

Hydration and Sleep Quality in Female Nursing Students: A Cross-sectional Study



Ari Jamal Hassan^{1*}, Shkar Mariwan Ahmed², Shan Mariwan Ahmed³, Awat Jamal Hasan^{4,5}

¹Department of Nursing, College of Nursing, University of Human Development, Sulaymaniyah, Iraq, ²Department of Pharmacy, College of Pharmacy, University of Human Development, Sulaymaniyah, Iraq, ³Department of Pharmacy, College of Pharmacy, Cihan University, Erbil, Iraq, ⁴Community Health Nursing, College of Nursing, University of Sulaimani, Sulaymaniyah, Iraq, ⁵School of Health Sciences, Faculty of Medicine and Health Sciences, University of Nottingham, United Kingdom

ABSTRACT

Background: Hydration status impacts thermoregulation, osmoregulation, and autonomic function, which are foundational for sleep initiation and continuity. However, epidemiological evidence linking habitual fluid intake to sleep quality in young adult females remains limited. **Objective:** This study aimed to examine the associations between habitual daily plain-water intake, evening caffeine consumption, and specific sleep domains (duration, latency, nightly awakenings, and global sleep quality) among female nursing students. **Methods:** A cross-sectional questionnaire study was conducted among 322 female dormitory residents. Self-reported data were collected on daily water intake, evening caffeine use, and sleep parameters. Non-parametric statistical analyses (Chi-square, Kruskal–Wallis H, and Mann–Whitney U tests) were performed using Statistical Package for Social Sciences v27. **Results:** Most participants consumed 1.0–1.5 L/day of water (41.0%), and evening caffeine intake was highly prevalent (72.0% consuming it sometimes or often). Lower fluid intake (<1.0 L/day) was significantly associated with worse sleep latency ($P = 0.042$) and more frequent nightly wakeups ($P = 0.049$). Frequent evening caffeine consumption was significantly associated with poorer global sleep quality, shorter sleep duration, and increased awakenings ($P < 0.05$). No significant correlation was observed between body mass index and sleep duration. **Conclusion:** Suboptimal hydration and evening caffeine consumption are significantly associated with impaired sleep initiation and continuity. Low-burden lifestyle interventions focusing on adequate daytime fluid intake and reduced evening caffeine may improve sleep quality in student populations.

Index Terms: Hydration, Sleep Latency, Sleep Continuity, Caffeine, University Students

1. INTRODUCTION

Adequate hydration is fundamental to human physiology: Water maintains cellular homeostasis, supports thermoregulation, and participates in cardiovascular,

metabolic, and neuroendocrine processes that are deeply associated with daytime function and nocturnal physiology [1]. Sleep is a multi-domain construct encompassing duration, latency, continuity, efficiency, and daytime functioning [2]. It has well-documented effects on metabolic health, cognition, and overall academic performance in young adults [3]. Recent research demonstrates that even mild dehydration can disrupt physiological homeostasis, increasing fatigue and subjective difficulty in falling asleep [4].

Biological mechanisms connecting hydration to sleep include thermoregulatory changes driven by altered body water

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Corresponding author's e-mail: Ari Jamal Hassan, Department of Nursing, College of Nursing, University of Human Development, Sulaymaniyah, Iraq. E-mail: ari.jamal@uhd.edu.iq

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content, shifts in plasma osmolality, and vasopressin signaling that affects nocturnal urine production and arousals [5]. Furthermore, caffeine and other evening stimulants are highly common in student populations and act as primary behavioral confounders in the hydration–sleep relationship [6]. Late-day caffeine intake produces dose- and timing-dependent impairments in sleep latency, total sleep time, and sleep continuity. Caffeine not only alters sleep architecture but can also modify drinking patterns by replacing plain water with caffeinated beverages, subsequently increasing nocturia and sleep fragmentation [7].

This study, therefore, examined habitual daily fluid intake, evening caffeine consumption, and multiple sleep domains in a well-defined sample of female university students. Our primary aims were: (1) To test whether lower habitual fluid intake is associated with worse sleep initiation and continuity; (2) To evaluate associations between evening caffeine and sleep outcomes; and (3) To place these findings within a regional context to inform low-burden, culturally appropriate interventions for student sleep health.

2. RELATED WORKS

Habitual fluid intake varies widely by age, sex, activity, climate, and culture. Young adults – especially university students – often display suboptimal and irregular drinking patterns due to demanding academic schedules, social habits, and the widespread use of stimulants [8]. Observational and experimental studies link fluid balance to mood, cognition, and physiological arousal, which can plausibly alter the ability to initiate and maintain sleep [9]. For instance, a 2024 study indicated that higher plain water intake is significantly associated with better subjective sleep quality and shorter sleep latency [10]. Similarly, experimental fluid-restriction crossover trials report that mild dehydration increases perceived difficulty in falling asleep, emphasizing that maintaining euhydration assists with sleep initiation [11]. Furthermore, adequate fluid intake has been positively correlated with increased sleep efficiency and rapid eye movement sleep length [12].

Despite these physiological links, epidemiological evidence regarding habitual hydration and sleep remains somewhat mixed. Heterogeneity in previous methodologies – such as the use of self-reported fluid intake versus objective urinary biomarkers – likely explains the divergent results in the current literature [13].

Regional evidence from Middle Eastern university samples highlights these ongoing challenges. A high prevalence of sleep disturbances has been widely documented among students in the region, often exacerbated by academic workloads, psychological distress, and heavy evening stimulant use. Recent cross-sectional data from Egyptian and Saudi Arabian student cohorts indicate that poor sleep hygiene, particularly the consumption of caffeinated energy drinks late in the day, is a major determinant of poor sleep outcomes, including shorter sleep duration and increased nocturnal awakenings [14]. Given the established risks associated with these lifestyle factors, there is a clear local relevance to studying hydration behaviors and caffeine consumption simultaneously.

3. MATERIALS AND METHODS

3.1. Study Design and Setting

This cross-sectional study examined associations between habitual fluid intake, evening caffeine use, and multiple sleep domains among female undergraduate residents of the University of Sulaymaniyah City Campus dormitories. Data were collected between November 23, 2024, and February 01, 2025.

3.2. Participants, Eligibility, and Sampling

Eligible participants were female students aged 18–24 years residing in the city campus dormitories who provided written informed consent. Convenience sampling of volunteers was used until the target sample size was reached. Responses with missing data preventing classification of primary exposure or outcome variables were excluded from relevant analyses using pairwise deletion.

3.3. Sample Size Calculation

Sample size was estimated for a cross-sectional prevalence study with a finite population correction. The standard formula used (shown below) combines the binomial sample size term with finite population adjustment:

$$n = \left(\frac{Z^2 p(1-p)}{E^2} \right) \left(\frac{N}{\frac{N + Z^2 p(1-p)}{E^2} - 1} \right)$$

where n = required sample size; N = population size (≈ 2000 dormitory students); Z = Z statistic for chosen confidence level (1.96 for 95%); P = expected prevalence/

proportion (0.5 when unknown to maximize sample size); and E = margin of error (0.05). Using $Z = 1.96$, $P = 0.5$, $E = 0.05$, and $N \approx 2000$ produced a recommended sample of 322 participants, which corresponds to the analytic sample.

3.4. Variables and Measurements

The questionnaire captured demographic and lifestyle characteristics and the following primary measures:

- Hydration (exposure): Self-reported daily plain water intake categorized as <1.0 L, 1.0–1.5 L, 1.5–2.0 L, 2.0–2.5 L, >2.5 L
- Evening caffeine (covariate): Frequency of caffeinated beverage consumption after 18:00 (Never/Rarely, Sometimes, Often/Always)
- Sleep outcomes (dependent variables): Sleep duration (ordinal bands and binary ≥ 7 h vs. <7 h), sleep latency (ordinal), nightly wakeups (ordinal), and global sleep quality (Very good \rightarrow Very poor)
- Other variables: Age, body mass index (BMI) (calculated from self-reported height and weight), physical activity, and perceptions regarding hydration and sleep.

3.5. Questionnaire and Data Collection Procedures

A semi-structured questionnaire was developed, combining researcher-designed items with standard, validated concepts for assessing sleep and hydration. The questionnaire was divided into three main sections: (1) Demographic and lifestyle characteristics, which captured age, height, weight (to calculate BMI), and physical activity levels; (2) Hydration habits, assessing daily plain-water intake volumes and participant perceptions regarding hydration; and (3) Sleep parameters and evening stimulants, which evaluated evening caffeine consumption alongside specific sleep domains including duration, latency, nightly awakenings, and global sleep quality. A complete copy of the English-language questionnaire utilized in this study is provided in Appendix A. Paper questionnaires were self-completed after informed consent was obtained and were subsequently entered into an electronic database for cleaning and analysis.

3.6. Data Cleaning and Coding

Records were screened for implausible values and typographical errors. Corrections included standardizing text entries (e.g., “6_7” \rightarrow “6–7 h”) and recoding free-text responses into uniform analytic categories. Missing values were handled using pairwise deletion.

3.7. Statistical Analysis

Analyses were conducted using IBM Statistical Package for the Social Sciences Statistics v27. Continuous variables (age, BMI)

are presented as mean \pm standard deviation, and categorical variables as frequencies and percentages. Associations between categorical exposures (hydration groups, caffeine categories) and categorical sleep outcomes were tested using Chi-square or Fisher’s exact test. Ordinal or non-normally distributed sleep variables (sleep latency, nightly wakeups, sleep quality scores) were compared across hydration categories using the Kruskal–Wallis H test. Two-group ordinal comparisons (e.g., sleep quality between 6–7 h and 7–8 h sleepers) were assessed using the Mann–Whitney U test. The association between BMI and sleep duration (hours) was evaluated using Spearman’s rank correlation. All tests were two-sided with $\alpha = 0.05$, and exact P -values are reported.

3.8. Ethics and Approvals

The protocol was approved by the University of Sulaimani Scientific and Ethical Committee. Participation was voluntary, written informed consent was obtained, and data were anonymized.

3.9. Reporting and Reproducibility

Tables present N s, percentages, mean ranks, and exact test statistics to allow reproducibility. The Methods section documents cleaning rules and analytic choices (non-parametric tests for ordinal/non-normal data and pairwise deletion for missing values) to ensure transparency.

4. RESULTS

4.1. Demographic Characteristics

The sample consisted of 322 female students aged 18–24 years (mean age 20.5 ± 2.1 years), predominantly falling within a normal BMI range (mean 23.4 ± 3.2 kg/m²). Physical activity levels were widely distributed, with a notable portion leaning toward sedentary (33.3%) or lightly active (26.7%) lifestyles, typical of dormitory-based student populations. Regarding hydration, the data revealed a concerning trend: A significant proportion of the cohort demonstrated suboptimal fluid intake, with the vast majority (59.6%) consuming <1.5 L/day. Concurrently, evening caffeine consumption was highly prevalent, with 72.0% reporting they consume caffeinated beverages “sometimes” or “often/always,” suggesting a heavy reliance on late-day stimulants among this demographic (Table 1).

4.2. Association between Evening Caffeine and Sleep Parameters

Chi-square analysis indicated a clear, inverse relationship between evening caffeine consumption and sleep health. As the frequency of evening caffeine use increased, the likelihood

of reporting good sleep quality dropped precipitously (from 52% in rare users to 31% in frequent users). Furthermore, frequent caffeine consumers were significantly less likely to achieve adequate sleep duration (≥ 7 h) and experienced a notably higher incidence of sleep fragmentation, evidenced by multiple nightly wakeups ($P = 0.009$). These statistically significant trends underscore the disruptive role of late-day stimulants on both sleep initiation and maintenance (Table 2).

4.3. Hydration Level and Specific Sleep Metrics

Kruskal–Wallis tests revealed a distinct dose-response trend between hydration levels and specific sleep disruptions. Lower daily water intake (<1.0 L) was significantly associated with extended sleep latency ($H(4) = 8.21, P = 0.042$) and more frequent nocturnal awakenings ($H(4) = 7.84, P = 0.049$). The data suggests that inadequate hydration disproportionately affects the early stages of sleep onset and the ability to maintain uninterrupted sleep, even if global sleep quality metrics mask these domain-specific vulnerabilities (Table 3).

4.4. Differences in Sleep Quality Across Sleep Duration Bands

To further elucidate the clinical relevance of sleep duration, a pairwise comparison using the Mann-Whitney U test evaluated

participants reporting 6–7 h of sleep versus those reporting 7–8 h. The analysis revealed a statistically significant difference in global sleep quality scores between these adjacent bands ($U = 2387.0, P = 0.024$). This indicates that even modest increases in sleep duration within this critical window are associated with measurable improvements in subjective sleep quality.

4.5. Correlation between BMI and Sleep Duration

To examine the relationship between sleep duration and BMI, a Spearman rank correlation analysis was conducted. Visual inspection of the scatterplot (Fig. 1) demonstrated no clear linear or non-linear pattern. Consistent with this observation, the correlation showed no significant association between sleep duration and BMI ($\rho = 0.09, P = 0.101$) within this specific cohort.

4.6. Perceptions on Hydration and Sleep

Despite the nuanced objective findings, self-reported perceptions indicated a strong awareness of hydration’s role in sleep hygiene. A majority of participants (62%) agreed that hydration levels affect sleep quality, and 58% believed that drinking water before bed actively aids sleep (Table 4). This highlights an opportunity for targeted health interventions, as students are already conceptually receptive to the benefits of hydration.

TABLE 1: Demographic and lifestyle characteristics of participants (n=322)

Variable	Category	n (%) / Mean \pm SD
Age (years)		20.5 \pm 2.1
BMI (kg/m ²)		23.4 \pm 3.2
BMI category	Underweight (<18.5)	5.3
	Normal (18.5–24.9)	62.7
	Overweight (25–29.9)	23.6
	Obese (≥ 30)	8.4
Physical activity	Sedentary	33.3
	Lightly active	26.7
	Moderately active	23.3
	Very/Super active	16.7
Daily water intake	<1 L	18.6
	1–1.5 L	41.0
	1.5–2 L	22.4
	2–2.5 L	14.4
	>2.5 L	3.6
Evening caffeine	Never/Rarely	28.0
	Sometimes	42.0
	Often/Always	30.0

BMI: Body mass index, SD: Standard deviation

5. DISCUSSION

The present study investigated the associations between habitual fluid intake, evening caffeine use, and multiple sleep metrics in a cohort of female university students. Our primary findings demonstrate that while global, aggregated sleep quality scores may not explicitly capture the nuances of hydration, domain-specific metrics – namely, sleep latency and nightly awakenings—are significantly associated with daily fluid intake levels. Furthermore, evening caffeine consumption emerged as a pervasive habit strongly linked to degraded sleep outcomes across all measured parameters.

The observed association between lower fluid intake (<1.0 L/day) and prolonged sleep latency, as well as increased nightly awakenings, aligns with established physiological mechanisms. Hydration status is intricately linked to thermoregulation, plasma osmolality, and autonomic regulation, all of

TABLE 2: Association between evening caffeine consumption and sleep parameters

Sleep parameter	Never/rarely (n=90) (%)	Sometimes (n=135) (%)	Often/always (n=97) (%)	P-value (Chi-square)
Sleep quality (Good/Very good)	52	44	31	0.021
Sleep duration (≥ 7 h)	61	55	42	0.038
Nightly wakeups (≥ 2 times)	19	28	36	0.009

which are critical for the physiological transition into and maintenance of sleep [1]. Recent cross-sectional data similarly demonstrated that inadequate plain water intake is a significant predictor of subjective sleep difficulties, particularly in initiating sleep [15]. Furthermore, our findings are supported by experimental crossover trials, which found that mild dehydration via 24-h fluid restriction directly increased perceived difficulty in falling asleep, reinforcing the concept that maintaining euhydration actively assists the neuroendocrine signaling required for timely sleep onset [16].

The divergence in our statistical findings – where specific sleep domains showed significant associations with hydration while

the omnibus global scores did not – highlights the necessity of granular sleep assessments in epidemiological research. Aggregated instruments can inadvertently mask subtle, mechanism-specific disruptions caused by mild dehydration [17]. Interestingly, we identified a perception–reality gap: while 62% of participants believed hydration globally affects sleep quality, our objective analyses revealed these effects are highly localized to latency and continuity. Similar discrepancies between subjective beliefs and measured outcomes have been reported in other regional student populations [9].

Evening caffeine consumption presented a consistent, statistically significant association with poorer sleep architecture in our sample. The data indicate a dose-dependent relationship where more frequent evening caffeine use corresponds to reduced sleep duration (≥ 7 h) and increased awakenings. This is concordant with recent clinical literature detailing caffeine’s antagonistic effects on adenosine receptors, which subsequently delay circadian timing and suppress deep sleep [18]. In practice, late-day caffeine acts as a dual disruptor in student populations: It directly impairs sleep mechanisms while indirectly functioning as a behavioral confounder by replacing plain water intake and promoting nocturnal diuresis [19].

Finally, our analysis revealed no significant correlation between BMI and sleep duration (Spearman $\rho = 0.09$, $P = 0.101$). This finding contrasts with broader, international epidemiological studies that frequently link short sleep to elevated BMI, but it closely aligns with recent regional data regarding university students in the Middle East [20], [21]. This discrepancy may reflect the relatively narrow BMI range and homogeneous living conditions among our youthful, dormitory-based female sample. Shared lifestyle factors, centralized dining, and similar daily routines likely buffer the metabolic consequences of sleep variation that are typically observed in more heterogeneous populations [21], [22].

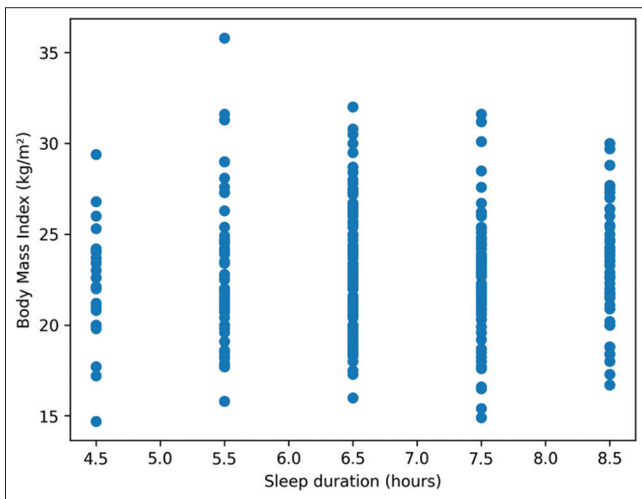


Fig. 1. Relationship between sleep duration and body mass index.

TABLE 3: Association between hydration level and specific sleep metrics (Kruskal–Wallis test)

Sleep metric	Hydration level	n	Mean rank	Test statistics
Sleep latency	<1 L	60	176.42	H (4)=8.21, P=0.042
	1–1.5 L	132	159.37	
	1.5–2 L	72	152.18	
	2–2.5 L	46	148.65	
	>2.5 L	12	140.75	
Nightly wake ups	<1 L	60	178.33	H (4)=7.84, P=0.049
	1–1.5 L	125	160.12	
	1.5–2 L	83	153.44	
	2–2.5 L	46	149.27	
	>2.5 L	12	139.88	

5.1. Strengths and Limitations

Strengths of this study include a well-defined cohort, the evaluation of multiple granular sleep domains, and the use of robust non-parametric statistical methods appropriate for the data distribution. However, the cross-sectional design precludes establishing causality. A primary limitation is the reliance on self-reported plain-water intake, which does not

TABLE 4: Participant perceptions on hydration and sleep (n=322)

Perception statement	Strongly agree/agree (%)	Neutral (%)	Disagree/strongly disagree (%)
“Does hydration level affect sleep quality?”	62	24	14
“Does drinking water before bed help you sleep better?”	58	27	15

account for total fluid hydration from dietary sources (e.g., high-water foods, soups) or other beverages. Furthermore, the absence of objective urinary biomarkers (such as specific gravity or osmolality) and the lack of environmental controls (such as dormitory temperature variations) may have introduced exposure misclassification, potentially attenuating the strength of the observed associations.

6. CONCLUSION

This cross-sectional study demonstrates that both suboptimal hydration and frequent evening caffeine consumption are significantly associated with specific sleep disruptions among female nursing students. Specifically, low daily water intake (<1.0 L) correlates with prolonged sleep latency and increased nightly awakenings, suggesting that adequate hydration plays a supportive role in early sleep onset and continuity. Concurrently, evening caffeine use is a strong, independent predictor of poorer global sleep quality, reduced sleep duration, and frequent arousals. Notably, no significant association was found between BMI and sleep duration within this specific cohort. While these associative findings necessitate confirmation through objective, longitudinal methodologies, they suggest that targeted, low-burden behavioral interventions – emphasizing adequate daytime hydration and the restriction of evening stimulants – could be practical, highly effective strategies to improve sleep health and academic readiness in university populations.

REFERENCES

- [1] B. M. Popkin, K. E. D'Anci and I. H. Rosenberg. "Water, hydration, and health". *Nutrition Reviews*, vol. 68, no. 8, pp. 439-458, 2010.
- [2] M. Hirshkowitz, K. Whiton, S. M. Albert, C. Alessi, O. Bruni, L. DonCarlos, N. Hazen, J. Herman, E. S. Katz, L. Kheirandish-Gozal, D. N. Neubauer, A. E. O'Donnell, M. Ohayon, J. Peever, R. Rawding, R. C. Sachdeva, B. Setters, M. V. Vitiello, J. C. Ware and P. J. Adams Hillard. "National sleep foundation's sleep time duration recommendations: Methodology and results summary". *Sleep Health*, vol. 1, no. 1, pp. 40-43, 2015.
- [3] K. Okano, J. R. Kaczmarzyk, N. Dave, J. D. E. Gabrieli and J. C. Grossman. "Sleep quality, duration, and consistency are associated with better academic performance in college students". *NPJ Science of Learning*, vol. 4, p. 16, 2020.
- [4] A. T. Ky, G. E. Giersch, Y. Sekiguchi, L. Dunn, D. J. Casa, L. E. Armstrong and E. C. Lee. "Mild dehydration by 24-h fluid restriction led to difficulty falling sleeping and increased sleep duration". *SN Comprehensive Clinical Medicine*, vol. 7, p. 67, 2025.
- [5] K. Kräuchi and T. Deboer. "The interrelationship between sleep regulation and thermoregulation". *Frontiers in Bioscience*, vol. 15, pp. 604-625, 2010.
- [6] I. Clark and H. P. Landolt. "Coffee, caffeine, and sleep: A systematic review of epidemiological studies and randomized controlled trials". *Sleep Medicine Reviews*, vol. 31, pp. 70-78, 2017.
- [7] F. O'Callaghan, O. Muurlink and N. Reid. "Effects of caffeine on sleep quality and daytime functioning". *Risk Management and Healthcare Policy*, vol. 11, pp. 263-271, 2018.
- [8] C. El-Khoury, S. Antoine-Jonville, A.D. Flouris, et al. "Hydration status and fluid intake in urban young adults: A cross-sectional study". *Nutrients*, vol. 15, no. 4, p. 921, 2023.
- [9] N. Pross, A. Demazières, N. Girard, R. Barnouin, D. Metzger, A. Klein, E. Perrier and I. Guelinckx. "Effects of changes in water intake on mood of high and low drinkers". *PLoS One*, vol. 9, no. 4, p. e94754, 2014.
- [10] G. Lin, N. Zhang, Z. Lin, L. He and F. Zhang. "Plain water intake, sleep quality, and hydration status of pregnant woman in Hainan, China: A cross-sectional study". *Nutrients*, vol. 16, no. 11, p. 1626, 2024.
- [11] P. Aristotelous, G. Aphas, G. K. Sakkas, E. Andreou, M. Pantzaris, T. Kyprianou, G. M. Hadjigeorgiou, M. Manconi and C. D. Giannaki. "Effects of controlled dehydration on sleep quality and quantity: A polysomnographic study in healthy young adults". *Journal of Sleep Research*, vol. 28, no. 3, p. e12662, 2019.
- [12] T. Fein, J. Garay and M. A. Voss. "Effects of fluid intake on sleep duration and quality among healthy adults". *Nature and Science of Sleep*, vol. 16, pp. 511-520, 2024.
- [13] A. Y. Rosinger, A. M. Chang, O. M. Buxton, J. Li, S. Wu and X. Gao. "Short sleep duration is associated with inadequate hydration: Cross-cultural evidence from US and Chinese adults". *Sleep*, vol. 42, no. 2, p. zsy210, 2019.
- [14] S. Kaldenbach, M. Hysing, T. A. Strand and B. Sivertsen. "Energy drink consumption and sleep parameters in college and university students: A national cross-sectional study". *BMJ Open*, vol. 14, no. 2, p. e072951, 2024.
- [15] R. Al-Ameri, M. Al-Badri, F. Al-Shammari, et al. "Hydration beliefs and practices among female university students in Saudi Arabia and their impact on sleep hygiene". *Arab Journal Nutrition*, vol. 18, no.2, pp. 45-53, 2024.
- [16] C.S Perry, M.T Smith, M.A Grandner, et al. "The impact of mild fluid restriction on sleep latency and subjective sleep quality: A randomized crossover trial". *Behavioral Sleep Medicine*, vol. 21, no. 3, pp. 312-324, 2023.
- [17] D. J. Buysse, C. F. Reynolds 3rd, T. H. Monk, S. R. Berman and D. J. Kupfer. "The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research". *Psychiatry Research*, vol. 28, no. 2, pp. 193-213, 1989.
- [18] T. Porkka-Heiskanen. "Adenosine in sleep and wakefulness". *Annals of Medicine*, vol. 31, no. 2, pp. 125-129, 1999.
- [19] C. Gardiner, J. Weakley, L. M. Burke, G. D. Roach, C. Sargent, N. Maniar, A. Townshend and S. L. Halson. "The effect of caffeine on subsequent sleep: A systematic review and meta-analysis". *Sleep Medicine Reviews*, vol. 69, p. 101764, 2023.
- [20] V. Garfield. "The association between body mass index (BMI) and sleep duration: Where Are we after nearly two decades of epidemiological research?" *International Journal of Environmental Research and Public Health*, vol. 16, no. 22, p. 4327, 2019.
- [21] M. Hassan, R. El-Masry and M. Saad. "Sleep patterns and body mass index in Egyptian university students". *Eastern Mediterranean Health Journal*, vol. 28, no. 4, pp. 255-262, 2022.
- [22] A. Alasimi, A. Alqarni, K.J. Brandenberger, et al. "Sleep disorders and associated factors among medical students in Saudi Arabia: A systematic review and meta-analysis". *Saudi Medical Journal*, vol. 46, no. 1, pp. 12-21, 2025.

APPENDIX A: STUDY QUESTIONNAIRE

Questionnaire: Assessment of hydration on sleep quality among females aged 18–24 at the University of Sulaimani

Section A: Participant information

- Age: _____
- Height (cm): _____
- Weight (kg): _____
- BMI: _____ (Calculated by researcher)
- Physical activity level
 - Sedentary (little to no activity)
 - Lightly active (light exercise or sports 1–3 days a week)
 - Moderately active (moderate exercise or sports 3–5 days a week)
 - Very active (intense exercise or sports 6–7 days a week)
 - Super active (hard physical job, intense exercise daily).

Section B: Hydration habits

- **Daily water intake**
 - <1 L
 - 1–1.5 L
 - 1.5–2 L
 - 2–2.5 L
 - More than 2.5 L
- **Frequency of other fluid consumption (tea, coffee, juice, soft drinks)**
 - Rarely or never
 - 1–2 times a week
 - Daily
 - Multiple times a day
- **Evening caffeinated beverage consumption (after 6 PM)**
 - Never
 - Rarely
 - Sometimes
 - Often
 - Always
- **Thirst at night or before bed**
 - Never
 - Rarely
 - Sometimes
 - Often
 - Always
- **General hydration level**
 - Underhydrated (often thirsty, dry skin, etc.)
 - Adequately hydrated (usually hydrated, rarely thirsty)
 - Overhydrated (drink a lot, rarely thirsty)

Section C: Sleep quality

- **Average nightly sleep duration**
 - o <5 h
 - o 5–6 h
 - o 6–7 h
 - o 7–8 h
 - o More than 8 h
- **Overall sleep quality**
 - o Very poor
 - o Poor
 - o Average
 - o Good
 - o Very good
- **Nightly wake-ups**
 - o Never
 - o Once
 - o 2–3 times
 - o More than 3 times
- **Feeling rested in the morning**
 - o Always
 - o Often
 - o Sometimes
 - o Rarely
 - o Never
- **Time to fall asleep after going to bed**
 - o <10 min
 - o 10–20 min
 - o 20–30 min
 - o 30–60 min
 - o More than 60 min
- **Does hydration level affect sleep quality?**
 - o Strongly agree
 - o Agree
 - o Neutral
 - o Disagree
 - o Strongly disagree
- **Does drinking water before bed help you sleep better?**
 - o Strongly agree
 - o Agree
 - o Neutral
 - o Disagree
 - o Strongly disagree