

Factors associated with the use of over-the-counter sleep aids containing diphenhydramine (Panadol Night) among University Students in Lebanon: A cross- sectional study

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Abstract

Background

Over-the-counter sleep aids containing diphenhydramine are widely accessible, yet their use among university students may raise concerns regarding self-medication and adverse effects. Evidence regarding Panadol Night use among university students in Lebanon remains limited. This study aimed to determine its prevalence and patterns of use and identify factors associated with its use, particularly sleep-related factors.

Methods

A cross-sectional study was conducted among 402 university students in Lebanon using an anonymous, self-administered online questionnaire. Data were collected on sociodemographic characteristics, Panadol Night use and perceptions, adverse effects, recommendation sources, insomnia, sleep quality, and perceived health. Sleep quality was assessed using the Pittsburgh Sleep Quality Index. Descriptive statistics, independent-samples t-tests, chi-square and exact tests, and multivariable binary logistic regression were used to examine factors associated with past-month Panadol Night use.

Results

Overall, 18.7% of participants reported lifetime Panadol Night use, 8.0% reported past-month use, and 4.7% reported current use. Approximately two-thirds of participants (66.2%) were classified as poor sleepers. Past-month users had significantly poorer sleep quality than non-users. In the primary multivariable model, participants aged 22–30 years had higher odds of past-month use than those aged 18–21 years (adjusted odds ratio [aOR] 2.64, 95% CI 1.19–5.87), while greater perceived safety was also associated with use (aOR 2.02, 95% CI 1.11–3.70). Sleep quality showed a significant non-linear association with past-month use. In secondary analyses, physician-diagnosed insomnia (aOR 4.62, 95% CI 1.81–11.82) and increasing pain-related sleep disturbance (aOR 1.67, 95% CI 1.13–2.45) were independently associated with use. Among lifetime users, past-month use was also associated with reported side effects, self-decision, and social-media recommendation.

Conclusions

Panadol Night use was associated with poorer sleep, insomnia, pain-related sleep disturbance, older age, and greater perceived safety among Lebanese university students. Self-directed use and reported adverse effects among recent users further highlight the need for education on appropriate over-the-counter sleep-aid use and better recognition and management of underlying sleep problems.

Background

Over-the-counter (OTC) medications are widely accessible and are often perceived as safe because they can be obtained without a prescription. However, their misuse has become an important public health concern, particularly among adolescents and young adults. OTC products may be used in non-medical, habitual, or potentially harmful ways, and university students may be particularly vulnerable because of sleep disturbances, psychosocial factors, and the accessibility of these medications [1–4]. In this population, self-medication may be used as a strategy to manage sleep difficulties and may coexist with other behaviors such as alcohol or stimulant use [3, 4]. Among OTC sleep aids, products containing diphenhydramine deserve particular attention. Diphenhydramine is a first-generation antihistamine commonly included in sleep-aid preparations because of its sedating effects. Its widespread availability as an OTC medication raises concerns regarding inappropriate or non-medical use [1, 2].

Sleep disturbance is particularly relevant when considering medication use among university students. A systematic review examining insomnia medication use in university populations found considerable variation in prevalence across studies and identified several factors associated with sleep-medication use, including poor sleep, female sex, smoking, stimulant-beverage consumption, and lower physical activity [4]. In Lebanon, university students also experience a substantial burden of sleep-related problems, which may negatively affect academic performance and daily functioning [5]. Furthermore, Lebanese university students have been shown to engage in non-medical use of psychoactive medications, including sleeping medications, demonstrating that inappropriate medication use is already relevant within this population [6]. These findings provide an important basis for examining the use and misuse of easily accessible OTC sleep aids among Lebanese university students.

Systematic reviews of OTC medication misuse have identified antihistamines as an important class involved in misuse, including recreational and non-indicated use [2]. Moreover, evidence indicates that prolonged or unsupervised diphenhydramine use is concerning because tolerance may develop rapidly, while anticholinergic adverse effects, next-day sedation, and other safety concerns limit its suitability for long-term management of sleep difficulties [7].

Evidence from toxicological studies further demonstrates that diphenhydramine misuse can lead to clinically significant consequences. Data from the United States have shown increasing rates of diphenhydramine overdose, abuse, and misuse, including intentional exposures among adolescents [8]. Serious outcomes associated with intentional exposure can include seizures, coma, cardiac complications, and death [8, 9]. These findings are important because they demonstrate that a medication commonly perceived as benign can carry substantial risks when used outside its recommended indication or dose.

Regional evidence also highlights the importance of investigating diphenhydramine-containing sleep aids among university students. In Saudi Arabia, diphenhydramine-containing OTC sleep products have been widely used among adults [10]. Among Jazan University students, 56.3% reported having used a diphenhydramine-containing medication to help them sleep, while 9.4% reported using it for more than

10 consecutive nights [1]. Male sex and enrollment in medical colleges were significantly associated with use, whereas age, income, marital status, and employment were not [1]. More recent Saudi university data also showed that OTC sleep-aid use remains common and identified Panadol Night among the commonly used sleep products [11]. More broadly, systematic evidence indicates that self-medication misuse is widespread across the Middle East, although existing regional research has focused mainly on medications other than OTC sleep aids [12].

Despite this evidence, an important gap remains regarding diphenhydramine-containing OTC sleep aids in Lebanon. Existing Lebanese research provides evidence of sleep disturbance and non-medical medication use among university students [5, 6]. However, to our knowledge, evidence specifically addressing Panadol Night, which according to the Lebanese Ministry of Public Health National Drugs Database contains 500 mg of paracetamol and 25 mg of diphenhydramine hydrochloride per caplet, remains limited [13]. Regional findings, particularly from Saudi Arabia, suggest that these products may be commonly used among young adults and university students [1, 10, 11]; however, differences in medication accessibility, cultural practices, educational background, and health-seeking behaviors highlight the need for Lebanon-specific evidence. Understanding the prevalence, patterns, and factors associated with Panadol Night use may therefore help identify students at greater risk of inappropriate use and support targeted education and safer OTC medication practices [1, 2, 12].

The aim of this study is to determine the prevalence and patterns of Panadol Night use among university students in Lebanon, investigate the factors associated with its use, and evaluate its relationship with sleep-related problems, including insomnia, poor sleep quality, and difficulty sleeping due to pain.

Methods

Participants and study design

This study employed a cross-sectional design using an online, self-administered questionnaire to assess factors associated with the over-the-counter (OTC) use of Panadol Night among university students in Lebanon. The target population included university students aged 18–30 years who were enrolled in Lebanese universities during the Summer of 2026. An English-language questionnaire was distributed using a convenience sampling approach through university networks and social media platforms, including all eligible respondents during the data collection period.

A total of 402 participants aged 18–30 years were included in the study, of whom 66.4% were female and 33.6% were male. All participants were informed about the study objectives, voluntary participation, anonymity, and confidentiality before completing the questionnaire. Electronic informed consent was obtained prior to participation. Participants who were younger than 18 years of age, were not enrolled in a Lebanese university, were residing outside Lebanon during the study period, or submitted duplicate or incomplete questionnaires were excluded from the study.

Ethical considerations

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, including respect for participants, confidentiality, voluntary participation, and the right to withdraw at any time without consequence [14]. Ethical approval was obtained from the Research Ethics Committee of the Higher Center for Research at the Holy Spirit University of Kaslik (USEK) prior to data collection (Approval Number: HRPP/202610/FT/0185). Participation was anonymous, and no identifying information was collected throughout the study.

Survey structure

The questionnaire was designed following a review of previous studies evaluating the use of over-the-counter sleep aids [1, 10, 15] and incorporated standardized validated instruments to assess sleep quality, perceived physical health, and perceived mental health [16–18]. It consisted of several sections evaluating participants' sociodemographic characteristics, knowledge regarding over-the-counter sleep aids, Panadol Night use, self-reported adverse effects, history of insomnia, subjective sleep quality, perceived physical health, and perceived mental health.

The first section collected participants' demographic characteristics, including age group, sex, living arrangement, household size, number of rooms in the household, and employment status. These variables were collected to characterize the study population and to allow comparisons across participant groups.

The second section assessed participants' knowledge and perceptions regarding over-the-counter sleep aids. Questions evaluated awareness of commonly available over-the-counter sleep aids marketed in Lebanon, including herbal preparations and melatonin-containing products. Participants were also asked to identify the approved indications of Panadol Night and to indicate their perception regarding its safety using a five-point Likert scale ranging from strongly agree to strongly disagree.

The third section evaluated patterns of Panadol Night use. Participants were asked about lifetime use, use during the previous month, and current use of the medication. Those reporting previous use were subsequently asked about the source of recommendation, including physicians, pharmacists, family members, friends, or other sources, as well as whether they believed Panadol Night could be used to treat chronic insomnia. Panadol Night is an over-the-counter medication containing 500 mg of paracetamol and 25 mg of diphenhydramine hydrochloride per caplet and is registered by the Lebanese Ministry of Public Health [13].

Participants reporting previous Panadol Night use were further asked whether they had experienced adverse effects following its use. The questionnaire evaluated the occurrence of insomnia, fatigue, headache, drowsiness, increased heart rate, abdominal problems, and daytime drowsiness. Participants were also asked about the actions they took after experiencing adverse effects, including discontinuing

Panadol Night, switching to another sleep aid, consulting a physician or pharmacist, consulting family members or friends, or taking no action [19, 20].

Sleep-related variables were assessed using a question evaluating previous physician diagnosis of insomnia followed by the Pittsburgh Sleep Quality Index (PSQI), a validated 19-item questionnaire assessing sleep quality during the previous month [16]. The PSQI evaluates seven domains of sleep, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Participants with a global PSQI score greater than 5 were classified as poor sleepers, whereas those with a score of 5 or less were classified as good sleepers according to the original scoring system [16].

Perceived physical health was assessed using the global health question from the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) [17]. Perceived mental health was evaluated using the global mental health question derived from the Patient-Reported Outcomes Measurement Information System [18].

The questionnaire incorporated previously validated instruments, including the Pittsburgh Sleep Quality Index (PSQI) [16], the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) [17], and the Patient-Reported Outcomes Measurement Information System (PROMIS) [18], in their original English versions.

Data collection and storage

The survey was administered electronically using an anonymous online questionnaire distributed through social media platforms and university networks. All participants provided electronic informed consent prior to completing the questionnaire, and participation was entirely voluntary. No personally identifiable information was collected, and all responses remained anonymous and confidential throughout the study. Access to the collected data was restricted to the research team, and all study files were stored in password-protected electronic files.

Data analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 27. Sociodemographic characteristics, knowledge regarding over-the-counter sleep aids, patterns of Panadol Night use, adverse effects, sleep quality, perceived general health, and perceived mental health were summarized using descriptive statistics, including frequencies, percentages, means and standard deviations, or medians and interquartile ranges, as appropriate.

The primary outcome variable was Panadol Night use during the previous month. Descriptive analyses were performed to determine the prevalence of lifetime use, use during the previous month, current use, sources of recommendation, perceived indications, and self-reported adverse effects associated with Panadol Night use.

The global Pittsburgh Sleep Quality Index (PSQI) score was calculated according to the original scoring guidelines, and participants were classified as poor sleepers ($PSQI > 5$) or good sleepers ($PSQI \leq 5$). In addition, a modified PSQI score excluding the sleeping-medication component (PSQI_NoMed) was calculated to minimize conceptual overlap between sleep quality and Panadol Night use. Sleep quality scores were compared between past-month users and non-users using independent-samples *t*-tests.

Associations between Panadol Night use during the previous month and participants' sociodemographic characteristics, knowledge regarding over-the-counter sleep aids, perceived indications and safety of Panadol Night, physician-diagnosed insomnia, pain-related sleep disturbance, sleep quality, perceived general health, and perceived mental health were assessed using Pearson's chi-square test or Fisher's exact test, as appropriate. For categorical variables with more than two levels and sparse expected cell counts, the Fisher–Freeman–Halton exact test was used. Crude odds ratios with corresponding 95% confidence intervals were calculated where appropriate.

A multivariable binary logistic regression model was constructed to identify factors independently associated with Panadol Night use during the previous month. The primary model included age, gender, perceived safety of Panadol Night, and the PSQI score excluding the sleeping-medication component. Age was dichotomized into 18–21 years and 22–30 years because of the small number of participants in the oldest age category. Adjusted odds ratios with corresponding 95% confidence intervals were reported. Multicollinearity among independent variables was assessed using variance inflation factors and tolerance statistics. Linearity in the logit was assessed for continuous predictors using the Box–Tidwell procedure. Because the relationship between PSQI_NoMed and the log odds of past-month Panadol Night use was non-linear, a quadratic PSQI term was included in the final model.

Secondary multivariable logistic regression models were conducted to examine the independent associations of physician-diagnosed insomnia and pain-related sleep disturbance with past-month Panadol Night use after adjustment for age, gender, and perceived safety. Among participants who had ever used Panadol Night, associations between past-month use, reported adverse effects, and sources of recommendation were assessed using Fisher's exact test. Model discrimination was evaluated using receiver operating characteristic curve analysis and the area under the curve. Regression diagnostics, including standardized residuals, Cook's distance, and leverage values, were examined to identify potentially influential observations.

All 402 participants had complete data for the variables included in the primary regression analysis; therefore, no cases were excluded because of missing data. Statistical significance was set at $p < 0.05$.

Results

A total of 402 university students were included in the study. Most participants were aged 18–21 years (74.4%). Females represented 66.4% of the sample, while males accounted for 33.6%. Overall, 75 participants (18.7%) reported ever using Panadol Night to help them sleep, 32 (8.0%) reported use during the past month, and 19 (4.7%) reported current use. A previous diagnosis of insomnia was reported by

35 participants (8.7%). Regarding perceived safety, 40.3% of participants agreed or strongly agreed that occasional Panadol Night use was safe, whereas 55.0% were neutral.

Overall, participants had a mean Global PSQI score of 7.32 (SD = 3.56), and 266 (66.2%) were classified as poor sleepers. The mean PSQI score excluding the sleeping-medication component was 7.07 (SD = 3.34). Past-month Panadol Night users reported significantly poorer sleep quality than non-users. Their mean PSQI score excluding medication was 10.09 (SD = 2.80), compared with 6.81 (SD = 3.26) among non-users, $t(400) = 5.53, p < .001$, mean difference = 3.29, 95% CI [2.12, 4.45]. This association remained evident after excluding the medication component of the PSQI, reducing potential overlap between sleep-medication use and the sleep-quality measure.

Table 1
Bivariate Associations Between Selected Factors and Past-Month Panadol Night Use

Factor	Category	Past-month users, n/N (%)	p
Age group	18–21 years	18/299 (6.0)	.017
	22–25 years	11/91 (12.1)	
	26–30 years	3/12 (25.0)	
Diagnosed insomnia	No	24/367 (6.5)	.003
	Yes	8/35 (22.9)	
Perceived safety	Disagree	0/19 (0.0)	.010
	Neutral	11/221 (5.0)	
	Agree	21/162 (13.0)	
Awareness of Panadol Night	No	4/136 (2.9)	.006
	Yes	28/266 (10.5)	
Perceived use for sleep problems	No	6/168 (3.6)	.008
	Yes	26/234 (11.1)	
Perceived use for headache	No	7/222 (3.2)	< .001
	Yes	25/180 (13.9)	
Pain-related sleep disturbance	None	9/251 (3.6)	< .001
	< Once/week	15/83 (18.1)	
	1–2 times/week	6/56 (10.7)	
	≥ 3 times/week	2/12 (16.7)	
General health	Poor	3/10 (30.0)	< .001
	Fair	18/104 (17.3)	
	Good	7/177 (4.0)	
	Very good	4/82 (4.9)	
	Excellent	0/29 (0.0)	
Mental health	Poor	4/30 (13.3)	< .001

Note. n/N = number of participants reporting past-month Panadol Night use divided by the total number of participants in that category. Percentages represent the proportion reporting past-month Panadol Night use within each category. Fisher's exact or Fisher–Freeman–Halton exact tests were emphasized where appropriate because of sparse expected cell counts.

Factor	Category	Past-month users, <i>n/N</i> (%)	<i>p</i>
	Fair	21/134 (15.7)	
	Good	7/159 (4.4)	
	Very good	0/58 (0.0)	
	Excellent	0/21 (0.0)	
PSQI classification	Good sleeper	1/136 (0.7)	< .001
	Poor sleeper	31/266 (11.7)	
<i>Note.</i> <i>n/N</i> = number of participants reporting past-month Panadol Night use divided by the total number of participants in that category. Percentages represent the proportion reporting past-month Panadol Night use within each category. Fisher's exact or Fisher–Freeman–Halton exact tests were emphasized where appropriate because of sparse expected cell counts.			

In bivariate analyses (Table 1), past-month Panadol Night use was significantly associated with age group (exact $p = .017$), diagnosed insomnia (Fisher's exact $p = .003$), perceived safety of Panadol Night (exact $p = .010$), awareness of Panadol Night (Fisher's exact $p = .006$), perceiving Panadol Night as useful for sleep problems (Fisher's exact $p = .008$) and headache (Fisher's exact $p < .001$), pain-related sleep disturbance (exact $p < .001$), self-rated general health (exact $p < .001$), self-rated mental health (exact $p < .001$), and PSQI sleep classification (Fisher's exact $p < .001$). Past-month use was generally more frequent among older participants, those with diagnosed insomnia, those perceiving Panadol Night as safer, those reporting pain-related sleep disturbance, and those with poorer general or mental health. Poor sleepers were also substantially more likely to report past-month use than good sleepers (11.7% vs. 0.7%).

Table 2

Multivariable logistic regression analysis of factors associated with past-month Panadol Night use

Predictor	B (SE)	Adjusted OR (95% CI)	p
Age 22–30 years vs 18–21 years	0.972 (0.407)	2.64 (1.19–5.87)	.017
Male vs female	−0.456 (0.470)	0.63 (0.25–1.59)	.333
Perceived safety	0.705 (0.308)	2.02 (1.11–3.70)	.022
PSQI excluding medication	1.103 (0.383)	—	.004
PSQI excluding medication ²	−0.042 (0.018)	—	.023

Note. OR = odds ratio; CI = confidence interval; PSQI = Pittsburgh Sleep Quality Index. The dependent variable was past-month Panadol Night use. Age 18–21 years and female gender were the reference categories. Perceived safety was entered on the original five-point scale, with higher scores representing greater perceived safety. Because the model contained both linear and quadratic PSQI terms, their individual ORs should not be interpreted as simple per-point effects. The 95% CIs shown for age, gender and perceived safety were calculated from the reported regression coefficients and standard errors. The overall model was significant, $\chi^2(5) = 44.34$, $p < .001$, Nagelkerke $R^2 = .245$; Hosmer–Lemeshow $\chi^2(8) = 2.50$, $p = .962$.

In the multivariable logistic regression model (Table 2), age, perceived safety of Panadol Night and sleep quality were independently associated with past-month use. Participants aged 22–30 years had approximately 2.6-fold higher odds of past-month use than those aged 18–21 years (aOR = 2.64, 95% CI 1.19–5.87; $p = .017$). Each one-point increase in perceived safety was associated with approximately twofold higher odds of past-month use (aOR = 2.02, 95% CI 1.11–3.70; $p = .022$). Sleep quality showed a significant non-linear association with past-month use, as indicated by significant linear ($p = .004$) and quadratic ($p = .023$) PSQI terms. The negative quadratic coefficient indicated that the increase in odds associated with poorer sleep quality attenuated at higher PSQI scores. Gender was not independently associated with past-month use ($p = .333$). The model was significant overall ($\chi^2(5) = 44.34$, $p < .001$) and showed adequate fit (Hosmer–Lemeshow $p = .962$).

Table 3
Secondary multivariable logistic regression models for past-month Panadol Night use

Predictor	Diagnosed insomnia model, aOR (95% CI)	<i>p</i>	Pain-related sleep disturbance model, aOR (95% CI)	<i>p</i>
Age 22–30 vs 18–21 years	2.72 (1.26–5.89)	.011	2.76 (1.28–5.96)	.010
Male vs female	0.49 (0.20–1.20)	.120	0.58 (0.24–1.42)	.231
Perceived safety	2.27 (1.29–4.00)	.005	1.98 (1.13–3.46)	.017
Diagnosed insomnia	4.62 (1.81–11.82)	.001	—	—
Pain-related sleep disturbance	—	—	1.67 (1.13–2.45)	.009

Note. aOR = adjusted odds ratio; CI = confidence interval. The outcome was past-month Panadol Night use. Reference categories were 18–21 years, female gender, and no diagnosed insomnia. Pain-related sleep disturbance was coded from 0 (not during the past month) to 3 (three or more times per week); its aOR therefore represents the change in odds for each one-category increase in frequency. The diagnosed-insomnia model was significant overall, $\chi^2(4) = 24.72$, $p < .001$, Nagelkerke $R^2 = .140$, Hosmer–Lemeshow $p = .987$. The pain-related sleep-disturbance model was also significant, $\chi^2(4) = 22.38$, $p < .001$, Nagelkerke $R^2 = .127$, Hosmer–Lemeshow $p = .094$.

In secondary adjusted analyses (Table 3), participants with a previous diagnosis of insomnia had more than fourfold higher odds of past-month Panadol Night use than those without an insomnia diagnosis (aOR = 4.62, 95% CI 1.81–11.82; $p = .001$). In a separate model, each one-category increase in the frequency of pain-related sleep disturbance was associated with higher odds of past-month use (aOR = 1.67, 95% CI 1.13–2.45; $p = .009$). Older age and greater perceived safety remained significantly associated with past-month use in both models, whereas gender remained non-significant.

Table 4

Associations of adverse effects and recommendation sources with past-month Panadol Night use among lifetime users (N = 75)

Factor	Category	Past-month users, n/N (%)	Fisher's exact p
Reported any side effect	No	11/45 (24.4)	< .001
	Yes	21/30 (70.0)	
Family/friend recommendation	No	16/35 (45.7)	.647
	Yes	16/40 (40.0)	
Self-decision	No	7/41 (17.1)	< .001
	Yes	25/34 (73.5)	
Pharmacist recommendation	No	22/51 (43.1)	1.000
	Yes	10/24 (41.7)	
Internet/website recommendation	No	26/66 (39.4)	.159
	Yes	6/9 (66.7)	
Social media recommendation	No	24/66 (36.4)	.004
	Yes	8/9 (88.9)	
Doctor recommendation	No	30/67 (44.8)	.454
	Yes	2/8 (25.0)	
Other recommendation	No	32/74 (43.2)	1.000
	Yes	0/1 (0.0)	
Note. n/N = number of participants reporting past-month Panadol Night use divided by the total number of lifetime users within that category. Percentages are calculated within each category. Fisher's exact tests were used because the comparisons involved binary variables and several categories had small cell counts.			

Among lifetime Panadol Night users (Table 4), past-month use was significantly associated with reported side effects, self-decision to use Panadol Night, and social media recommendation. Past-month use was reported by 70.0% of participants who had experienced side effects compared with 24.4% of those who had not (OR = 7.21, 95% CI 2.56–20.31; Fisher's exact $p < .001$). Similarly, 73.5% of participants who reported deciding to use Panadol Night on their own were past-month users compared with 17.1% of those who did not report self-decision (OR = 13.49, 95% CI 4.43–41.13; $p < .001$). Social media recommendation was also associated with past-month use (88.9% vs. 36.4%; OR = 14.00, 95% CI 1.65–118.8; $p = .004$), although this estimate should be interpreted cautiously because only nine

participants reported a social media recommendation. No significant associations were observed for recommendations from family or friends, pharmacists, internet/websites, doctors, or other sources.

Additionally, the final multivariable model showed good discrimination, with an area under the receiver operating characteristic curve of 0.824 (SE = 0.033, 95% CI 0.759–0.889; $p < .001$). Model diagnostics did not indicate problematic influence requiring case exclusion; all valid observations were retained in the final analysis.

Discussion

Misuse of over-the-counter medications, particularly sedating antihistamines such as diphenhydramine, remains a medication-safety concern; U.S. poison-center data documented a 63% increase in intentional diphenhydramine exposures between 2005 and 2016 [8]. Our study showed that Panadol Night, an OTC medication containing 500 mg of paracetamol and 25 mg of diphenhydramine hydrochloride per caplet [13] was mainly associated with sleep-related problems and perceptions of medication safety. Overall, 18.7% had ever used Panadol Night for sleep, 8.0% had used it during the past month, and 4.7% were current users. In Egypt, 157 of 1,640 medical students (9.6%) explicitly reported sleep-aid use; among these students, 77.1% reported melatonin, 29.3% herbal products, 12.1% eszopiclone, 8.9% quetiapine, and 5.7% regimens containing diphenhydramine [21].

Internationally, 4% of Portuguese higher-education students reported OTC sleep-aid or supplement use, increasing to 12% among those with insomnia [22]. Similarly, 5.7% of U.S. adults used OTC medications or supplements for sleep most days or every day, while 28.7% of Canadian adults reported using natural products or OTC sleep aids during the previous year [23, 24]. In a 2024 Saudi university study, 56.3% reported previous use of diphenhydramine-containing sleep aids, 17.4% reported past-30-day use, 14.0% were current users, and 9.4% reported use for more than 10 consecutive nights [1]. In 2023, lower estimates were reported in a Saudi adult sample, with 42.3% reporting lifetime Panadol Night use, 12.1% past-month use, and 11.7% current use [10]. In Lebanon, a 2012 study among university students reported a 5.8% lifetime prevalence of nonmedical use of prescription sleeping medications, providing additional evidence of self-directed medication use for sleep in this population [6].

Participants who reported using Panadol Night during the previous month in our study had significantly poorer sleep quality, with a modified PSQI mean of 10.09 compared with 6.81 among non-users ($p < 0.001$), even after excluding the sleeping-medication component. Moreover, 11.7% of poor sleepers reported past-month use compared with only 0.7% of good sleepers. A similar relationship was observed among Indian medical students: 6.3% reported sleeping-pill use overall, but use occurred in approximately 16.5% of students with insomnia compared with 1.8% of those without insomnia, with a significant association between insomnia and sleeping-pill use [25].

The multivariable analyses further supported the importance of sleep-related factors. Sleep quality remained associated with past-month use after adjustment for age, gender, and perceived safety, with the significant quadratic term indicating that the increase in odds became less pronounced at the

highest PSQI scores. Previous insomnia diagnosis was associated with more than fourfold higher adjusted odds of recent use (aOR = 4.62, 95% CI 1.81–11.82), while pain-related sleep disturbance was also associated with use (aOR = 1.67, 95% CI 1.13–2.45). These findings indicate that Panadol Night use is closely associated with the presence and severity of sleep-related difficulties.

Age and perceived safety were also independently associated with past-month use. Students aged 22–30 years had 2.64 times the adjusted odds of use compared with those aged 18–21 years, while gender was not significantly associated. Greater perceived safety was associated with approximately twice the adjusted odds of use (aOR = 2.02). Age-related differences have also been reported in the United States, where regular OTC sleep-aid or supplement use increased from 3.9% among adults aged 18–34 years to 7.6% among those aged ≥ 65 years [23]. Regarding safety perceptions, 14.9% of Saudi adults who considered Panadol Night safe reported past-month use compared with 9.5% of those who did not, with perceived safety remaining significant after adjustment (aOR = 1.65) [10].

Poorer self-rated general and mental health were also associated with recent use at the bivariate level. Past-month use reached 30.0% among students reporting poor general health and 17.3% among those reporting fair health, compared with 4.0% among those reporting good health. Similarly, use was 15.7% among students reporting fair mental health and 13.3% among those reporting poor mental health, compared with 4.4% among those reporting good mental health. In Norway, 56% of university students reported using OTC analgesics or sleep aids, while 64% reported sleep problems, 35% depression, and 28% anxiety [26]. These findings suggest that OTC medication use may occur alongside broader physical and psychological difficulties.

Among lifetime Panadol Night users, 40.0% reported at least one side effect; fatigue and drowsiness were each reported by 70.0% of those experiencing side effects, followed by increased heart rate (60.0%) and headache (56.7%). Past-month use was also more frequent among those reporting side effects than those who did not (70.0% vs. 24.4%). Internationally, misuse has also been documented with other non-prescription sedating H1-antihistamines: in France, 37.1% of past-month sedating H1-antihistamine users met criteria for misuse, and 72.2% of doxylamine users reported daily use despite its intended short-term use [27].

Regarding sources of recommendation, 53.3% reported family or friends as a recommendation source, 45.3% self-decision, 32.0% pharmacists, 12.0% social media, and only 10.7% physicians. However, past-month use was substantially higher among those reporting self-decision (73.5% vs. 17.1%) and social-media recommendation (88.9% vs. 36.4%). Self-medication was similarly prominent among Indian medical students, where 96% of sleeping-pill users reported self-medication [25]. Among Norwegian university students using OTC medications, 47.3% relied on their own knowledge, 32.4% sought information from pharmacy employees, and 24.3% used the internet; however, overall social-media use was not significantly associated with OTC medication consumption [26].

Our findings indicate that Panadol Night use among Lebanese university students is primarily associated with sleep-related difficulties, perceived medication safety, and self-directed use. The findings support

greater education regarding appropriate OTC sleep-aid use and improved recognition and management of persistent sleep problems.

Strengths

The strength of this study lies in its novelty. To our knowledge, it is the first study to investigate diphenhydramine-containing sleep-aid use among university students in Lebanon. This allowed the prevalence, patterns of use, and associated factors to be characterized within this population.

Limitations

The cross-sectional design limits the ability to establish causal or temporal relationships between Panadol Night use and the associated factors identified. In addition, the use of convenience sampling means that the findings may not be generalizable to all university students in Lebanon. Also, because the data were collected using a self-administered questionnaire, responses may have been affected by recall bias, particularly for previous Panadol Night use and reported side effects.

Conclusions

Our study provides the first evidence on diphenhydramine-containing sleep-aid use among university students in Lebanon. Panadol Night use was reported by 18.7% of students during their lifetime, 8.0% during the previous month, and 4.7% as current use. Use during the previous month was associated with poorer sleep quality, older age, and greater perceived safety, while insomnia and pain-related sleep disturbance were also associated with use. Self-directed use and reported side effects among participants who used Panadol Night during the previous month further emphasize concerns surrounding its use. These findings highlight the need to increase awareness regarding the appropriate use and potential risks of OTC diphenhydramine-containing sleep aids and to improve recognition and management of underlying sleep problems among university students.

Abbreviations

aOR: Adjusted odds ratio

AUC: Area under the curve

CI: Confidence interval

H1: Histamine H1 receptor

IQR: Interquartile range

MOPH: Ministry of Public Health

OR: Odds ratio

OTC: Over-the-counter

PROMIS: Patient-Reported Outcomes Measurement Information System

PSQI: Pittsburgh Sleep Quality Index

ROC: Receiver operating characteristic

SD: Standard deviation

SE: Standard error

SF-36: Medical Outcomes Study 36-Item Short Form Health Survey

SPSS: Statistical Package for the Social Sciences

Declarations

Ethics approval and consent to participate

The study was performed in accordance with the Declaration of Helsinki, and was reviewed and approved by the Research Ethics Committee of the Higher Center for Research at the Holy Spirit University of Kaslik - USEK, under HRPP/202610/FT/0185.

Informed consent to participate was obtained from all of the participants in the study, and they were informed before participating about their role in the study, as well as the measures ensuring their anonymity and confidentiality throughout data collection, analysis, and publication.

Consent for publication

N/A

Availability of data and materials

The data used and analyzed in the current study are available upon request. Contact the corresponding author Michel Gergi: michel.e.gergi@net.usek.edu.lb

Competing Interests

Not applicable.

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Authors' contributions

MG, SA, and JMH contributed to the conception and design of the study, methodology, data analysis and interpretation, and drafting and revision of the manuscript. CMDBT and GM contributed to questionnaire development, data collection, data analysis, and critical review and revision of the manuscript. All authors read and approved the final manuscript and agreed to be accountable for their respective contributions and for the integrity of the work.

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