

Sleep patterns and quality during summer and academic year among female university students

Sultan M. Alshabrani, MD, Hana A. Alzuabi, MBBS, Dalal H. Alkalthem, MBBS, Ghada H. Alhadidi, MBBS, Ghada M. Alrajhi, MBBS.

ABSTRACT

الأهداف: قياس أنماط النوم ونوعيته خلال العطلة الصيفية والأسابيع الأربعة الأولى من العام الدراسي بين طالبات الجامعة.

المنهجية: شملت هذه الدراسة الطالبات في جامعة الأميرة نورة في الرياض في المملكة العربية السعودية. تم تحديد المشاركات من خلال أخذ عينات ملائمة واستبيانات مكتملة عبر الإنترنت. سأل الاستبيان عن خمس مناسبات باستخدام مقياس جودة النوم (SQS) وعن جدول نومهن خلال العطلة الصيفية والأسابيع الأربعة الأولى من العام الدراسي.

النتائج: كان هناك 385 مشاركة. زاد عدد الطالبات اللاتي نمن قبل منتصف الليل بمرور الوقت من العدد = 127 (32.9%) طالبة أثناء الإجازة إلى العدد = 127 (44.6%) طالبة في الأسبوع الرابع ($p < 0.001$). انخفض متوسط ساعات النوم من 8.97 (الانحراف المعياري $SD = 2.6$) ساعة خلال الصيف إلى 7.01 ($p < 0.001$, $SD = 2.7$) ساعة في الأسبوع 4. اشتكت الطالبات من قلة جودة النوم خلال العام الدراسي، خاصة في الأسبوع الأول ($p = 0.023$)، من الصيف. بينت الطالبات رضا أعلى عن النوم أثناء العطلة الصيفية (العدد = 97؛ 25.2%) مقارنة بالأسبوع الأول (العدد = 38؛ 9.9%) والأسبوع الرابع (العدد = 36؛ 9.4%) (الاحتمال $p < 0.001$). عانت الطالبات من التعب والإرهاق أثناء النهار (العدد = 79؛ 20.5%)؛ قيمة الاحتمال $p = 0.002$ وانخفاض التركيز في الأسبوع 4 (العدد = 79؛ 20.5%)؛ قيمة الاحتمال $p < 0.001$ مقارنة بالصيف.

الخلاصة: اختلفت أنماط نوم الطالبات بين الإجازة والعام الدراسي، حيث كان لديهم أوقات نوم غير منتظمة ونوم غير كافي. ونتيجة لذلك، كان لدى الطالبات نقص في جودة النوم، مما أثر سلباً على أدائهن.

Objectives: To measure sleep patterns and quality during summer vacation and weeks 1–4 of the academic year among female university students.

Methods: This retrospective prospective cohort study included female students at a university in Riyadh,

Saudi Arabia. Participants were recruited with convenience sampling and completed questionnaires online. The questionnaire asked about 5 occasions using the Sleep Quality Scale (SQS) and about their sleep schedule during summer vacation and weeks 1–4 of the academic year.

Results: There were 385 participants. The number of students who slept before midnight increased over time from $n = 127$ (32.9%) students during vacation to $n = 127$ (44.6%) students in week 4 ($p < 0.001$). The average sleep hours decreased from 8.97 (standard deviation $SD = 2.6$) hours during summer to 7.01 ($p < 0.001$, $SD = 2.7$) hours in week 4. Students reported poorer sleep quality during the academic year, particularly in week 1 ($p = 0.023$), than summer. Students reported higher satisfaction with sleep during summer vacation ($n = 97$; 25.2%) than week 1 ($n = 38$; 9.9%) and week 4 ($n = 36$; 9.4%) ($p < 0.001$). Students experienced daytime fatigue and tiredness ($n = 79$; 20.5%; $p = 0.002$) and low concentration in week 4 ($n = 79$; 20.5%; $p < 0.001$) compared to summer.

Conclusion: In the studied population, multiple sclerosis was the most prevalent cause of ON. Women were more likely to have ON. The prognosis for eyesight was substantially connected with the length of ON.

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From the Department of Neurosciences (Alshabrani), and the College of Medicine (Alzuabi, Alkalthem, Alhadidi, Alrajhi), King Abdullah bin Abdulaziz University Hospital, Princess Nourah Bint Abdulrahman University, Riyadh, Kingdom of Saudi Arabia

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*Address correspondence and reprint request to: Dr. Sultan M. Alshabrani, Department of Neurosciences, King Abdullah bin Abdulaziz University Hospital, Princess Nourah Bint Abdulrahman University, Riyadh, Kingdom of Saudi Arabia. E-mail: sumalshabrani@kaau.edu.sa
ORCID: <https://orcid.org/0000-0003-1406-6572>*

Sleep is an essential physiological process that plays a significant role in overall wellbeing. Adequate sleep is fundamental for cognitive functioning, physical health, and emotional wellbeing. Sleep quality and sleep patterns can be influenced by numerous factors, including environmental changes, academic demands, and lifestyle choices.¹ University students require an adequate amount of restorative sleep to support their optimal academic performance, but their sleep patterns often fluctuate between summer vacation and the academic year. It is recommended that young adults aged 18 to 25 years obtain 7 to 9 hours of sleep per night.¹

A study conducted in the southern region of Saudi Arabia revealed that the majority of university students in the area have poor sleep quality.² Moreover, a study in Abha, Saudi Arabia, concluded that university medical students have delayed sleep schedules, initial insomnia, and short sleep duration.³ Other studies in Makkah and Jeddah, Saudi Arabia, showed that university students have poor sleep quality in comparison to the general population.^{4,5} Gender disparities in sleep patterns and sleep-related issues are also critical aspects being examined in Saudi Arabia. Empirical studies have demonstrated that females mostly report higher rates of insomnia and sleep disturbance than males.⁶ A recent systematic review and meta-analysis reported poor sleep quality among university students in the UK.⁷

Seasonal influence is a critical aspect of sleep patterns. The transition process from the summer break and the academic year represents a shift from a relaxed schedule to structured plans with the unique climate of Saudi Arabia.^{8,9} The transition process impacts sleep patterns in numerous ways, such as changed exposure to daylight, temperature preferences, and modified daily activities.^{10,11} Additionally, a study in Japan noted that Indonesian students living in Japan experience differences in thermal comfort and sleep quality during summer and winter. During summer, the students reported lower thermal comfort and poorer sleep quality compared to winter. This could be attributed to the hot and humid climate of Japan during summer, which is different from the students' native Indonesian climate. The findings suggest a need for interventions to improve the thermal environment and promote better sleep among Indonesian students in Japan during summer.¹²

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A longitudinal study was carried out using data from a commercially available sleep tracker to evaluate the four-year trend in sleep duration and quality, which concluded that there was a decrease in both sleep duration and sleep quality over the period. Participants in the study had an average sleep duration of 6.83 hours per night at the beginning of the study, which decreased to 6.55 hours per night at the end. Additionally, sleep quality decreased from an average score of 82.4 to 78.7 out of 100.¹³ Based on this background, the present study evaluated the sleep pattern and quality during summer vacation and the first month of the academic year in a group of female university students at Princess Nourah Bint Abdulrahman University in Riyadh, Saudi Arabia.

Methods. This retrospective prospective cohort study was conducted at Princess Nourah Bint Abdulrahman University in Riyadh, Saudi Arabia. The study examined female college students between the period of April 2023 and September 2023. We included the students currently enrolled in the institution who were willing to be part of the study. Visiting students and those with a history of psychiatric problems were excluded.

According to principles of Helsinki Declaration, participants voluntarily participated in the study after receiving giving a clear description of its objectives. They had full rights to withdraw from the study at any time. Ethical approval was obtained from the Institutional Review Board of Princess Noura University before beginning the study.

Convenience sampling was used to recruit participants, who were asked to complete questionnaire-based surveys on their own via a survey link created by REDCap, which is a free and has open access. The sample size was estimated using the G power calculator with a confidence level of 95% and margin of error of 5%. The sample size was 385 female students.

The questionnaire was distributed in the fourth week of the academic year and asked students about 5 different occasions using the Sleep Quality Scale (SQS) and about their sleep schedule during summer vacation and in weeks 1, 2, 3, and 4 of the academic year. The questionnaire included questions about their sociodemographic information, sleep pattern (schedule), bedtime, and waking time during 24 hours, as well as the SQS developed by Yi et al. The SQS is a 28-item tool that has been validated in an adult population and has questions answered on a 4-point Likert scale (0 = rarely, 1=sometimes, 2=often, 3=almost always). The SQS evaluates 6 domains of sleep quality: daytime symptoms, restoration after sleep, problems

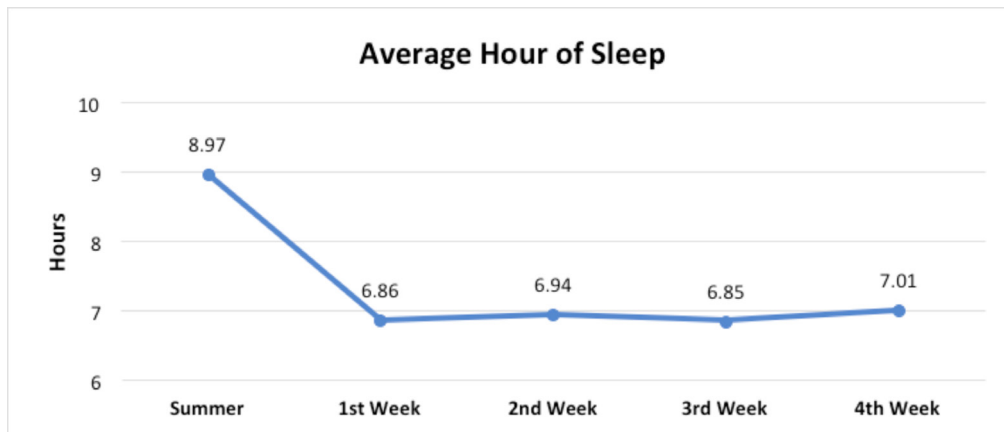


Figure 1 - Mean sleep hours in summer vacations and 4 weeks of the academic year.

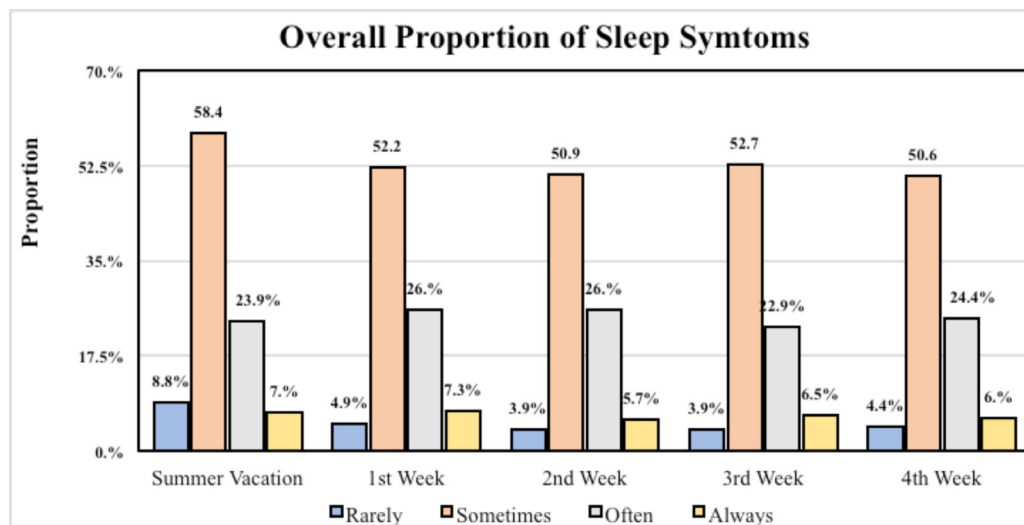


Figure 2 - Overall proportion of sleep quality in summer vacations and 4 weeks of the academic year.

initiating and maintaining sleep, difficulty waking, and sleep satisfaction.

Statistical analysis was conducted using IBM SPSS Statistics for Windows version 22.0 (IBM Corp, Armonk, NY, USA). Descriptive statistics were used to describe the studied sample in terms of means, standard deviations (SDs), and ranges. Quantitative data were analyzed using a t-test, and the association of qualitative variables was analyzed by a chi-squared test. A *p*-value less than 0.05 was considered as statistically significant. Multivariate analysis was performed based on the results of the univariate analysis.

Results. The study included 385 female participants' students. Table 1 shows the sociodemographic

information and other characteristics of the respondents. The largest group corresponded to the range of 18-24 years, representing *n*=352 (91.4%) respondents. The vast majority of respondents were Saudi, accounting for *n*=378 (98.2%) participants, while non-Saudis represented only *n*=7 (1.8%) participants. The majority of respondents identified as single (*n*=365 participants; 94.8%). Most of the respondents (*n*=346; 89.9%) were bachelor's degree students.

Table 2 shows data on sleep and wake patterns and average sleeping hours during both summer vacation and 4 weeks of the academic year. There was a gradual increase in the number of participants who slept before midnight with each passing week. At the beginning of the summer vacation, *n*=127 (32.9%) participants

Table 1 - The Sociodemographic and other features of the respondents (n=385).

Variables	Frequency (n=385)	Percent (%)
<i>Gender</i>		
Female	385	(100)
<i>Age (Years)</i>		
18-24	352	(91.4)
25-30	24	(6.2)
31-35	2	(0.6)
>35	7	(1.8)
<i>Nationality</i>		
Non-Saudi	7	(1.8)
Saudi	378	(98.2)
<i>Marital Status</i>		
Divorced	6	(1.6)
Married	12	(3.1)
Single	365	(94.8)
Widow	2	(.5)
<i>Education</i>		
Bachelor	346	(89.9)
Diploma	19	(4.9)
Post Graduate student(master/PhD)	20	(5.2)

reported sleeping before midnight, which increased to n=172 (44.6%) participants in the fourth week of the academic year. Conversely, the number of participants sleeping after midnight decreased from n=180 (46.7%) participants during summer vacation to n=119 (30.9%) participants in the fourth week of the academic year. Similarly, the number of participants sleeping after dawn decreased from n=76 (19.7%) participants during summer vacation to n=34 (8.8%) participants in the fourth week of the academic year. Based on the Mann-Whitney test, there were significant differences in sleep timing among participants between summer vacation and the 4 weeks of the academic year.

Regarding waking patterns, the majority of participants woke up in the morning throughout the study period. The percentage of respondents waking up in the morning gradually increased from n=194 (50.3%) respondents during summer vacation to n=243 (63.1%) respondents in the fourth week of the academic year. Conversely, the number of participants waking up in the afternoon or evening decreased over time. Based on the Mann-Whitney test, there were significant differences in waking time among participants between summer vacation and the 4 weeks of the academic year. During summer vacation, the average sleeping hours were 8.97 hours with a SD of 2.6 hours. However, in the first four weeks of the academic year, the number of

sleeping hours gradually decreased to 7 hours ($p<0.001$) with a varying SD of 2.2 to 2.7 hours.

Figure 1 indicates that the mean sleeping hours showed a fluctuating pattern across the study period, with the highest mean of 8.97 hours occurring during summer vacation and the lowest mean of 7.01 hours ($p<0.001$) occurring in the fourth week of the academic year. The SD also varied, ranging from 2.2 to 2.7 hours.

Table 3 shows the sleep quality assessment using the SQS to compare sleep experiences during summer vacation and 4 weeks of the academic year. Several significant findings emerged from the analysis. Participants reported significantly more difficulty in falling asleep during all four weeks of the academic year during the first week (n=52; 13.5%) and during 4th week (n=44; 11.4%), which is significantly more than in summer vacation (n=24; 6.2%; $p<0.001$). Similarly, they experienced significantly more challenges in falling into a deep sleep in summer vacation (n=146; 37.9%) compared to the first week (n=72; 18.7%) and fourth week (n=75; 19.5%; $p<0.001$).

There were significant differences in difficulty falling asleep again after waking up in the middle of the night, particularly during the first (n=46 (11.9%) and fourth (n=42; 10.9%) weeks of the academic year compared to summer vacation (n=30; 7.8%; $p<0.001$). Participants reported feeling more refreshed after sleep during summer vacation (n=94; 24.4%) compared to the first (n=46 (11.9%) and fourth (n=47; 12.2%) weeks of the academic year ($p<0.001$). Additionally, they were significantly more likely to feel unlikely to sleep after waking up during summer vacation (n=61; 15.8%) than during the first (n=39; 10.1%) and fourth (n=38; 9.9%) weeks of the academic year ($p<0.05$).

Participants expressed a stronger desire to sleep more after waking up during the first (n=112; 29.1%) and fourth (n=111; 28.8%) weeks of the academic year compared to summer vacation (n=82; 21.3%) ($p<0.001$). They also felt more that they had enough hours to sleep during summer vacation (n=140; 36.4%) than in the first (n=43; 11.2%) and fourth (n=36; 9.4%) weeks of the academic year ($p<0.001$). In the third week of the academic year, the number of participants experiencing a loss of appetite due to sleep loss was notably lower (n=30; 7.8%) compared to the summer vacation period (n=42; 10.9%; $p=0.045$). Conversely, difficulty in thinking during the 4 weeks of the academic year was significantly more prevalent compared to summer vacation ($p<0.001$).

The relief of fatigue after sleep had significantly lower prevalence during the 4 weeks of the academic year compared to summer vacation ($p<0.05$). Participants

Table 2 - Sleep & Wake-up pattern and average sleeping hours in summer vacations and 4 weeks of the academic year.

Sleep pattern	Summer vacations n (%)	1 st Week n (%)	2 nd Week n (%)	3 rd Week n (%)	4 th Week n (%)
<i>Sleeping Pattern</i>					
Before Midnight	127(32.9)	181(47.0)	183(47.5)	184(47.7)	172(44.6)
After Midnight	180(46.7)	144(37.4)	132(34.2)	116(30.1)	119(30.9)
After Fajr Time (Dawn)	76(19.7)	35(9.1)	37(9.6)	37(9.6)	34(8.8)
¹ P-value in association with summer		<0.001	<0.001	<0.001	<0.001
<i>Wake-Up Pattern</i>					
Morning Time	194(50.3)	263(68.3)	259(76.6)	255(66.2)	243(63.1)
Afternoon Time	114(29.6)	30(7.7)	30(7.7)	30(7.7)	21(5.4)
Evening Time	73(18.9)	66(18.4)	61(17.4)	49(14.7)	51(16.2)
² P-value in association with summer		<0.001	<0.001	<0.001	<0.001
<i>Sleeping Hour</i>					
Mean±SD	8.97±2.6	6.86±2.5	6.94±2.2	6.85±2.4	7.01±2.7
³ P-value in association with summer		<0.001	<0.001	<0.001	<0.001

reported higher satisfaction with sleep during summer vacation (n=97; 25.2%) compared to the first (n=38; 9.9%) and fourth (n=36; 9.4%) weeks of the academic year ($p<0.001$). Poor sleep made it harder to concentrate at work during the first week (n=87; 22.6%) compared to summer vacation (n=85; 22.1%; $p<0.001$). Sleepiness interfered with daily life during both summer vacation (n=60; 15.6%) and the four weeks of the academic year, especially the fourth week (n=51; 13.2%; $p<0.001$).

Additionally, it was significantly more difficult to leave bed during the four weeks of academic life, especially in the first and second weeks (n=81; 21.0%), compared to summer vacation (n=73; 19.0%; $p<0.001$). Poor sleep also caused increased tiredness at work, which was more prevalent during summer vacation (n=93; 24.2%; $p<0.001$). Having a clear head after sleep was significantly more prevalent during summer vacation (n=108; 28.1%) compared to the four weeks of the academic year ($p<0.05$). Regarding overall sleep quality, sleep deprivation symptoms were more prevalent during the first week of the academic year (n=28; 7.3%) compared to summer vacation (n=27; 7.0%), but with marginal significance ($p=0.023$). However, there was no statistically significant difference in symptoms between summer vacation (n=27; 7.0%) and the second, third, and fourth weeks of the academic year.

Figure 2 displays the overall proportion of sleep quality during both summer vacation and the four weeks of the academic year. During summer vacation, the majority sometimes experienced disturbed sleep-deprivation symptoms (58.4%), while 23.9% had them often. A smaller percentage always experienced them (7.1%), and 8.8% rarely experienced such symptoms. These

patterns remained relatively similar in the subsequent four weeks of the academic year. This figure indicate that during summer vacation, the students tended to sleep late and wake up late, while during the academic year, they slept early and woke up early. The average sleep hours decreased during the academic year compared to summer vacation. During the academic year, the students reported fewer hours of sleep, difficulty falling asleep, feeling less refreshed after sleep, and having more daytime fatigue compared to summer vacation. These symptoms caused difficulty concentrating, which interfered with academic performance in the first four weeks of the academic year.

Discussion. One of the main findings of the study is that the number of participants sleeping before midnight increased over time from n=127(32.9%) participants during summer vacation to n=172 (44.6%) participants in the fourth week of the academic year ($p<0.001$). Conversely, the number of participants sleeping after midnight decreased from n=180 (46.7%) participants during summer vacation to n=119 (30.9%) participants in the fourth week of the academic year ($p<0.001$). The percentage of respondents waking up in the morning gradually increased from n=194 (50.3%) participants during summer vacation to n=243 (63.1%) participants in the fourth week of the academic year ($p<0.001$). These differences indicate that most students sleep late after midnight and wake up late during summer vacation. During the academic year, students need to sleep early to wake up early. This shift in circadian sleep rhythm is expected, but it is important to see whether this change affects sleep quality and daytime performance.

Table 3 - Sleep quality assessment with Sleep Quality Scale (SQS) in summer vacations and 4 weeks of the academic year.

Sleep Quality Scale (SQS)		Summer Vacations n (%)	1 st Week n (%)	2 nd Week n (%)	3 rd Week n (%)	4 th Week n (%)
Difficulty in Sleep	Always	24(6.2)	52(13.5)	31(8.1)	43(11.2)	44(11.4)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Fall into Deep Sleep	Always	146(37.9)	72(18.7)	75(19.5)	72(18.7)	75(19.5)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Wake-up While sleeping	Always	42(10.9)	42(10.9)	36(9.4)	39(10.1)	41(10.6)
	*p-value		0.087	0.493	0.080	0.126
Difficulty sleeping again if wake up at midnight	Always	30(7.8)	46(11.9)	42(10.9)	48(12.5)	42(10.9)
	p-value		<0.001	0.004*	<0.001*	<0.001*
Wake up Easily due to Noise	Always	64(16.6)	62(16.1)	55(14.3)	67(17.4)	60(15.6)
	*p-value		0.357	0.638	0.250	0.285
Toss and Turn During Sleep	Always	64(16.6)	64(16.6)	56(14.5)	57(14.8)	55(14.3)
	*p-value		0.249	0.350	0.431	0.572
Never go back to sleep after wake up	Always	11(2.9)	17(4.4)	18(4.7)	21(5.5)	18(4.7)
	*p-value		0.284	0.225	0.461	0.136
Feel refreshed after sleep	Always	94(24.4)	46(11.9)	45(11.7)	42(10.9)	47(12.2)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Feel unlikely to sleep after waking up	Always	61(15.8)	39(10.1)	36(9.4)	37(9.6)	38(9.9)
	p-value		0.007	0.004*	0.020*	0.011*
Headache due to Poor Sleep	Always	132(34.3)	126(32.7)	125(32.5)	125(32.5)	119(30.9)
	*p-value		0.276	0.109	0.102	0.161
Irritability due to Poor Sleep	Always	117(30.4)	102(26.5)	97(25.2)	100(26.0)	95(24.7)
	*p-value		0.654	0.606	0.684	0.816
Like to Sleep more after waking up	Always	82(21.3)	112(29.1)	114(29.6)	110(28.6)	111(28.8)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Enough Hours to Sleep	Always	140(36.4)	43(11.2)	39(10.1)	35(9.1)	36(9.4)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Poor Sleep Cause me to lose my appetite	Always	42(10.9)	31(8.1)	33(8.6)	30(7.8)	34(8.8)
	*p-value		0.188	0.137	0.045	0.100
Poor sleep make hard for me to think	Always	81(21.0)	86(22.3)	85(22.1)	82(21.3)	79(20.5)
	*p-value		<0.001	<0.001	<0.001	0.004
Feel Vigorous after Sleep	Always	54(14.0)	31(8.1)	22(5.7)	24(6.2)	24(6.2)
	p-value		0.053	0.015	0.011*	0.027*
Poor Sleep Cause me to lose interest in work	Always	94(24.4)	87(22.6)	84(21.8)	76(19.7)	76(19.7)
	*p-value		0.123	0.231	0.369	0.277
Fatigue relieved after sleep	Always	100(26.0)	62(16.1)	56(14.5)	58(15.1)	57(14.8)
	p-value		0.026	0.021*	0.023*	0.024*
Poor Sleep Cause me to make mistake at work	Always	38(9.9)	38(9.9)	37(9.6)	38(9.9)	36(9.4)
	*p-value		0.207	0.301	0.133	0.255
Satisfied with Sleep	Always	97(25.2)	38(9.9)	33(8.6)	35(9.1)	36(9.4)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Poor sleep cause forget thing Easily	Always	68(17.7)	62(16.1)	63(16.4)	67(17.4)	65(16.9)
	p-value		0.013	0.033	<0.001	0.003*
Poor Sleep make hard to concentrate at work	Always	85(22.1)	87(22.6)	85(22.1)	87(22.6)	79(20.5)
	p-value		<0.001	<0.001*	<0.001*	<0.001*
Sleepiness interferes with daily Life	Always	60(15.6)	61(15.8)	55(14.3)	54(13.2)	51(13.2)
	*p-value		<0.001	0.001	0.003	0.007
Lose desire in all things due to poor sleep	Always	64(16.6)	57(14.8)	55(14.3)	54(14.0)	52(13.5)
	*p-value		0.228	0.234	0.261	0.298
Difficult getting out from bed	Always	73(19.0)	81(21.0)	81(21.0)	76(19.7)	73(19.0)
	p-value		0.008	<0.001*	<0.001*	0.011*
Poor Sleep cause easily tiredness at work	Always	93(24.2)	90(23.4)	86(22.3)	78(20.3)	79(20.5)
	p-value		<0.001	<0.001*	<0.001*	0.002*
Clear Head after Sleep	Always	108(28.1)	63(16.4)	57(14.8)	59(15.3)	59(15.3)
	p-value		0.015	0.016*	0.012*	0.023*
Poor sleep makes my life painful	Always	68(17.7)	59(15.3)	61(15.8)	57(14.8)	53(13.8)
	*p-value		0.285	0.486	0.541	0.569
Overall Sleep Score	Always	27(7.0)	28(7.3)	22(5.7)	25(6.5)	23(6.0)
	*p-value		0.023	0.074	0.280	0.229

*Note: p-value is calculated by Mann-Whitney and show the association between summer and 1,2,3,4 week of the academic year

Another finding of the study is that there was significant variation in average sleeping hours between summer vacation and academic year. The highest mean sleeping hours were observed during summer vacation (8.97 (SD=2.6) hours). This was significantly different ($p<0.001$) from the lowest mean sleeping hours observed during the first four weeks of the academic year. During the first week, the mean was 6.86 (± 2.5) hours, while in the second week, it was 6.94 (± 2.2) hours. In the third week, it was 6.85 (± 2.4) hours, and in the fourth week, it was 7.01 (± 2.7) hours. This indicates that there was a significant amount of variability in sleeping hours within each time period. This finding concurs with those of a study by Gusman et al¹⁴ in the US, which indicated that there is a need to address the mental health and wellbeing of college students during times of crisis and adapting educational approaches to support their health trajectories.¹⁴

The majority of the participants reported significantly more difficulty in falling asleep ($p<0.001$) during the first four weeks of the academic year (n=52 (13.5%) in week 1; n=31 (8.1%) in week 2; n=43 (11.2%) in week 3; and n=44 (11.4%) in week 4) compared to summer vacation (n=24; 6.2%). Participants experienced significantly more challenges in falling into a deep sleep ($p<0.001$) during the first four weeks of the academic year (n=72 (18.7%) in week 1, n=75 (19.5%) in week 2, n=72 (18.7%) in week 3, and n=75 (19.5%) in week 4) compared to summer vacation (n=146; 37.9%). Students had significant difficulty sleeping again after waking up in the middle of night ($p<0.001$) during the first four weeks of the academic year (n=46 (11.9%) in week 1, n=42 (10.9%) in week 2, n=48 (12.5%) in week 3, and n=42 (10.9%) in week 4) compared to summer vacation (n=30; 7.8%). In addition, students significantly reported feeling refreshed after sleep ($p<0.001$) in the first four weeks of the academic year (n=46 (11.9) in week 1, n=45 (11.7%) in week 2, n=42 (10.9%) in week 3, and n=47 (12.2%) in week 4) compared to summer vacation (n=94; 24.4%). Students were more likely to feel unlikely to sleep after waking up in the first four weeks of the academic year (n=39 (10.1%) in week 1, n=36 (9.4%) in week 2, n=37 (9.6%) in week 3, and n=38 (9.9%) in week 4) compared to summer vacation (n=94; 24.4%).

Students significantly expressed a strong desire to sleep more after waking up ($p<0.001$) in the first 4 weeks of the academic year (n=112 (29.1%) in week 1, n=114 (29.6%) in week 2, n=110 (28.6%) in week 3, and n=111 (28.8%) in week 4) compared to summer vacation (n=82; 21.3%). Moreover, students significantly felt that they had enough hours to sleep

($p<0.001$) in the first four weeks of the academic year (n=43 (11.2%) in week 1, n=39 (10.1%) in week 2, n=35 (9.1%) in week 3, and n=36 (9.4%) in week 4) compared to summer vacation n=82 (21.3%). Furthermore, participants reported significantly less satisfaction with sleep ($p<0.001$) during the first four weeks of the academic year (n=38 (9.9%) in week 1, n=33 (8.6%) in week 2, n=35 (9.1%) in week 3, and n=36 (9.4%) in week 4) compared to summer vacation (n=97 (25.2%).

We explored changes in appetite, daytime energy, and cognitive functions among female university students. Some participants had a loss of appetite because of sleep deprivation in the first four weeks of the academic year (n=31 (8.15) in week 1, n=33 (8.6%) in week 2, n=30 (7.8%) in week 3, and n=34 (8.8%) in week 4) compared to summer vacation (n=42; 10.9%). However, this difference was not statistically significant.

Regarding daytime energy, students reported significantly more tiredness and fatigue after sleep ($p<0.001$) in the first four weeks of the academic year (n=90 (23.4%) in week 1, n=86 (22.3%) in week 2, n=78 (20.3%) in week 3, and n=79 (20.5%) in week 4) compared to summer vacation (n=93; 24.2%). Moreover, students reported more relief of fatigue during summer vacation compared to the first 4 weeks of the academic year. Daytime sleepiness significantly interfered with daily life ($p<0.001$) during the first 2 weeks of the academic year (n=61 (15.8%) in week 1 and n=55 (14.3%) in week 2), but the effect was slightly less significant during the third and fourth weeks (n=54 (13.2%), $p=0.003$ in week 3; n=51 (13.2%), $p=0.007$ in week 4) compared to summer vacation (n=60; 15.6%). Additionally, leaving bed was significantly more difficult ($p<0.001$) in the second and third weeks of the academic year (n=81 (21%) in week 2 and n=76 (19.7%) in week 3), but it was less significant during the first and fourth weeks (n=81 (21%), $p=0.008$ in week 1 and n=73 (19%), $p=0.011$ in week 4) compared to summer vacation (n=73; 19.0%).

Regarding cognitive functions, students reported significant difficulty with thinking due to poor sleep ($p<0.001$) in the first four weeks of the academic year (n=86 (22.3%) in week 1, (n=85 (22.1%) in week 2, (n=82 (21.3%) in week 3, and (n=79 (20.5%) in week 4) compared to summer vacation (n=81; 21 %). Students reported significantly more forgetfulness due to poor sleep ($p<0.001$) in the third and fourth weeks of the academic year (n=67 (17.4%) in week 3 and n=65 (16.9%) in week 4) compared to summer vacation (n=68; 17.7%). However, the difference between summer vacation and the first two weeks of the

academic year was not significant ($p=0.0130$ in week 1 and $p=0.033$ in week 2).

Moreover, students reported that poor sleep made it significantly harder to concentrate at university ($p<0.001$) during the first four weeks of the academic year ($n=87$ (22.6%) in week 1, $n=85$ (22.1%) in week 2, $n=87$ (22.6%) in week 3, and $n=79$ (20.5%) in week 4) compared to summer vacation ($n=85$; 22.1%). However, the results did not show that they made mistakes in tasks due to these cognitive changes. Participants reported feeling more clear-headed after sleep during summer vacation ($n=108$; 28.1%) compared to the first four weeks of the academic year ($n=63$ (16.4%, $p=0.015$ in week 1; $n=57$ (14.8%, $p=0.016$ in week 2; $n=59$ (15.3%, $p=0.012$ in week 3, and $n=59$ (15.3%, $p=0.023$) in week 4).

We examined the effect of sleep on mood aspects like interest, motivation, and mood. We did not find any significant difference between summer vacation and the first 4 weeks of the academic year. However, some students had depressive mood symptoms. The overall SQS score was not significantly different between summer vacation and the first four weeks of the academic year. However, the scale showed that participants reported significantly more satisfaction ($p<0.001$) with sleep during summer vacation ($n=97$; 25.2%) compared to the first 4 weeks of the academic year ($n=38$ (9.9%) in week 1, $n=33$ (8.6%) in week 2, $n=35$ (9.1%) in week 3, and $n=36$ (9.4%) in week 4). This finding can be explained by the SQS scale representing certain conditions that were significantly different between variable times in our sample, but the overall average score was not different.

Regarding the overall findings, it seems that changes in circadian sleep rhythms between summer vacation and the academic year may play an important role. University students tend to have changes in circadian sleep rhythms due to irregular bedtime schedules and insufficient sleep, leading to poor sleep quality. Many studies report that circadian rhythm changes between seasons like long holidays and studying or work days may cause sleep deprivation, fatigue, excessive daytime sleepiness, and low concentration.^{15,16} University students have morning, afternoon, and night classes. Additionally, they mostly study at night and may delay sleep, and these sleep-wake patterns may mimic shift work. Studies found that shift work may lead to poor sleep quality and negative daytime symptoms. In Saudi Arabia, Alshahrani et al¹⁷ found that healthcare professionals working on shifts performed dismally during the day due to sleep deprivation.¹⁷ This finding

may apply to university students due to irregular bed timing and insufficient sleep patterns.

Finally, our study included female university students of a certain nationality, marital status, and level of academic education. We did not examine other medical, psychological, and social characteristics and their effect on sleep patterns and quality. Studies have found that different variables may affect sleep patterns and quality among university students. They examined variables like gender, race, ethnicity, and religious behaviors. They also examined body mass index (BMI) and medical comorbidities. Moreover, they examined the effect of psychological factors like the impact of peers, personality traits, and depression.

In a study conducted in the USA, Wang et al¹⁸ indicated that social networks have a significant impact on the sleep patterns of college students. The study found that students who had larger and more cohesive social networks tended to have more regular sleep schedules and better sleep quality compared to those with smaller and less-connected social networks. This suggests that social connections and support may play a role in promoting healthy sleep behaviors among college students.¹⁸

Our study did not assess other important factors that may influence sleep quality and lead to sleep deprivation. These factors include socioeconomic status, physical activity, and nutrition. Other factors include the use of digital devices before bedtime and caffeine consumption. Rassolnia and Nobari found that socio-economic status and physical activity have significant effect on sleep quality and mental well-being among college students, which address the importance of these factors among this population.¹⁹ Other reviews have suggested that physical activity and nutrition can significantly affect the quality of sleep.^{20,25} Different research studies indicated that the Use of digital device before bedtime can lead to poor sleep quality, and altered circadian cycle among children, adolescents and young adults.²¹⁻²³ Moreover, Researcher have found that frequent caffeine consumption among young subjects is associated with fragmented sleep and poor sleep quality leading to sleep deprivation.²⁴ Additionally, they have found that frequent Caffeine consumption, alcohol use, and heavy meals can disrupt sleep and cause poor sleep quality.²⁵

Limitations. One limitation of this study is the reliance on self-reported data. Participants were asked to recall and report their sleep patterns and experiences, which may be subject to recall bias or inaccuracies. Additionally, self-reported data may be influenced by individual perceptions and interpretations, leading

to potential measurement error. Another limitation is the lack of a control group. This study only compared sleep patterns and experiences during summer vacation and the first four weeks of the academic year. Without a control group of individuals who did not have a summer vacation, it is difficult to determine whether the observed differences are solely due to the vacation period or whether other factors may be influencing sleep patterns.

Furthermore, the study did not account for other potential factors that may influence sleep patterns and quality, such as socioeconomic status, use of digital devices before bedtime, physical activity, nutrition, and caffeine consumption, stress levels and underlying medical and mental conditions. These factors could confound the results and limit the ability to draw causal conclusions about the relationship between summer vacation and sleep. Lastly, the study only assessed sleep patterns and experiences over a four-week period. It is possible that sleep patterns and experiences may fluctuate over longer periods of time or may be influenced by other factors that were not captured in this study. Future research should consider longer-term assessments and the inclusion of additional variables to provide a more comprehensive understanding of the relationship between summer vacation and sleep. Future research may include other important potential factors that may influence sleep patterns and quality, such as socioeconomic status, use of digital devices before bedtime, physical activity, nutrition, and caffeine consumption, stress levels and underlying medical and mental conditions.

In conclusion, our study found that sleep patterns among female university students are different between summer vacation and the academic year. During summer vacation, the students tended to sleep late and wake up late, while during the academic year, they slept early and woke up early. The average sleep hours decreased during the academic year compared to summer vacation. During the academic year, the students reported fewer hours of sleep, difficulty falling asleep, feeling less refreshed after sleep, and having more daytime fatigue compared to summer vacation. These symptoms caused difficulty concentrating, which interfered with academic performance in the first four weeks of the academic year.

Overall, the students were able to change their sleep schedules between summer vacation and the first four weeks of the academic year, but they had fewer hours of sleep, which might have interfered with their daily routines and academic performance. University students need to improve their sleep schedules during summer

before the academic year. They also need to have enough hours of sleep for an optimal daytime energy and concentration for better academic performance.

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