

The Relationship Between Breakfast Skipping, Circadian Rhythm Disruption, and Concentration Levels Among University Students in Erbil City, 2025-2026

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Abstract

Background and Aim Breakfast skipping and circadian rhythm disruption are increasingly prevalent lifestyle behaviors among university students and are recognized as important determinants of cognitive performance. Irregular meal timing and disrupted sleep–wake cycles may impair students’ ability to maintain attention and focus during academic activities. This study aimed to examine the relationship between breakfast skipping, circadian rhythm disruption, and concentration levels among university students in Erbil City during the 2025–2026 academic year.

Methods This cross-sectional study was conducted from October 30 to November 20, 2025, among university students in Erbil City using purposive sampling. Data were collected from five universities using a structured self-administered questionnaire that included sociodemographic characteristics, the Zainab Breakfast Skipping Assessment (ZBSA), the Akam-Circadian Rhythm Disruption Scale (AKAM-CRD), and the Concentration Levels-Akam Scale (CL-AKAM). Statistical analyses were performed using SPSS version 26.0. Descriptive statistics, Pearson’s and Spearman’s correlation coefficients, chi-square tests, and multiple linear regression analyses were employed.

Results A total of 319 students participated in the study. Most participants demonstrated moderate levels of breakfast skipping (57.37%), circadian rhythm disruption (78.68%), and concentration (68.34%). Breakfast skipping was positively correlated with circadian rhythm disruption ($r = 0.33$, $p < 0.01$). Circadian rhythm disruption showed a significant negative association with concentration levels ($r = -0.14$, $p < 0.01$). In regression analysis, circadian rhythm disruption emerged as a stronger negative predictor of concentration compared with breakfast skipping.

Conclusion Breakfast skipping and circadian rhythm disruption are significantly associated with concentration levels among university students. Interventions promoting regular sleep–wake patterns and healthy breakfast habits may improve concentration and academic performance in this population.

Keywords Breakfast Skipping · Circadian Rhythm Disruption · Concentration Levels · University Students · Academic Performance

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Introduction

Breakfast skipping, circadian rhythm disruption, and concentration difficulties are interconnected lifestyle and health concerns that are becoming increasingly prevalent among young adults, particularly university students. Breakfast skipping refers to the habitual omission of the first meal of the day, a behavior linked to impaired cognitive function, diminished academic performance, and poor nutritional status (Cheng and Rebecca Yew, 2025, Minari and Pisani, 2025). Circadian rhythm disruption is characterized by a misalignment of the body's natural biological clock, often resulting from irregular sleep-wake patterns, late-night activities, or inconsistent meal timings, leading to fatigue and reduced mental alertness (Schuler and Hope, 2020). Concentration levels denote the ability to sustain attention and focus on academic or daily tasks, which are strongly influenced by both nutritional and sleep-related behaviors. The problem arises when students skip breakfast and experience circadian rhythm disturbances, as these factors impair their ability to concentrate in academic settings, ultimately affecting learning outcomes, productivity, and overall well-being. Globally, studies indicate that between 20% and 30% of young adults regularly skip breakfast (Kim et al., 2023), with higher rates observed in developing countries due to lifestyle pressures and socioeconomic factors (Dieteren and Bonfrer, 2021). In the Middle East, breakfast skipping has been reported among 35% to 45% of university populations, often associated with late-night study habits and irregular class schedules (Khan et al., 2024). In Iraq, research highlights a growing trend of unhealthy eating behaviors and poor sleep hygiene among students, reflecting similar global patterns. In Erbil City specifically, the university student population faces unique challenges related to academic demands, cultural transitions, and lifestyle changes. Anecdotal reports and limited surveys suggest that many students in Erbil neglect breakfast and follow irregular sleep routines, habits that may contribute to decreased concentration levels during academic activities. However, comprehensive data examining the combined effects of these factors remain limited in the Kurdistan Region.

Previous research has consistently highlighted the impact of breakfast skipping and circadian rhythm disruption on student health and academic performance across diverse populations. Global studies demonstrate that breakfast omission is associated with impaired memory, reduced attention span, and lower academic achievement (Asadullah et al., 2024). Research conducted in Europe and Asia

emphasizes that irregular eating and sleep patterns exacerbate metabolic disturbances and cognitive fatigue, conditions that significantly reduce concentration levels among university students (Shah et al., 2025). In Middle Eastern countries, a rising trend of breakfast skipping among university students has been documented, with this habit often linked to late-night studying, social activities, and increased reliance on fast food (Valdez, 2019). Studies from Saudi Arabia and Jordan found significant correlations between poor breakfast habits, disrupted sleep cycles, and reduced classroom engagement, highlighting the regional relevance of these issues (ALHUSSAIN et al., 2024, Alkhalidy et al., 2021). However, most of these studies relied on self-reported data and employed cross-sectional designs, methodological approaches that limit the ability to establish causal relationships between these variables. Furthermore, there is a notable absence of evidence focusing specifically on the Kurdish context, where cultural practices, dietary patterns, and lifestyle factors unique to the Kurdistan Region may influence these associations differently than in other Middle Eastern populations studied to date.

The limited research on breakfast skipping and circadian rhythm disruption in the Kurdish context represents a significant gap in the literature, as cultural and environmental factors in the Kurdistan Region create distinct conditions that warrant specific investigation. The local educational system, family structures, and social norms in Erbil City establish a unique environment that differs from other Middle Eastern settings previously studied. Prior research has established general associations between eating habits, sleep patterns, and cognitive outcomes internationally; however, little attention has been given to the combined effect of these variables on academic performance in the Iraqi-Kurdish context. Previous studies also did not fully consider how cultural and environmental factors contribute to irregular routines among Kurdish university students. In Erbil City, factors such as late-night socializing, exam stress, cultural eating patterns, dietary preferences, and the transition from family-centered meal structures to independent university life can all undermine students' ability to focus and maintain healthy routines. The Kurdistan Region's emphasis on higher education as a pathway to professional advancement makes understanding academic performance factors particularly relevant in this context. By exploring breakfast skipping, circadian rhythm disruption, and concentration levels together within this specific cultural setting, the present study provides a more holistic understanding of lifestyle-related determinants of concentration and extends existing literature by contextualizing the issue in a setting where such research is

notably absent. Ultimately, this study aims to examine the relationship between breakfast skipping, circadian rhythm disruption, concentration levels, and academic difficulties among university students in Erbil during the 2025-2026 academic year. It seeks to offer evidence-based insights and practical recommendations to support student well-being and academic success in the Kurdistan Region, while also serving as a model for similar investigations in comparable cultural contexts across the Middle East.

Research Question

What is the relationship between breakfast skipping, circadian rhythm disruption, and concentration levels among university students in Erbil City during the 2025–2026 academic year?

Methods

Study Design, Setting, Period, and Sampling

This cross-sectional study was conducted among university students in Erbil City, Iraq, during the 2025-2026 academic year. Data were collected from October 30 to November 20, 2025, using purposive sampling from five institutions: Hawler Medical University, Salahaddin University-Erbil, Chihan University-Erbil, Tishk International University, and Knowledge University.

Sample Size

The required sample size was calculated using a 95% confidence level, a 5% margin of error, and an assumed prevalence of 50% for breakfast skipping among university students, which was selected to maximize the estimated sample size. Based on these parameters, a minimum sample of 385 participants was required. However, due to limitations in student availability and participation during the data collection period, a total of 319 students were ultimately recruited and included in the final analysis. Despite not reaching the initially calculated sample size, the obtained sample was considered adequate to conduct the planned statistical analyses and to provide meaningful insights into the study objectives.

Inclusion

Eligible participants were full-time undergraduate students aged 18–25 years, enrolled in the selected universities in Erbil City, who had been residing in the city for at least the current semester and maintained regular class attendance. Students were required to provide informed consent and be free from diagnosed psychiatric, neurological, or chronic medical conditions that could influence dietary habits, sleep patterns, or concentration.

Exclusion

Students were excluded if they had diagnosed chronic

medical conditions (diabetes, thyroid disorders, sleep disorders, psychiatric or neurological conditions), were taking medications affecting sleep or cognition, worked night shifts, followed medically prescribed diets, were pregnant or breastfeeding, provided incomplete questionnaires (>20% missing data), or declined informed consent.

Study Tools and Data Collection

A structured, self-administered questionnaires were used to collect data on sociodemographic characteristics, breakfast skipping patterns (ZBSA, 24 items), circadian rhythm disruption (AKAM-CRD, 15 items), and concentration levels (CL-AKAM, 21 items). All instruments used 5-point Likert scales and demonstrated an overall very good reliability. Data were collected from October 30 to November 20, 2025, via online (Google Forms) and paper-based questionnaires. After obtaining oral informed consent, participants from five universities in Erbil City completed the questionnaire independently in approximately 15-20 minutes. All responses were anonymous and coded numerically. Questionnaires with more than 20% missing data were excluded.

Pilot Study

A pilot study was conducted on October 1, 2025, with 30 university students from Hawler Medical University to assess the feasibility, clarity, validation, and reliability of the study instruments before full-scale data collection. These participants met the inclusion criteria but were excluded from the final. The pilot aimed to evaluate questionnaire comprehensibility, assess completion time, identify technical issues, and examine internal consistency reliability of the instruments. Participants provided feedback on item clarity, wording, and response options, leading to minor modifications for improved clarity and cultural appropriateness. Reliability analysis using Cronbach's alpha coefficient demonstrated good internal consistency across all scales: ZBSA ($\alpha = 0.89$), AKAM-CRD ($\alpha = 0.81$), and CL-AKAM ($\alpha = 0.84$) (Taber, 2018), all exceeding the acceptable threshold of 0.70. The average completion time of 15-20 minutes was deemed acceptable, and following these refinements and reliability confirmation, the questionnaire was ready for main data collection.

Measures

The first section collected information on 6 sociodemographic variables including age, gender, marital status, academic year/level, field of study, and self-rated sleep quality over the past month.

The Zainab Breakfast Skipping Assessment (ZBSA) was used to evaluate breakfast consumption patterns. This 24-item instrument was developed for this study and

consists of three subscales: frequency of breakfast skipping (8 items), reasons for breakfast skipping (8 items), and consequences of breakfast skipping (8 items). Each item is rated on a 5-point Likert scale ranging from 1 (Never) to 5 (Always), yielding a total score range of 24-120 points. Participants were classified into three categories: low level breakfast skipping (24-56 points), moderate level (57-88 points), and high level (89-120 points). Higher scores indicate more frequent breakfast skipping behavior and greater associated challenges.

The Akam-Circadian Rhythm Disruption Scale (AKAM-CRD) was employed to measure circadian rhythm patterns over the past two weeks. This 15-item instrument assesses sleep-wake irregularities, sleep difficulties, daytime dysfunction, and environmental factors affecting circadian rhythms. Items are rated on a 5-point Likert scale from 1 (Never) to 5 (Always), with total scores ranging from 15-75 points. Participants were categorized as having low disruption (15-30 points), moderate disruption (31-52 points), or high disruption (53-75 points). Higher scores reflect greater circadian rhythm disturbance and impact on daily functioning.

The Concentration Levels-Akam Scale (CL-AKAM) was used to measure concentration abilities. This 21-item instrument evaluates five domains: academic focus (7 items), memory and retention (3 items), mental clarity (4 items), attention control (3 items), and productivity (4 items). Participants rated their experiences over the past two weeks using a 5-point Likert scale from 1 (Never) to 5 (Always), with total scores ranging from 21-105 points. Concentration levels were classified as low (21-42 points), moderate (43-70 points), or high (71-105 points). Higher scores indicate better concentration and cognitive functioning.

Ethical Approval and informed consent:

This study followed the Institutional Research Ethics Board and the Declaration of Helsinki guidelines. The ethical code was obtained from Hawler Medical University, College of Nursing, number 10, on September 7th. Oral informed consent was obtained from all participants before they filled out the questionnaires.

Statistical Analysis

Data were summarized and reported using frequency and percentage for qualitative variables (e.g., sociodemographic characteristics and categorical levels of breakfast skipping, circadian rhythm disruption, and concentration). Quantitative variables were presented as mean and standard deviation. The relationships between breakfast skipping scores, circadian rhythm disruption scores, and concentration level scores were assessed using Pearson's

correlation coefficient for continuous variables. Associations between ordinal categories of the study variables were examined using Spearman's rank correlation, while categorical associations were further evaluated using the Chi-square test with Cramér's V where appropriate. To determine the predictors of concentration levels, multiple linear regression models were performed in three stages: Model 1 included breakfast skipping scores as the independent variable; Model 2 included circadian rhythm disruption scores; and Model 3 simultaneously incorporated both breakfast skipping and circadian rhythm disruption scores to examine their combined predictive effect. Model fit was assessed using R^2 and adjusted R^2 values. All statistical analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY). Statistical significance was set at $p < 0.05$.

Results

Demographic and Clinical Characteristics of Participants

A total of 319 university students were involved in the current study, with a mean age of 20.81 ± 2.62 years, ranging from 17 to 36 years. The sample was predominantly male (196, 61.44%), while females accounted for 123 participants (38.56%). Most students were single (297, 93.10%), whereas 18 participants were married (5.64%) and 4 were widowed (1.25%). Regarding academic level, the largest proportions were in the second year (113, 35.42%) and third year (106, 33.23%), indicating a concentration of participants in the middle years of study. The majority of students were enrolled in health sciences programs (279, 87.46%), with smaller representations from natural sciences (15, 4.70%), humanities (14, 4.39%), and engineering and technology (11, 3.45%). Concerning self-rated sleep quality, nearly half of the participants reported good sleep quality (143, 44.83%), while poor or very poor sleep quality was reported by 112 students (35.11%), highlighting notable variability in sleep perceptions among the study population. Detailed demographics and other variables are presented in *Table 1*.

Distribution of Breakfast Skipping, Circadian Rhythm Disruption, and Concentration Levels

The results showed that breakfast skipping had a mean score of 60.22 ± 15.02 , with a median of 60.00 (IQR: 50.00–72.00), indicating that most participants clustered around the moderate range; accordingly, 183 students (57.37%) were classified as having a moderate level of breakfast skipping, while 128 students (40.13%) demonstrated a low level and only 8 students (2.51%) fell into the high-level category. Regarding circadian rhythm disruption, the mean score was 44.27 ± 9.06 with a median of 44.00 (IQR: 39.00–49.50),

and the majority of participants exhibited moderate disruption (251, 78.68%), whereas 53 students (16.61%) experienced high disruption and 15 students (4.70%) reported low disruption. For concentration levels, the mean score was 59.24 ± 14.05 , with a median of 60.00 (IQR:

52.00–68.00), and most participants demonstrated moderate concentration levels (218, 68.34%), followed by high concentration levels in 61 students (19.12%), while low concentration levels were observed in 40 students (12.54%). For further details, see *Table 2*.

Table 1: Demographic Characteristics of the Study Participants (N = 319)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	20.81 ± 2.62	—
	Range	17–36	—
Gender	Male	196	61.44
	Female	123	38.56
Marital Status	Single	297	93.10
	Married	18	5.64
	Widowed	4	1.25
Academic Year	First year	45	14.11
	Second year	113	35.42
	Third year	106	33.23
	Fourth year	38	11.91
	Fifth year or above	17	5.33
Field of Study	Health Sciences	279	87.46
	Engineering & Technology	11	3.45
	Natural Sciences	15	4.70
	Humanities	14	4.39
Self-Rated Sleep Quality	Very poor	27	8.46
	Poor	85	26.65
	Fair	39	12.23
	Good	143	44.83
	Excellent	25	7.84

Note: Values are presented as frequency (n) and percentage (%), except for age which is expressed as mean ± standard deviation (SD). Percentages may not total 100% due to rounding. Descriptive statistics were used for all variables.

Table 2: Assessment Scores and Category Distributions of Study Variables (N = 319)

Assessment Scale	Score Range	Mean ± SD	Median (IQR)	Category n (%)
Breakfast Skipping (ZBSA)	24–120	60.22 ± 15.02	60.00 (50.00–72.00)	Low (24–56): 128 (40.13%) Moderate (57–88): 183 (57.37%) High (89–120): 8 (2.51%)
Circadian Rhythm Disruption (AKAM-CRD)	15–75	44.27 ± 9.06	44.00 (39.00–49.50)	Low (15–30): 15 (4.70%) Moderate (31–52): 251 (78.68%) High (53–75): 53 (16.61%)
Concentration Levels (CL-AKAM)	21–105	59.24 ± 14.05	60.00 (52.00–68.00)	Low (21–42): 40 (12.54%) Moderate (43–70): 218 (68.34%) High (71–105): 61 (19.12%)

Note: Data are presented as mean ± standard deviation (SD), median with interquartile range (IQR), and frequency with percentage.

Correlations Between Breakfast Skipping, Circadian Rhythm Disruption, and Concentration Levels

The results revealed significant associations among breakfast skipping, circadian rhythm disruption, and concentration levels. A positive correlation was observed between breakfast skipping and circadian rhythm disruption using Pearson's correlation ($r = 0.33$), which was supported by Spearman's rank correlation ($\rho = 0.19$) and a significant categorical association ($\chi^2 = 25.33$, Cramér's $V = 0.20$; $p < .01$). The relationship between breakfast skipping and

concentration levels showed a weak positive association based on Pearson ($r = 0.08$) and Spearman ($\rho = 0.09$) coefficients, with a statistically significant categorical relationship ($\chi^2 = 26.30$, Cramér's $V = 0.20$; $p < .01$). In contrast, circadian rhythm disruption demonstrated a negative association with concentration levels, as indicated by Pearson ($r = -0.14$) and Spearman ($\rho = -0.13$) correlations, alongside a significant chi-square result ($\chi^2 = 33.98$, Cramér's $V = 0.23$; $p < .01$), reflecting an inverse relationship between circadian rhythm disturbance and concentration performance. (Table 3)

Table 3: Correlation Analysis Between Breakfast Skipping, Circadian Rhythm Disruption, and Concentration Levels (N = 319)

Variables	Pearson r	Spearman ρ	χ^2 (Cramér's V)
Breakfast Skipping ↔ Circadian Rhythm	0.33	0.19	25.33 (0.20)
Breakfast Skipping ↔ Concentration	0.08	0.09	26.30 (0.20)
Circadian Rhythm ↔ Concentration	-0.14	-0.13	33.98 (0.23)

Note: Pearson correlation was used for continuous total scores, Spearman rank correlation for ordinal category levels, and Chi-square test with Cramér's V for categorical associations. Statistical significance was set at $p < .05$ and $< .01$ where applicable; all Chi-square values reported as significant were at $p < .01$.

Table 4: Multiple Linear Regression Models Predicting Concentration Levels (N = 319)

Model	Predictor	B	β	t	R ² (Adj. R ²)
Model 1: Breakfast Skipping	Constant	54.61	—	16.81	0.01 (0.00)
	Breakfast Skipping	0.08	0.08	6.08	
Model 2: Circadian Rhythm Disruption	Constant	68.97	—	17.72	0.02 (0.02)
	Circadian Rhythm	-0.22	-0.14	-12.73	
Model 3: Combined Model	Constant	64.09	—	59.07	0.04 (0.03)
	Breakfast Skipping	0.14	0.15	2.79	
	Circadian Rhythm	-0.30	-0.19	-4.40	

Note: Linear regression analysis was performed to identify predictors of concentration levels. B represents unstandardized coefficients and β standardized coefficients. Statistical significance was set at $p < .05$ and $p < .01$; all coefficients reported as significant met at least $p < .01$.

Predictors of Concentration Levels Based on Breakfast Skipping and Circadian Rhythm Disruption

The results showed that breakfast skipping and circadian rhythm disruption were significant predictors of concentration levels across the regression models. In Model 1, breakfast skipping alone demonstrated a positive association with concentration, accounting for a small proportion of variance ($R^2 = 0.01$, adjusted $R^2 = 0.00$), with an unstandardized coefficient of $B = 0.08$ and a standardized coefficient of $\beta = 0.08$. In Model 2, circadian rhythm disruption independently predicted concentration levels in a negative direction ($B = -0.22$, $\beta = -0.14$), explaining a higher proportion of variance ($R^2 = 0.02$, adjusted $R^2 = 0.02$) compared with breakfast skipping alone. In the combined

model (Model 3), both predictors remained statistically significant, where breakfast skipping showed a positive effect on concentration ($B = 0.14$, $\beta = 0.15$), while circadian rhythm disruption demonstrated a stronger negative effect ($B = -0.30$, $\beta = -0.19$), with the model explaining 4% of the variance in concentration levels (adjusted $R^2 = 0.03$), indicating that circadian rhythm disruption contributed more substantially to variations in concentration than breakfast skipping when both factors were considered together. For more details, refer to Table 4.

Discussion

This study aimed to examine the relationship between breakfast skipping, circadian rhythm disruption, concentration levels, and academic difficulties among university students in Erbil during the 2025-2026 academic year. The findings revealed that the majority of participants

demonstrated moderate levels of breakfast skipping and circadian rhythm disruption, with most students exhibiting moderate concentration levels. Significant associations were identified between these variables, with breakfast skipping positively correlating with circadian rhythm disruption and concentration levels, while circadian rhythm disruption showed a negative relationship with concentration performance.

University students face unique challenges that affect their daily routines, eating behaviors, and sleep patterns, all of which can significantly impact their academic performance and cognitive functioning (Mahalle, 2025, Almoraie et al., 2024). In Erbil, the convergence of traditional cultural practices, modern academic demands, and evolving lifestyle patterns creates a complex environment where students must navigate multiple competing priorities. Despite growing awareness of the importance of regular eating patterns and adequate sleep for cognitive performance, there remains limited understanding of how breakfast skipping and circadian rhythm disruption specifically interact to influence concentration levels among university students in the Kurdistan Region. Furthermore, the specific mechanisms through which these factors collectively impact academic success in this population remain poorly understood. Given the importance of these details, we aimed to investigate the relationships between breakfast skipping, circadian rhythm disruption, and concentration levels among university students in Erbil.

The demographic profile of our study participants, with a mean age of approximately twenty-one years and a predominance of male students, reflects typical enrollment patterns in university settings within the region. The concentration of participants in middle academic years, particularly second- and third-year students, aligns with international patterns where students at this stage face increasing academic pressures while still developing effective self-management strategies (Fareeq Saber et al., 2024). The overwhelming representation of health sciences students in our sample corresponds with the educational landscape in Erbil, where health-related programs attract substantial enrollment due to career opportunities and societal demand for healthcare professionals.

The marital status distribution, with the vast majority of participants being single, mirrors global university demographics where traditional student populations are predominantly unmarried young adults (TAJWAR, 2024). This characteristic is particularly relevant when examining lifestyle behaviors, as single students living independently or in dormitories often face greater challenges in maintaining regular meal patterns and consistent sleep schedules compared to those living within family structures.

The self-rated sleep quality findings, where more than one-third of participants reported poor or very poor sleep, parallel concerning trends observed in student populations worldwide, suggesting that sleep difficulties represent a universal challenge in higher education contexts regardless of geographic location (Mota et al., 2021).

The moderate level of breakfast skipping observed in the majority of participants reflects a widespread pattern among university students globally, where irregular eating schedules and meal skipping have become normalized behaviors (Shah et al., 2025). Research from various countries consistently demonstrates that university students frequently skip breakfast due to time constraints, late-night studying habits, and prioritization of sleep over morning meals (Khan et al., 2024). The concentration of participants in the moderate breakfast skipping category suggests that while complete breakfast omission is not universal, inconsistent breakfast consumption represents a common pattern that warrants attention due to its potential cumulative effects on health and academic performance.

The distribution of circadian rhythm disruption, with the vast majority of students experiencing moderate levels, aligns with findings from international studies documenting widespread sleep-wake cycle irregularities among university populations (Arora et al., 2025). This pattern likely reflects the conflict between biological sleep preferences, particularly in young adults who naturally tend toward later sleep and wake times, and the demands of early morning classes and academic responsibilities (Yeo et al., 2023). The relatively small proportion experiencing low disruption suggests that maintaining consistent circadian rhythms represents a significant challenge for most students, potentially reflecting both individual choices and systemic factors within the university environment.

The positive correlation between breakfast skipping and circadian rhythm disruption represents an important finding that highlights the interconnected nature of health behaviors. This relationship suggests that students who experience irregular sleep-wake patterns are more likely to skip breakfast, potentially due to shortened morning routines or reduced appetite associated with sleep disruption (Teixeira et al., 2018). Similar associations have been documented in other student populations, where late bedtimes and inadequate sleep duration contribute to reduced morning appetite and increased likelihood of breakfast omission (Grummon et al., 2021). The consistency of this relationship across different cultural contexts underscores the fundamental biological mechanisms linking sleep patterns with eating behaviors.

The weak positive association between breakfast

skipping and concentration levels presents a counterintuitive finding that contrasts with much of the existing literature suggesting negative effects of breakfast skipping on cognitive performance (Cheng and Rebecca Yew, 2025). However, this relationship may reflect compensatory mechanisms or selection effects, where students who skip breakfast might engage in other behaviors that partially offset potential negative impacts. Alternatively, the relationship could be influenced by unmeasured confounding variables such as caffeine consumption or snacking patterns. The complexity of this relationship highlights the need for more nuanced understanding of how meal timing interacts with other lifestyle factors to influence cognitive outcomes.

The negative association between circadian rhythm disruption and concentration levels aligns strongly with established research demonstrating that sleep-wake cycle irregularities impair cognitive functioning, attention, and academic performance (Okuda et al., 2021). Studies across diverse educational settings consistently show that students with greater circadian disruption experience reduced ability to sustain attention, process information efficiently, and maintain focus during academic tasks (Valdez, 2019, Gabay et al., 2022). The inverse relationship observed in our study reinforces the critical importance of sleep regularity for optimal cognitive functioning, suggesting that interventions targeting circadian rhythm stability may yield significant benefits for student concentration and academic success.

The regression analysis findings, demonstrating that circadian rhythm disruption exerts a stronger negative effect on concentration than the positive effect of breakfast skipping, provide crucial insights into the relative importance of these factors. When both predictors were considered together, circadian rhythm disruption emerged as the more substantial contributor to concentration variations, suggesting that sleep-wake cycle stability represents a primary target for interventions aimed at improving student cognitive performance (Crouse et al., 2021). This finding emphasizes that while nutritional behaviors matter, the foundational role of adequate and regular sleep cannot be overlooked in supporting academic success.

Despite the valuable insights provided by this study, several limitations should be acknowledged. The cross-sectional design precludes causal inferences regarding the directionality of relationships between breakfast skipping, circadian rhythm disruption, and concentration levels. The predominance of health sciences students may limit generalizability to students in other academic disciplines. Self-reported measures of sleep quality and eating behaviors are subject to recall bias and social desirability effects. Future research should employ longitudinal designs to

examine temporal relationships and potential mediating mechanisms, incorporate objective measures of sleep and eating patterns, and develop targeted interventions addressing both nutritional behaviors and sleep hygiene to optimize student concentration and academic performance across diverse educational contexts.

Conclusion

Breakfast skipping and circadian rhythm disruption are significantly associated with concentration levels among university students, with circadian rhythm disruption demonstrating a stronger negative influence on cognitive focus than breakfast skipping. Promoting consistent sleep-wake routines alongside healthy breakfast habits may enhance students' concentration, academic performance, and overall well-being, and should be considered a priority in university-based health promotion and student support programs.

Statements and Declarations

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Competing Interests The authors declare no conflict of interest.

Ethics Statement The ethical code was obtained from Hawler Medical University, College of Nursing, number 10, on September 7th.

Data Availability Statement The data that support the findings of this study are available from the corresponding author upon reasonable request.

Clinical trial registration This study did not constitute a clinical trial and therefore did not require registration.

Transparency Statement The lead author Akam Ahmad Radha affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Author Contributions Zainab Mohammed Qadir: conceptualization; data curation; methodology; writing—original draft; Visualization; writing—review & editing. Asma Ibrahim Hussein: conceptualization; data curation; methodology; writing—original draft; Visualization; writing—review & editing. Doaa K. Al-seleet: conceptualization; data curation; methodology; writing—original draft; Visualization; writing—review & editing. Hana Kamil Zainalddin: conceptualization; data curation; methodology; writing—original draft; Visualization; writing—review & editing. Akam Ahmad Radha: conceptualization; formal analysis; investigation; methodology; project administration; supervision; writing—review & editing. All authors have read and approved the final version of the manuscript. The corresponding author had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

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