-types or "larks"), evening-types (E-types or "owls"), and intermediate-types (I-types) (Adan et al., 2012). The acrophase of circadian rhythms occurs earlier in M-types compared to E-types (Horne & Ostberg, 1976). Unlike E-types, M-types tend to wake up and perform physically and cognitively at their best during the early morning hours but find it difficult to stay awake late into the night (Jankowski & Ciarkowska, 2008; Sławińska et al., 2018).

The sleep–wake circadian cycle is a fundamental rhythm in human biology, and it considerably influences athletic performance (Davenne, 2009). Previous research indicates that an evening chronotype is linked to higher levels of daytime dysfunction, considerable sleep debt, lower sleep quality, and later bedtimes (Bakotic et al., 2017). However, other studies have found that chronotype does not influence the sleep quality of athletes (Lastella et al., 2015; Monma et al., 2018). Consequently, student-athletes may tend to have a late chronotype owing to the academic and sporting commitments that disrupt their sleep patterns.

Daytime Sleepiness and Sleep Quality

Sleepiness is defined as a state of exhaustion, tiredness, or reduced awareness (Johns, 1993). Nighttime sleep deprivation is commonly associated with daytime drowsiness, fatigue, depression, impaired daily functioning, and various health and safety concerns (Owens, 2014; Roehrs et al., 1983; Shochat et al., 2014; Wolfson & Carskadon, 1998). Excessive daytime sleepiness (EDS) is characterized by difficulties in staying awake or alert during the day and an increased urge to sleep. Individuals who are sedentary tend to experience increased drowsiness (Chervin, 2019). While feeling drowsy at certain times after a lack of sleep is normal, it is considered EDS if it occurs almost daily for a minimum of three months (J. Brown & Makker, 2020). EDS can result from various factors, including chronic sleep deprivation (Slater & Steier, 2012), waking multiple times at night to use the bathroom (Sacomori et al., 2014), smoking, insufficient exercise, and other lifestyle choices that can negatively affect sleep quality and increase daytime sleepiness (Theorell-Haglöw et al., 2015).

A previous study highlighted the prevalence of daytime sleepiness among professional athletes and college student-athletes. During the season, most athletes reported experiencing daytime sleepiness along with reduced sleep efficiency (Sexton-Radek et al., 2013). Australian rules football players exhibited an average Epworth sleepiness scale (ESS) score of 8.1, with 34% scoring above 10 (Antic et al., 2013). College basketball players recorded high ESS averages, with a mean score of 9.64 (Mah et al., 2011). Additionally, rugby and cricket players were found to have poor sleep quality and EDS (Richard et al., 2015). Mah et al.'s recent study examined sleep quality, sleep duration, and levels of daytime sleepiness among 628 collegiate athletes across 29 different individual and team sports. The results indicated that these athletes experienced poor sleep quality, regularly obtained insufficient sleep, and suffered from EDS (Mah et al., 2018).

Stress Level and Sleep Quality

University student-athletes are required to balance academics with their demanding training and competition schedules, face the pressure to maintain peak physical health and performance, and cope with fatigue, pain, and injuries associated with high-level competition (Cosh & Tully, 2015; Shelley N Armstrong et al., 2015; Simons et al., 1999). Additionally, collegiate athletes often sacrifice adequate sleep to accommodate their early training sessions and the academic responsibilities that follow training or games (Cosh & Tully, 2015; Wilson & Pritchard, 2005).

A study involving over 500 college athletes found that they experienced above-average stress levels owing to the challenges of balancing sports and academics (Surujlal et al., 2013). Research by Watson indicates that sleep deprivation can negatively impact both academic and athletic performance, increase stress levels, and contribute to further sleep issues (J. C. Watson, 2016). Additionally, a recent study highlights a connection between sleep quality and symptoms of anxiety and stress among Jiu-Jitsu practitioners (Cantão et al., 2024). Sleep is crucial for athlete health, recovery, and performance after exercise. The study of athlete sleep is an important and specialized area in sports research. Therefore, it is essential to investigate the factors related to sleep and their potential to enhance sports performance. This study examines the relationship between chronotype, daytime sleepiness, perceived stress levels, and sleep quality in university student-athletes and compares these findings with those of their non-athlete counterparts.

Materials and Methods

Participants and Design

This study used descriptive–analytic methods in a cross-sectional study design. The authors contacted university lecturers to share information about the study during their classes and encourage student participation. Participants who agreed to join the study were informed about the research objectives and asked to sign a consent form to uphold ethical standards. They were also informed that completing the questionnaire via the Google Forms platform would take approximately 15–20 min. Additionally, participants were made aware that they could withdraw from the study by contacting the author through the provided email or phone number within thirty days of submitting the questionnaires.

In this study, 462 bachelor's degree students from Universitas Negeri Jakarta in East Jakarta, Indonesia, participated using a convenience sampling method. The participants were divided into two groups. The first group comprised student-athletes from the sports science faculty, while the second group consisted of non-

athlete students from various faculties, including language and arts, economics, education sciences, social sciences, mathematics and natural sciences, engineering, and psychological education. To qualify for inclusion in the research, participants had to be enrolled as full-time students. Student-athletes were required to be active competitors engaged in regular training sessions, whether in a university club or at the provincial or national level, and must be at least 18 years old. Non-athletes were selected based on specific criteria, i.e., their weekly physical activity level had to be below the recommended minimum. This meant their physical activity level was categorized as under 150 min per week, classifying them as non-active according to the Physical Activity Guidelines for Americans (U.S. Department of Health and Human Services, 2018).

Instrument

This study used five questionnaires as its instruments. A sociodemographic questionnaire was administered to collect background information. To assess chronotype, the morningness–eveningness questionnaire (MEQ) was used (Horne & Ostberg, 1976). The ESS was used to evaluate daytime sleepiness (Johns, 1993). The Perceived Stress Scale (PSS) measured stress levels (Cohen, S., Kamarck, T., Mermelstein, 1983), while the Pittsburgh Sleep Quality Index (PSQI) assessed sleep quality (Buysse et al., 1989). Cronbach's alpha was calculated for each questionnaire to evaluate its internal consistency.

A sociodemographic questionnaire was used to determine eligibility according to the study's inclusion and exclusion criteria. The questionnaire collected information on respondents' gender, age, body mass index (BMI), type of sport, athlete level (club, provincial, or national), years of training experience, university year, faculty, and grade point average (GPA) on a 4.0 scale.

The MEQ is a one-dimensional instrument designed to identify an individual's sleep–wake cycle and preferred hours of functioning over the past few weeks. It includes 19 questions, each offering four or five detailed response options, scored from one to four or five points. A higher score indicates a morning preference, while a lower score suggests an evening preference (Horne & Ostberg, 1976). The chronotype is categorized into three groups: evening types (total score of 16–41), intermediate types (total score of 42–58), and morning types (total score of 59–86). The Indonesian version of the MEQ has been found to be valid and reliable, with a Cronbach's alpha of 0.84.

The ESS comprises an 8-item scale that evaluates an individual's overall level of daytime sleepiness. The scores are categorized into three groups: normal daytime sleepiness (total score of 0–10), mild daytime sleepiness (total score of 11–15), and severe daytime sleepiness (total score of 16–24). The Indonesian adaptation of the ESS demonstrates a reliability level of $r = 0.82$.

The PSS is a ten-item instrument designed to assess the level of perceived stress over the past month (Cohen, S., Kamarck, T., Mermelstein, 1983). Responses are provided on a five-point Likert scale, with total scores ranging from 0 (indicating no stress) to 40 (indicating severe stress). Stress levels are categorized into three groups: low stress (score 0–13), moderate stress (score 14–26), and high stress (score 27–40). The Indonesian adaptation of the PSS demonstrates a reliability coefficient of $r = 0.87$.

The PSQI evaluates seven aspects of sleep quality over a one-month period: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The questionnaire consists of 18 items rated on a scale from 0 to 3. The total scores from these seven components yield a global score ranging from 0 to 21, reflecting both sleep quantity and quality. A final score exceeding five indicates poor sleep quality. The Indonesian version of the MEQ has demonstrated validity and reliability with a Cronbach's alpha of 0.81.

Data Analysis

The data collected from respondents were entered into the Statistical Package for the Social Sciences (SPSS) Version 26.0 software for analysis. Cronbach's alpha values were calculated for the MEQ, ESS, PSS, and PSQI to assess internal reliability. The mean (M), standard deviation (SD), and descriptive statistics were calculated. The chi-square test (χ^2) was used in the student-athlete group to explore the relationships between chronotype, EDS, perceived stress levels, and sleep quality. An independent sample t-test was performed for each variable to compare student-athletes and non-athlete students. Cohen's guidelines were followed to interpret the effect size for mean differences.

Results

Sample's Descriptive Statistic

Table 1 presents the descriptive statistics for both populations. The final sample comprised 462 respondents, with the student-athlete group including 249 participants. Of these, 63.9% ($n = 159$) were male, and 36.1% ($n = 90$) were female. The average age of the participants was 21.87 years, and 83.1% ($n = 207$) maintained a healthy BMI. Among the athletes, 50.2% participated in individual sports (such as martial arts, track and field, and swimming), while 40.8% engaged in team sports (including soccer, volleyball, basketball, floorball, and rugby). The student-athlete group was predominantly composed of club or varsity athletes at 70.3% ($n = 175$), with 29.7% ($n = 74$) competing at the provincial or national levels. Furthermore, 92% of student-athletes had been training in their respective sports for over a year ($n = 229$). Notably, 3.2% of participants came from outside the sports science faculty but were included in the student-athlete group because they met the inclusion criteria.

The non-athlete student group included 213 participants, with 27.7% ($n = 59$) being male and 72.3% ($n = 154$) female. The average age of this group was 20.48 years, and 55.9% ($n = 119$) had a healthy BMI. Most participants in the non-athlete group were from the education sciences, mathematical and natural sciences, and engineering faculties. Additionally, 6.6% ($n = 14$) of the sports science faculty students were classified as non-athlete participants owing to their lack of regular training activities and reported low levels of physical activity.

Table 1. Descriptive statistics of the respondents' sociodemographic characteristics ($n = 462$)

	Student-athletes ($n = 249$)		Non-athletes ($n = 213$)	
	N	%	N	%
Gender				
Male	159	63.9	59	27.7
Female	90	36.1	154	72.3
Age (Mean)	21.87		20.48	
BMI kg/m² (Mean)	22.1		22.6	
Underweight	13	5.2	39	18.3
Normal/healthy weight	207	83.1	119	55.9
Overweight	24	9.6	42	19.7
Obese	5	2.0	13	6.1
Type of sports				
Individual sports	125	50.2		
Team sports	124	49.8		
Athlete Level				
Club athlete	175	70.3		
Province athlete	66	26.5		
National athlete	8	3.2		
Years of training experience				
<1 year	20	8.0		
1–3 years	56	22.5		
3–5 years	44	17.7		
5–10 years	87	34.9		
>10 years	42	16.9		
University year				
1	54	21.7	103	48.4
2	47	18.9	44	20.7
3	55	22.1	45	21.1
4	59	23.7	16	7.5
≥5	34	13.7	5	2.3
Faculty				
Languages and arts	0	0	18	8.5
Economics	1	0.4	14	6.6
Sport sciences	241	96.8	14	6.6
Education sciences	2	0.8	56	26.3
Social sciences	1	0.4	8	3.8
Mathematics and natural sciences	0	0	37	17.4
Engineering	3	1.2	57	26.8
Psychological education	1	0.4	9	4.2
GPA (Mean)	3.46		3.62	

Correlation Between Chronotype and Sleep Quality

The statistical analysis of the relationship between chronotype and sleep quality among student-athletes is presented in Table 2. A significant correlation exists between chronotype and sleep quality ($\chi^2 = 23.072$, $p < 0.05$). Table 2 also shows the descriptive statistics comparing students with good and poor sleep quality across the morning and intermediate to evening chronotypes. Specifically, 54.79% of student-athletes who identified as morning types reported good sleep quality, while those with intermediate to evening preferences experienced poor sleep quality at a rate of 75.73%.

An odds ratio (OR) statistical analysis quantifies the relationship between a risk factor and an outcome for two variables (Andrade, 2015). The results of this analysis indicate an odds ratio of 0.3, suggesting that intermediate to evening type student-athletes face a 0.3 times higher risk of experiencing poor sleep quality compared to their morning-type counterparts.

To simplify the interpretation of the odds ratio, it will be adjusted to $1 / 0.3 = 3.3$. This means that student-athletes with a preference for morning types are 3.3 times more likely to achieve good sleep quality compared to those with intermediate to evening types.

Table 2. Correlation between chronotype and sleep quality in student-athletes (n = 249)

Sleep quality	Chronotype		Total n (%)	χ^2	p	OR (95% CI)
	Intermediate-evening n (%)	Morning n (%)				
Good	25 (23.81%)	80 (76.19%)	105 (100%)	23.072	0.000*	0.3(0.15;0.46)
Bad	78 (54.17%)	66 (45.83%)	144 (100%)			
Total	103 (41.37%)	146 (58.63%)	249 (100%)			

*p < 0.05

Correlation Between Daytime Sleepiness and Sleep Quality

Table 3 presents the chi-square analysis examining the relationship between EDS and sleep quality among student-athletes. The analysis revealed no significant correlation between EDS and sleep quality ($\chi^2 = 3.208$, $p > 0.05$). However, the table shows the descriptive statistics highlighting differences between students with good and poor sleep quality in relation to their levels of daytime sleepiness. Among student-athletes with normal daytime sleepiness, 47.93% reported good sleep quality, while 52.07% experienced poor sleep quality. In contrast, a majority of student-athletes with moderate to severe daytime sleepiness reported poor sleep quality, accounting for 57.83%. The odds ratio analysis confirmed the absence of a significant association between these two variables.

Table 3. Correlation between daytime sleepiness and sleep quality in student-athletes (n = 249)

Sleep quality	Daytime sleepiness		Total n (%)	χ^2	p	OR (95% CI)
	Low n (%)	Moderate-high n (%)				
Good	58 (47.93%)	47 (36.72%)	105 (42.17%)	3.208	0.073	1.6(1.0;2.6)
Bad	63 (52.07%)	81 (63.28%)	144 (57.83%)			
Total	121 (48.59%)	128 (51.41%)	249 (100%)			

*p < 0.05

Correlation Between Perceived Stress Level and Sleep Quality

Table 4 reveals a significant association between stress perception and sleep quality in student-athletes ($\chi^2 = 4.645$, $p < 0.05$). The table also presents descriptive data comparing student-athletes with good and poor sleep quality, as well as those experiencing mild and moderate to severe stress levels. Among student-athletes with mild stress levels, 57.14% reported good sleep quality. Conversely, those with moderate to severe stress levels were more likely to experience poor sleep quality (60.87%). Odds ratio analysis indicates an odds ratio of 2.1, suggesting that student-athletes with moderate to severe stress levels are 2.1 times more likely to experience poor sleep quality compared to those with mild stress levels.

Table 4. Correlation between perceived stress level and sleep quality in student-athletes (n = 249)

Sleep quality	Perceived stress level		Total n (%)	χ^2	p	OR (95% CI)
	Low n (%)	Moderate-high n (%)				
Good	24 (57.14%)	81 (39.13%)	105 (42.17%)	4.645	0.031*	2.1(1.06;4.06)
Bad	18 (42.86%)	126 (60.87%)	144 (57.83%)			
Total	42 (16.87%)	207 (83.13%)	249 (100%)			

*p < 0.05

Comparison Between Student-Athletes and Non-Athletes

Table 5 presents descriptive statistics comparing student-athletes and non-athletes across four factors examined in this study: chronotype, stress level, sleep quality, and EDS. Statistical analysis revealed significant differences between the two groups on chronotype ($t = 6.03$, $p < 0.05$), stress level ($t = -3.61$, $p < 0.05$), and sleep quality ($t = -3.97$, $p < 0.05$). However, no significant difference was found in excessive sleepiness during the day ($t = -0.67$, $p > 0.05$). Overall, student-athletes exhibited a higher mean chronotype value (59.46), indicating a preference for morningness (chronotype range: 59–86), while non-athletes had a mean chronotype value of 54.88, indicating a preference for intermediate types (chronotype range: 42–58). Regarding daytime sleepiness, the average mean value for both groups indicates normal daytime sleepiness (<11). For the stress level variable, both groups have scores above the low-stress category (>13). However, student-athletes had a lower average stress level (17.18) compared to non-athletes (18.64). Regarding sleep quality, both groups reported an average mean >5, indicating poor sleep quality. Student-athletes had a slightly lower average sleep quality score (6.04) than non-athletes (7.03). It is worth noting that the observed differences generally have a small effect size, except for the variables of chronotype and daytime sleepiness, where the effect size appears to be medium.

Table 5. Descriptive statistics of all research variables in student-athletes and non-athletes (n = 462)

	<i>M ± SD</i>		<i>t</i>	<i>p</i>	<i>d</i>
	Student-athletes (<i>n</i> = 249)	Non-athlete students (<i>n</i> = 213)			
Chronotype (MEQ)	59.46 ± 7.70	54.88 ± 8.61	6.03	0.000*	.54
Daytime sleepiness (ESS)	10.56 ± 3.73	10.79 ± 3.77	−0.67	0.502	.61
Perceived stress (PSS)	17.18 ± 4.17	18.64 ± 4.56	−3.61	0.000*	−.33
Sleep quality (PSQI)	6.04 ± 2.50	7.03 ± 2.85	−3.97	0.000*	−.36

* *p* < 0.05

Fig.1 shows the chronotype preferences of student-athletes and non-athletes. The majority of student-athletes (58.63%, *n* = 146) exhibited a morningness preference, while 41.37% (*n* = 103) had an intermediate–evening type preference. Conversely, non-athletes predominantly had an intermediate–evening type preference (63.38%, *n* = 135), followed by a morningness preference (36.62%, *n* = 78).

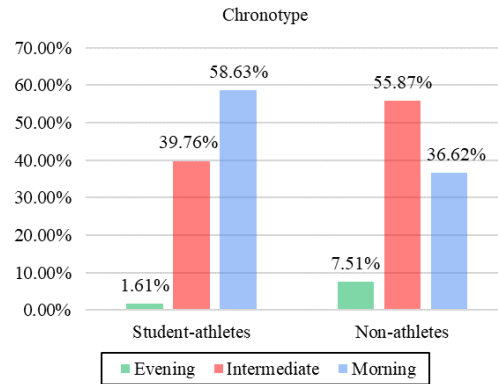


Fig.1. Comparison of chronotype between student-athletes and non-athlete students (n = 462)

Fig.2 shows the findings on daytime sleepiness in student-athletes and non-athletes. Both groups exhibited average values exceeding 50%, indicating moderate to excessive daytime sleepiness. However, a higher percentage of student-athletes (48.59%, *n* = 121) reported normal daytime sleepiness compared to non-athletes (44.13%, *n* = 94).

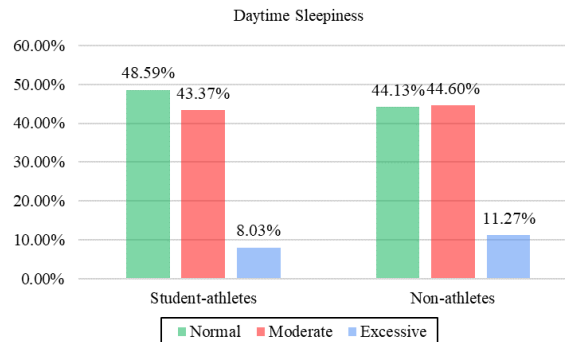


Fig.2. Comparison of daytime sleepiness between student-athletes and non-athletes (n = 462)

Fig.3 shows the findings on stress levels in student-athletes and non-athletes. Both groups had average values exceeding 80%, indicating moderate to high stress levels. However, student-athletes exhibited a slightly higher percentage of low-stress levels (16.87%, *n* = 42) and a lower percentage of moderate–high stress levels (83.13%, *n* = 207) compared to non-athletes.

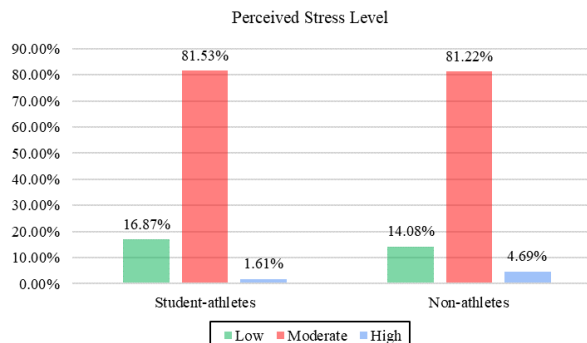


Fig.3. Comparison of perceived stress levels between student-athletes and non-athletes (n = 462)

Fig.4 shows the findings on sleep quality in student-athletes and non-athletes. Over 50% of both groups reported poor sleep quality. However, student-athletes had a lower percentage of poor sleep quality (57.83%, $n = 144$) compared to non-athletes (67.61%, $n = 144$). Additionally, student-athletes had a higher percentage of good sleep quality (42.17%, $n = 105$) compared to non-athletes (32.39%, $n = 69$). Notably, student-athletes had a slightly longer average sleep duration (6.8 h) than non-athletes (6.5 h).

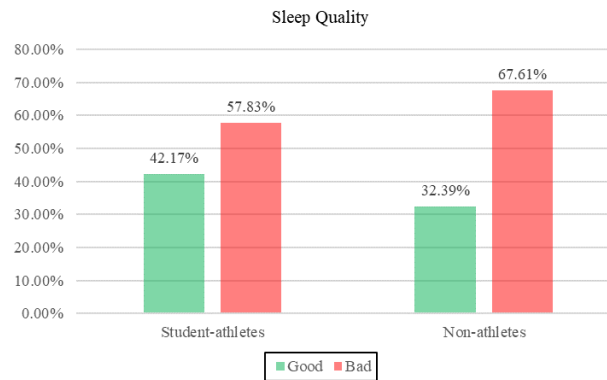


Fig.4. Comparison of sleep quality between student-athletes and non-athletes ($n = 462$)

Table 6 presents the mean and standard deviation of seven PSQI components for the student-athlete group. The average sleep duration was 6.84 ± 1.03 hours per day. Sleep latency and sleep disturbances had the highest scores among the measured components. Regarding sleep latency, 37.5% of respondents could fall asleep in less than 15 min after going to bed, 36.95% fell asleep within 16–30 min, 17.27% within 31–60 min, and 8.43% took more than 60 min to fall asleep. Student-athletes reported experiencing sleep disturbances owing to various factors, including waking up in the middle of the night or early in the morning, needing to use the restroom, or feeling too cold or hot.

Sleep efficiency and sleep medication had the lowest scores among the measured components. Sleep efficiency refers to the percentage of time spent sleeping in bed, with 85% or greater considered normal. The average sleep efficiency rate among student-athletes was 91.91%. Only 5.62% of student-athletes used medication to aid sleep. The average global PSQI score was 6.04 ± 2.50 , with higher scores indicating poorer sleep quality. A score above 5 classified an individual as a "poor" sleeper, while a score of 5 or below indicated a "good" sleeper.

Table 6. Statistical analysis of PSQI in student-athletes ($n = 249$)

Variables	$M \pm SD$	Modus	Min–Max	95% CI
Subjective sleep quality	1.04 ± 0.60	1	0–3	0.97;1.12
Sleep latency	1.47 ± 0.88	1	0–3	1.36;1.58
Sleep duration	0.86 ± 0.62	1	0–3	0.78;0.94
Sleep efficiency	0.47 ± 0.79	0	0–3	0.38;0.57
Sleep disturbance	1.14 ± 0.54	1	0–3	1.07;1.21
Use of sleep medication	0.07 ± 0.30	0	0–2	0.03;0.11
Daytime dysfunction	0.98 ± 0.73	1	0–3	0.89;1.07
Total	6.04 ± 2.50	6	1–18	5.73;6.36

Discussion

This study explored the relationship between chronotype, EDS, perceived stress levels, and sleep quality among university student-athletes, comparing the results with those of non-athletes. The findings indicate a significant association between chronotype and sleep quality in student-athletes, suggesting that chronotype is a crucial factor influencing sleep quality in this population. Specifically, student-athletes with morningness preferences tend to have better sleep quality, while those with intermediate to evening chronotypes are more likely to experience poor sleep quality. This pattern aligns with previous research (Bender et al., 2019), which demonstrated that eveningness was commonly associated with reduced sleep quality in athletes. Additionally, another study found that eveningness predicted later timing of falling asleep in student-athletes (Litwic-Kaminska & Jankowski, 2022).

The study found no statistically significant relationship between EDS and sleep quality among student-athletes. Descriptive statistics reveal notable trends. Nearly half of student-athletes with normal daytime sleepiness reported good sleep quality, while a slight majority still experienced poor sleep, suggesting that minimal daytime sleepiness does not guarantee good sleep quality. Conversely, most student-athletes with moderate to severe daytime sleepiness reported poor sleep quality, indicating a potential link between increased

daytime sleepiness and poorer sleep quality. The absence of a significant relationship between EDS and sleep quality contrasts with previous findings, such as those by Mah et al., who reported that longer sleep duration was linked to reduced daytime sleepiness in college athletes (Mah et al., 2018).

The findings of this study suggest that stress plays a critical role in the sleep quality of student-athletes, aligning with previous research indicating a link between stress and poor sleep among college students. Increased perceived stress levels have been associated with sleep difficulties (F. C. Brown et al., 2002; Erlacher et al., 2011; Juliffa et al., 2014; Lastella et al., 2014; Lund et al., 2010; Potuto & James O'Hanlon, 2007; Silva & Paiva, 2019; Verlander et al., 1999). Moreover, increased perceived stress is associated with sleepiness and may increase the risk of poor cardiovascular outcomes (Cummings et al., 2016; Valente et al., 2019).

This study highlights significant differences between student-athletes and non-athletes in chronotype, stress levels, and sleep quality, with no significant difference in EDS. Student-athletes exhibit a stronger preference for morningness compared to non-athletes, who tend to have an intermediate chronotype. This finding aligns with previous research by Kunorozva et al. (Kunorozva et al., 2012) and Lastella et al. (Lastella et al., 2010), suggesting that competitive athletes have a tendency towards morning-type. Athletes' chronotype distribution has been shown to skew more significantly towards morningness (Bender et al., 2019). Potential causes of EDS include frequent nocturnal awakenings to use the restroom (Sacomori et al., 2014), smoking, and other lifestyle habits (Theorell-Haglöw et al., 2015). Early morning training (before 8 a.m.) in various sports, such as swimming and athletics, has also been associated with reduced overall sleep and increased daytime sleepiness (Sargent et al., 2012). The findings of this study are consistent with previous research indicating significant daytime sleepiness in student-athletes (Antic et al., 2013; George et al., 2003; Mah et al., 2011; Mah et al., 2018).

Student-athletes reported slightly lower stress levels and better sleep quality compared to non-athletes, who experienced higher stress and poorer sleep quality. Despite these differences, both groups fell into categories indicating poor sleep quality and moderate stress. While most effect sizes were small, the difference in chronotype showed a medium effect size, highlighting a more distinct variation in circadian preferences between the groups. These findings suggest that although athletes may manage stress and sleep more effectively than non-athletes, they still encounter considerable challenges related to poor sleep quality and stress. College student-athletes must balance academic responsibilities such as coursework, test preparation, and campus involvement with personal healthcare and managing interpersonal relationships. Furthermore, student-athletes must engage in vigorous training and competitions to meet sports performance demands. This combination of academic and athletic responsibilities makes university student-athletes particularly prone to stress. A previous study found that student-athletes reported above-average stress levels owing to the challenges of balancing sports and academics (Surujlal et al., 2013; J. C. Watson, 2016). showed that the majority of male and female collegiate athletes slept less than the recommended amount for their age, and 44% reported subjectively poor sleep quality (Carter et al., 2020).

Conclusions

This study highlights the significant role of chronotype in determining sleep quality among university student-athletes, aligning with previous research. Morningness is associated with better sleep quality, while eveningness predicts poorer sleep outcomes, suggesting that circadian preferences influence sleep patterns in athletes. Stress was also identified as a key factor affecting sleep quality, with higher perceived stress levels associated with poorer sleep outcomes. Notably, no significant correlation was established between EDS and sleep quality; however, trends indicate that student-athletes with moderate to severe daytime sleepiness may be susceptible to impaired sleep. These results highlight the complex nature of sleep health in athletes, suggesting that managing stress and aligning with one's chronotype may help improve sleep quality.

Comparisons between student-athletes and non-athletes indicate that athletes generally exhibit a stronger preference for morningness, marginally lower stress levels, and slightly better sleep quality. However, both groups experience challenges related to stress and poor sleep quality, underscoring the need for comprehensive athlete care approaches that incorporate stress reduction strategies and interventions tailored to their circadian preferences. This study had some limitations. The sample was drawn from a single university with a sports science faculty, which may limit generalizability. Future research could expand to include multiple universities and a larger participant pool. Additionally, data collection occurred during the in-season training period for student-athletes; collecting data during the off-season could provide valuable comparisons. Furthermore, exploring additional factors that correlate with sleep quality, such as urban versus rural living environments, dietary programs, and other potential influences, would enhance our understanding of this multifaceted issue. These results highlight the significance of considering chronotype when designing interventions aimed at improving sleep quality in student-athletes. Such interventions should extend beyond reducing daytime sleepiness, encompassing broader strategies such as promoting adequate sleep duration, establishing regular sleep schedules, and implementing appropriate recovery protocols. This finding also underscores the importance for coaches, educators, and healthcare professionals working with student-athletes to be cognizant of stress levels and their potential impact on sleep. Consequently, stress reduction should be emphasized as a fundamental component of athlete care.

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Conflicts of interest

The authors declare no competing interests.

References

- Adan, A., Archer, S. N., Hidalgo, M. P., Di Milia, L., Natale, V., & Randler, C. (2012). Circadian typology: a comprehensive review. *Chronobiology International*, 29(9), 1153–1175. <https://doi.org/10.3109/07420528.2012.719971>
- Andrade, C. (2015). Understanding relative risk, odds ratio, and related terms: as simple as it can get. *Journal of Clinical Psychiatry*, 76(7), e857–e861. <https://doi.org/10.4088/JCP.15f10150>
- Antic, N. A., Weeks, R., McEvoy, D., Sargent, C., Jarema, L., Okeefe, M., & Catcheside, P. (2013). Prevalence of sleep disorders and excessive daytime sleepiness in an elite Australian rules football team. *American Journal of Respiratory and Critical Care Medicine*, 187, A3455.
- Bakotic, M., Radošević-Vidacek, B., & Bjelajac, A. K. (2017). Morningness–eveningness and daytime functioning in university students: the mediating role of sleep characteristics. *Journal of Sleep Research*, 26, 210–218. <https://doi.org/doi:10.1111/jsr.12467> Bastien,
- Bender, A. M., Van Dongen, H. P. A., & Samuels, C. H. (2019). Sleep quality and chronotype differences between elite athletes and non-athlete controls. *Clocks and Sleep*, 1(1), 3–12. <https://doi.org/10.3390/clockssleep1010002>
- Brown, F. C., C. W., Jr, B., & Soper, B. (2002). Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behavioral Medicine*, 28(1), 33–38. <https://doi.org/10.1080/08964280209596396>
- Brown, J., & Makker, H. K. (2020). An approach to excessive daytime sleepiness in adults. *British Medical Journal*, 368, 1–6. <https://doi.org/10.1136/bmj.m1047>
- Buyse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Research*, 28, 193–213.
- Cantão, E. W., Passos, G. S., Oliveira, D. M. D. E., Borges, V. D. E. A., & Santana, M. G. D. E. (2024). Association between sleep quality and symptoms of anxiety and stress in Jiu-jitsu practitioners. 24(9), 1064–1071. <https://doi.org/10.7752/jpes.2024.09229>
- Carter, J. R., Gervais, B. M., Adomeit, J. L., & Greenlund, I. M. (2020). Subjective and objective sleep differ in male and female collegiate athletes. *Sleep Health*, 6(5), 623–628. <https://doi.org/10.1016/j.sleh.2020.01.016>
- Chervin, R. D. (2019). Approach to the patient with excessive daytime sleepiness. UpToDate. <https://www.uptodate.com/contents/approach-to-the-patient-with-excessive-daytime-sleepiness>
- Cohen, S., Kamarck, T., Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior. Journal of Health and Social Behavior*, 24(4), 385–396. <https://doi.org/10.2307/2136404>
- Cosh, S., & Tully, P. J. (2015). Stressors, coping, and support mechanisms for student athletes combining elite sport and tertiary education: implications for practice. *The Sport Psychologist*, 29, 120–133. <https://doi.org/https://doi.org/10.1123/tsp.2014-0102>
- Cummings, D. M., Kirian, K., Howard, G., Howard, V., Yuan, Y., Muntner, P., Kissela, B., Redmond, N., Judd, S. E., & Safford, M. M. (2016). Consequences of comorbidity of elevated stress and/or depressive symptoms and incident cardiovascular outcomes in diabetes: results from the reasons for geographic and racial differences in stroke (regards) study. *Diabetes Care*, 39, 101–109. <https://doi.org/10.2337/dc15-1174>
- Davenne, D. (2009). Sleep of athletes - problems and possible solutions. *Biological Rhythm Research*, 40(1), 45–52. <https://doi.org/10.1080/09291010802067023>
- Erlacher, D., Ehrlenspiel, F., Adegbesan, O. A., & El-Din, H. G. (2011). Sleep habits in German athletes before important competitions or games. *Journal of Sports Sciences*, 29(8), 859–866. <https://doi.org/10.1080/02640414.2011.565782>
- Gaultney, J. F. (2010). The prevalence of sleep disorders in college students: impact on academic performance. *Journal of American College Health*, 59(2), 91–97. <https://doi.org/10.1080/07448481.2010.483708>
- George, C. F. P., Kab, V., Kab, P., Villa, J. J., & Levy, A. M. (2003). Sleep and breathing in professional football players. *Sleep Medicine*, 4, 317–325. [https://doi.org/https://doi.org/10.1016/S1389-9457\(03\)00113-8](https://doi.org/https://doi.org/10.1016/S1389-9457(03)00113-8)
- Gerber, M., Brand, S., Holsboer-Trachsler, E., & Pühse, U. (2010). Fitness and exercise as correlates of sleep

- complaints: is it all in our minds? *Medicine and Science in Sports and Exercise*, 42(5), 893–901.
<https://doi.org/10.1249/MSS.0b013e3181c0ea8c>
- Goel, N., Rao, H., Durmer, J. S., & Dinges, D. F. (2009). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, 29(4), 320–339. <https://doi.org/10.1055/s-0029-1237117>
- Hayes, L. D., Bickerstaff, G. F., & Baker, J. S. (2010). Interactions of cortisol, testosterone, and resistance training: influence of circadian rhythms. *Chronobiology International*, 27(4), 675–705.
<https://doi.org/10.3109/07420521003778773>
- Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Hillard, P. J. A., S. Katz, E., Kheirandish-Goza, L., N. Neubauer, D., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., & Ware, J. C. (2015). National sleep foundation's updated sleep duration recommendations: final report. *Journal of the National Sleep Foundation*, 1(4), 233–243. <https://doi.org/http://dx.doi.org/10.1016/j.sleh.2015.10.004>
- Horne, J. A., & Ostberg, O. (1976). A self assessment questionnaire to determine morningness eveningness in human circadian rhythms. *International Journal of Chronobiology*, 4(2), 97–110.
- Jankowski, K. S., & Ciarkowska, W. (2008). Diurnal variation in energetic arousal, tense arousal, and hedonic tone in extreme morning and evening types. *Chronobiology International*, 25(4), 577–595.
<https://doi.org/10.1080/07420520802261770>
- Johns, M. W. (1993). Daytime sleepiness, snoring, and obstructive sleep apnea the Epworth Sleepiness Scale. *Chest Journal*, 103(1), 30–36. <https://doi.org/doi:10.1378/chest.103.1.30>
- Juliffa, L. E., Halson, S. L., & Peiffer, J. J. (2014). Understanding sleep disturbance in athletes prior to important competitions. *Journal of Science and Medicine in Sport*, 18(1), 13–18.
<https://doi.org/10.1016/j.jsams.2014.02.007>
- Kunorozva, L., Stephenson, K. J., Rae, D. E., & Roden, L. C. (2012). Chronotype and PERIOD3 variable number tandem repeat polymorphism in individual sports athletes. *Chronobiology International*, 29(8), 1004–1010. <https://doi.org/10.3109/07420528.2012.719966>
- Lastella, M., Lovell, G. P., & Sargent, C. (2014). Athletes' precompetitive sleep behaviour and its relationship with subsequent precompetitive mood and performance. *European Journal of Sport Science*, 14(Suppl 1), S123–S130. <https://doi.org/10.1080/17461391.2012.660505>
- Lastella, M., Roach, G. D., Halson, S. L., & Sargent, C. (2015). Sleep/wake behaviours of elite athletes from individual and team sports. *European Journal of Sport Science*, 15(2), 94–100.
<https://doi.org/10.1080/17461391.2014.932016>
- Lastella, M., Roach, G. D., Hurem, D. C., & Sargent, C. (2010). Does chronotype affect elite athletes' capacity to cope with the training demands of elite triathlon? *Australasian Chronobiology Society*, 25–28.
- Li, L., Wang, Y., Wang, S., Zhang, L., Li, L., Xu, D., Ng, C. H., Ungvari, G. S., Cui, X., Liu, Z., Li, S. De, Jia, F., & Xiang, Y. (2018). Systematic reviews and meta-analysis prevalence of sleep disturbances in Chinese university students: a comprehensive meta-analysis. *J Sleep Res.*, 27, 1–13.
<https://doi.org/10.1111/jsr.12648>
- Litwic-Kaminska, K., & Jankowski, K. S. (2022). Self-reported chronotype and objective sleep timing in university student athletes and non-athletes. *Sleep Science*, 15(3), 351–355.
<https://doi.org/https://doi.org/10.5935/1984-0063.20220062>
- Lund, H. G., A. B., Reider, B. D., A. B., Whiting, A. B., N. R., Prichard, J. R., & Ph, D. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health*, 46(2), 124–132. <https://doi.org/10.1016/j.jadohealth.2009.06.016>
- Mah, C. D., Kezirian, E. J., Marcello, B. M., & Dement, W. C. (2018). Poor sleep quality and insufficient sleep of a collegiate student-athlete population. *Sleep Health*, 4(3), 251–257.
<https://doi.org/10.1016/j.sleh.2018.02.005>
- Mah, C. D., Mah, K. E., Kezirian, E. J., & Dement, W. C. (2011). The effects of sleep extension on the athletic performance of collegiate basketball players. *Sleep*, 34(7), 943–950. <https://doi.org/10.5665/SLEEP.1132>
- Monma, T., Ando, A., Asanuma, T., Yoshitake, Y., Yoshida, G., Miyazawa, T., Ebine, N., Takeda, S., Omi, N., Satoh, M., Tokuyama, K., & Takeda, F. (2018). Sleep disorder risk factors among student athletes. *Sleep Medicine*, 44, 76–81.
- Owens, J. (2014). Insufficient sleep in adolescents and young Adults: an update on causes and consequences. *Pediatrics*, 134(3), e921–e932. <https://doi.org/10.1542/peds.2014-1696>
- Pilcher, J. J., & Huffcutt, A. I. (1996). Effects of sleep deprivation on performance: a meta-analysis. *Sleep*, 19(4), 318–326.
- Potuto, J. R., & James O'Hanlon. (2007). National study of student athletes regarding their Experiences as college students. *College Student Journal*, 41(4), 947–966.
- Reilly, T., & Edwards, B. (2007). Altered sleep-wake cycles and physical performance in athletes. *Physiology and Behavior*, 90(2–3), 274–284. <https://doi.org/10.1016/j.physbeh.2006.09.017>
- Richard, S., Gill, N., Vaile, J., & Smart, D. (2015). Prevalence of poor sleep quality, sleepiness and obstructive sleep apnoea risk factors in athletes. *European Journal of Sport Science*, 16(7).
<https://doi.org/http://dx.doi.org/10.1080/17461391.2015.1120781>

- Roehrs, T., Zorick, F., Sicklesteel, J., Wittig, R., & Roth, T. (1983). Excessive daytime sleepiness associated with insufficient sleep. *Sleep*, 6(4), 319–325.
- Sacomori, C., Cardoso, F. L., Louzada, F. M., & Pereira, É. F. (2014). Excessive daytime sleepiness and nocturia in women. *Sleep Medicine*, 15(6), 677–680. <https://doi.org/10.1016/j.sleep.2014.01.017>
- Sargent, C., Halson, S., & Roach, G. D. (2012). Sleep or swim? Early-morning training severely restricts the amount of sleep obtained by elite swimmers. *European Journal of Sport Science*, 14(Suppl 1), S310–S315. <https://doi.org/10.1080/17461391.2012.696711>
- Sargent, C., Lastella, M., Halson, S. L., & Roach, G. D. (2014). The impact of training schedules on the sleep and fatigue of elite athletes. *Chronobiology International*, 31(10), 1160–1168. <https://doi.org/10.3109/07420528.2014.957306>
- Sexton-Radek, K., Hernandez, A., & Pauley, S. (2013). Sleep quality in college athletes. *Journal of Sleep Disorders & Therapy*, 2(7), 1–2.
- Shelley N Armstrong, Burcin, M. M., Bjerke, W., & Early, J. (2015). Depression in student athletes: a particularly at-risk group? A systematic review of the literature. *Athletic Insight*, 7, 177–193.
- Shochat, T., Cohen-Zion, M., & Tzischinsky, O. (2014). Functional consequences of inadequate sleep in adolescents: a systematic review. *Sleep Medicine Reviews*, 18(1), 75–87.
- Silva, M. R. G., & Paiva, T. (2019). Sleep, energy disturbances and pre-competitive stress in female traveller athletes. *Sleep Science*, 12(4), 279–286. <https://doi.org/10.5935/1984-0063.20190093>
- Simons, H. D., Rhee, D. Van, & Covington, M. V. (1999). Academic motivation and the student athlete. *Journal of College Student Development*, 40, 151–161.
- Simpson, N. S., Gibbs, E. L., & Matheson, G. O. (2016). Optimizing sleep to maximize performance: implications and recommendations for elite athletes. *Scandinavian Journal of Medicine and Science in Sports*, 27(3), 266–274.
- Slater, G., & Steier, J. (2012). Excessive daytime sleepiness in sleep disorders. *Journal of Thoracic Disease*, 4(6), 608–616.
- Sławińska, M., Stolarski, M., & Jankowski, K. S. (2018). Effects of chronotype and time of day on mood responses to CrossFit training. *Chronobiology International*, 36(2), 237–249. <https://doi.org/10.1080/07420528.2018.1531016>
- Surujlal, J., van Zyl, Y., & Nolan, V. T. (2013). Perceived stress and coping skills of university student-athletes and the relationship with life satisfaction. *African Journal for Physical, Health Education, Recreation and Dance*, 19(4:2), 1047–1059.
- Theorell-Haglöw, J., Åkerstedt, T., Schwarz, J., & Lindberg, E. (2015). Predictors for development of excessive daytime sleepiness in women: a population-based 10-year follow-up. *Sleep*, 38(12), 1995–2003. <https://doi.org/10.5665/sleep.5258>
- U.S. Department of Health and Human Services. (2018). *Physical activity guidelines for Americans* (2nd ed.). Department of Health and Human Services.
- Valdez, P., Ramirez, C., Garcia, A., Talamantes, J., & Cortez, J. (2010). Circadian and homeostatic variation in sustained attention. *Chronobiology International*, 27(2), 393–416. <https://doi.org/10.3109/07420521003765861>
- Valente, F., Batista, C., Simões, V., Tomé, I., & Carrilho, A. (2019). Quality of sleep among Portuguese anaesthesiologists: A cross-sectional study. *Acta Medica Portuguesa*, 32(10), 641–646. <https://doi.org/10.20344/amp.11468>
- Venter, R. E. (2012). Role of sleep in performance and recovery of athletes: a review article. *South African Journal for Research in Sport, Physical Education and Recreation*, 34(1), 167–184.
- Verlander, L. A., Benedict, J. O., & Hanson, D. P. (1999). Stress and sleep patterns of college students'. *Perceptual and Motor Skills*, 88, 893–898. <https://doi.org/10.2466/pms.1999.88.3.893>
- Watson, J. C. (2016). The effect of athletic identity and locus of control on the stress perceptions of community college perceptions of community college student-athletes. *Community College Journal of Research and Practice*, 40(9), 729–738. <https://doi.org/10.1080/10668926.2015.1072595>
- Watson, N. F., Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., Dinges, D. F., Gangwisch, J., Grandner, M. A., Kushida, C., Malhotra, R. K., Martin, J. L., Patel, S. R., Quan, S. F., & Tasali, E. (2015). Joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society on the recommended amount of sleep for a healthy adult: methodology and discussion. *Sleep*, 38(8), 1161–1183. <https://doi.org/http://dx.doi.org/10.5665/sleep.4886>
- Wilson, G., & Pritchard, M. (2005). Comparing sources of stress in college student athletes and non-athletes. *Journal of Sport Psychology*, 7(1), 1–8.
- Wolfson, A. R., & Carskadon, M. A. (1998). Sleep schedules and daytime functioning in adolescents. *Child Development*, 69(4), 875–887.