Research article

Associations of smartphone addiction, chronotype, sleep quality, and risk of eating disorders among university students: A cross-sectional study from Sharjah/United Arab Emirates

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ARTICLE INFO

ABSTRACT

Objectives: As smartphone addiction (SA) becomes more prevalent among young adults, there is growing concern over its impact on dietary and lifestyle habits, such as disturbed sleep and eating patterns. However, limited literature exists particularly on the association between SA and eating disorders (ED). Thus, this study aims to study the prevalence of SA risk, poor sleeping quality, evening chronotype, and ED risk among university students in the UAE. It also aims to assess the associations between them, emphasizing the one between ED and SA risks.
Methods: In this cross-sectional study, a self-administered online questionnaire was disseminated via convenience sampling. Pittsburgh Sleep Quality Index, Morningness-Eveningness Questionnaire, Eating Attitude Test-26 items, and Smartphone Addiction Scale-Short Version were used to measure sleep quality, chronotype, ED risk, and SA risk, respectively. Descriptive and analytical statistics were applied, and $P < 0.05$ was considered for statistical significance.
Results: Out of 552 students (mean age: 21.2 ± 5.1 years), 71% had poor sleep quality, 33.9% reported evening chronotype, 37.9% had ED risk, and 56.2% had SA risk. SA risk was significantly associated with both poor sleep quality (OR = 2.93; 95% CI: 2.01–4.29; $p < 0.001$) and evening chronotype ($p = 0.005$). ED risk was significantly associated with poor sleep quality ($p < 0.001$). Poor sleep quality predicted ED risk best.
Conclusion: High prevalence of SA, ED risk, and poor sleep quality was reported among university students in the UAE. Associations between poor sleep quality, evening chronotype, SA risk, and ED risk were further confirmed, with sleep quality predicting ED risk.

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1. Introduction

As smartphones have become integral in facilitating daily life [1], with more than 90% of the United Arab Emirates (UAE) population were reported as smartphone users [2]. Nonetheless, smartphone overuse can turn compulsive [3] and be labeled with smartphone addiction (SA) [4,5,6]. With the increased SA prevalence [7], there is also a growing concern over its impact on quality of life [9,8,10], and its possible associations with other prevalent distorted dietary and lifestyle behaviors, such as poor sleeping [11], disturbed eating patterns [12,13], and an evening preference [14].

College students tend to have poor sleep patterns due to their hectic university schedules; however, it could be also associated with increased smartphone usage with its sleep-impairing effects [11]. The endogenous circadian clock, i.e. chronotype, is also impacted by different technology devices' usage (such as mobile phones and computer screens) [14,15]. Three forms of chronotype differ in behavioral, biological, and psychological variables: 1) morningness - waking up early in the morning and being exhausted in the early evening hours; 2) eveningness - sleeping late at night and waking up late the next day; and 3) intermediate - 'neither type'. The evening chronotype has been associated with extensive smartphone usage [14,16].

Poor sleep quality and evening chronotype were also associated with eating disorders (ED) [17–19]. ED represents abnormal eating habits, which include anorexia nervosa, bulimia, and binge eating [20]. ED's prevalence is 10.5% among medical students according to a global meta-analysis [21]. ED-diagnosed individuals scored higher on insomnia and sleep disturbances scales [17,18], and were more likely to categorize as evening chronotypes, compared to controls [19].

ED and SA share similar associated factors, including poor sleep quality, evening chronotype, impulsivity [22], comfort-seeking related to emotional dysregulation, and disturbed self-body image by social media's influence [13]. Moreover, SA was one of the mediating factors between poor sleep quality and disturbed eating habits association among Chinese students [23]. Thus, we hypothesize a possible relationship between the risks of SA and ED. With SA and ED prevalence rising in the Middle East, further evidence is needed to explore the association between these two distortions, as limited studies have shown an existing association [12]. Moreover, cultural and socioeconomic variables may influence the study outcomes differently, as reported in other countries [24–28]. Additionally, ED diagnoses were more prevalent in young adult women in their 20's to 30s and young adult men in their 30s than in other age groups globally [29]. Similarly, the 20–34 year age group scored the highest on the problematic smartphone usage scale in a multiple-sample analysis [30]. Young adults had a prevalent sleeping type of 'delayed sleeping' according to latent class analysis in a UK cohort study [31]; additionally, they experienced the poorest sleep quality during COVID-19 [32]. Since university students are typical of these ages, ED prevalence and associated factors should be assessed in this age group. Vast evidence exists on the direct relationships between SA and sleep quality [11,14,15], and sleep quality and ED [17–19], with few studies highlighting substantial rates of poor sleep quality [33–36], ED risk [37], and problematic smartphone usage among young adults [38]. Nonetheless, little is known about the associations between these particular variables in the multi-ethnic environment of the UAE. Moreover, very few studies explored the relationship between SA and ED. Thus, we aimed to investigate the prevalence of SA, poor sleep quality, evening chronotype, and ED among university students in the UAE; and assess the associations between them, with an emphasis on the relationship between SA and ED risks.

2. Materials and methods

2.1. Study design, sampling, and data collection

A cross-sectional survey was conducted between March 9–25, 2021, on university students from the University of Sharjah, a national university in the UAE with an ethnically diverse student population. The required sample size of participants was calculated, based on the assumption that the prevalence of ED is about 50% of the UAE population (since a specific figure was unavailable), and considering a 20% dropout rate. The sample size (n) is calculated according to the formula: $N = Z^2 * [P * (1 - P)]/E^2$, where ($Z = 1.96$) is the z-score associated with a level of confidence, P is the proportion of subjects with the outcome of interest, and ($E = 0.05$) is the Margin of Error. Therefore, $N = (1.96)^2 * 0.5 * (1–0.5)/(0.05)^2$, which results in N = 384. Considering a 20% dropout rate, $N+(0.2*N) = 384 + 77 = 461$. As a result, the sample size was 461. Moreover, this sample size is close to the sample sizes of previous studies on SA [38], sleep quality [34], and insomnia [36] in UAE university students. However, 552 subjects agreed to participate and completed the surveys. A self-administered online questionnaire was distributed via email and social media platforms. Inclusion criteria embraced all Arabic and English-speaking university students, registered during the spring semester of the 2020–2021 academic year. The Research Ethics Committee at the University of Sharjah, Sharjah, UAE (REC-21-02-24-01-S), approved the study and it was performed according to the Declaration of Helsinki's principles.

2.2. Questionnaire design

Pittsburgh Sleep Quality Index (PSQI), Morningness-Eveningness Questionnaire (MEQ), Eating Attitude Test - 26 Items (EAT-26), Smartphone Addiction Scale – Short Version (SAS-SV), were used as assessment tools, alongside a sociodemographic questionnaire. These questionnaires were compiled into one questionnaire using Google Forms, and consisted of 6 sections: first, research description, objectives, and informed consent request; second to fifth included PSQI, MEQ, EAT-26, and SAS-SV, respectively; and finally, the sixth section included sociodemographic characteristics: age, sex, marital status, nationality, college of study, education level, current Cumulative Grade Point Average (CGPA), money amount spent monthly, current living situation, smoking status, and self-reported height and weight. From the self-reported heights and weights, body mass index (BMI, kg/m^2) was calculated, which categorizes as

underweight (BMI: <18.5), normal (BMI: 18.5–24.9), overweight (BMI: 25–29.9), or obese (BMI: ≥30). The final questionnaire was available in both English and Arabic languages. Along with the original English versions, Arabic-validated versions of PSQI [39], MEQ [40], EAT-26 [41], and SAS-SV [42] were used. Upon reading the study protocol and providing their informed consent, participants were able to proceed with the study questionnaire.

PSQI is a validated 19-items questionnaire that assesses sleep quality over the past month and evaluates the following factors: subjective sleep quality, latency, duration, efficiency, disturbances, use of sleep medication, and daytime dysfunction [39,43]. Its questions are based on a 4-point Likert score and are grouped into seven component scores, scoring from 0 to 3. The final sum of components' scores can range from 0 to 21, with a score >5 indicating poor sleep quality, and≤5 indicating good sleep quality. MEQ is also a validated 19-items questionnaire, which measures chronotype or circadian peak time [44]. The score ranges from 16 to 86, indicating the following chronotypes: (≤30) definite evening, (31–41) moderate evening, (42–58) intermediate, (59–69) moderate morning, and (≥70) definite morning. The five classes were later categorized into three: evening chronotype (definite and moderate evening), intermediate, and morning chronotype (moderate and definite morning). EAT-26, a reduced version of EAT-40, measures

Table 1
Sociodemographic characteristics of participants (n = 552).

Variables		n (%)
Sex		
	Female	439 (79.5)
	Male	113 (20.5)
Age (years)		21.2 ± 5.1[a]
Marital Status		
	Single	513 (92.9%)
	Married	33 (6%)
	Divorced or Widowed	6 (1.1%)
Nationality		
	UAE nationals and GCC countries	272 (49.3%)
	Arab non-GCC	69 (12.5%)
	Non-Arab	211 (38.2%)
College Major		
	Health and Medical Colleges	205 (37.1%)
	Other Colleges	347 (62.9%)
Academic Level		
	Freshmen year, Year 1, and Year 2	309 (56.0%)
	Year 3 and higher	243 (44.0%)
CGPA		
	≤3 (Satisfactory-Good)	190 (34.4%)
	>3 (Very good – Excellent)	362 (65.6%)
Amount spent monthly (Arab Emirates Dirham-AED)		
	<5000	467 (84.6%)
	≥5000	85 (15.4%)
Current Living Condition		
	Living with Family	522 (94.6%)
	Not Living with Family	30 (5.4%)
Smoking Status		
	Non-smokers	520 (94.2%)
	Smokers	32 (5.8%)
Religious Affiliation		
	Muslims	542 (98.2%)
	Other religions or no-religion affiliation	10 (1.8%)
Body Mass Index (kg/m^2)		
	Underweight (<1.85)	59 (10.7%)
	Normal (18.5–24.9)	276 (50.0%)
	Overweight (25–29.9)	130 (23.6%)
	Obese (≥30)	81 (14.7%)
Sleep Quality (Global PSQI)		
	Poor sleep quality (>5)	392 (71.0%)
	Good sleep quality (≤5)	160 (29.0%)
Chronotype		
	Morningness	52 (9.4%)
	Intermediate	313 (56.7%)
	Eveningness	187 (33.9%)
Eating attitude		
	Disordered	209 (37.9%)
	Normal	343 (62.1%)
Smartphone addiction		
	Risk	310 (56.2%)
	No Risk	242 (43.8%)

[a] Mean ± standard deviation; GCC: Gulf Cooperation Council countries; CGPA: Cumulative Grade Point Average; BMI: Body Mass Index.

disturbed eating attitudes and symptoms [41,45] by evaluating dieting, bulimia and food preoccupation risks, and oral control of an individual. The total score ranges from 0 to 78, where a score >20 indicates the presence of disturbed eating patterns. SAS-SV, a shortened version of the Smartphone Addiction Scale, can evaluate SA risk [42,46]. It considers six components: daily life disturbances, positive anticipation, withdrawal, cyberspace-oriented relationship, tolerance, and overuse. The answers are based on the Likert scale of 1–6, with (1) strongly disagree and (6) strongly agree, and the total score ranges from 10 to 60. A total score of ≥ 31 for males and ≥ 33 for females indicates high SA risk.

2.3. Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences software, version 25.0 (SPSS, Chicago, IL, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were expressed as mean $\pm$ standard deviation (SD). The normality of the data was tested by the Shapiro-Wilk test and all data were normally tested. The Chi-square test was used to explore the association between categorical variables. An independent *t*-test and One-Way Analysis of Variance (ANOVA) test were applied for the comparison of the mean scores of sleep quality, chronotype, ED risk, and SA risk according to different sociodemographic characteristics. A linear regression test was applied to examine the association of the ED risk score with the scores of poor sleep quality, evening chronotype, and SA risk. The statistical significance level was set at $p < 0.05$. The three independent variables (sleep quality, ED risk, and SA risk scores) were included in the regression analysis (Table 5) because our study aimed to explore their associations with ED.

3. Results

Table 1 presents the participants' sociodemographic characteristics. A total of 552 participants have completed the study, with the majority being females (79.5%), single (92.9%), Muslim (98.2%), and having a mean age of 21.2 $\pm$ 5.1 years. Half (49.3%) of the participants were either UAE nationals or from the Gulf Cooperation Council (GCC) countries, 38.2% were non-Arabs, and 12.5% were Arabs from non-GCC countries. One-third of students were from colleges of health sciences and medicine (37.1%) and two-thirds were from other colleges (62.9%). Academically, 56% were junior students (freshmen to year 2) and 44% were seniors, and 65.6% of students had a CGPA >3 (very good-excellent). Most participants reported <5000 Arab Emirates Dirham (AED) as monthly income (84.6%), identified as non-smokers (94.2%), and lived with their families (94.6%). Half of the participants (50%) had a BMI within the normal range, 23.6% were overweight, 10.7% were underweight, and 14.7% were obese. Most participants (71%) reported poor sleep quality, and 33.9% had an evening chronotype. Around two-fourth of participants (37.9%) had a risk of ED and 56.2% presented a risk of SA.

Table 2 illustrates the association between SA risk, chronotype, sleep quality, and ED risk. SA risk and chronotype ($p = 0.002$) have been significantly associated. Although the majority belonged to the intermediate chronotype (53.2% and 61.2% respectively) regardless of SA risk's presence, 39.7% of those with SA risk had an evening chronotype, compared to 26.4% of those without SA risk. A significant association ($p < 0.001$) was also found between SA risk and sleep quality, where 89.4% with SA risk had higher reported poor sleep quality compared to those without SA risk (70.4%). There was no significant association between SA and ED risk.

Associations between ED risk, chronotype, and sleep quality, are shown in Table 3. The ED risk was independent of the chronotype category. However, there was a significant association between ED risk and sleep quality ($p = 0.016$), as those with ED risk had higher reports of poor sleep quality (86.1%) than good sleep quality (13.9%) compared to those without ED risk (77.8% and 22.2%, respectively).

Table 4 presents the sleep quality scores, chronotypes, ED risk, and SA risk according to different sociodemographic characteristics. Females scored significantly higher on global sleep quality (PSQI) (7.94 $\pm$ 3.59), indicating poorer sleep quality compared to males (6.436.43 $\pm$ 3.16 and 32.16 $\pm$ 12.46, respectively). Although both were within the intermediate category, married participants scored significantly higher on morningness compared to single participants (49.83 $\pm$ 9.08 vs. 45.97, p = 0.01). Additionally, married students had significantly lower SA risk (30.91 $\pm$ 10.31 vs, 35.31 $\pm$ 12.18, p = 0.03). UAE and GCC national (20.95 $\pm$ 16.28) students had significantly (p = 0.01) higher EAT scores (17.01 $\pm$ 14.47 and 16.95 $\pm$ 14.41, respectively). Students in health sciences scored significantly higher on the sleep quality scale, indicating poorer sleep (8.17 $\pm$ 3.48; p = 0.006) compared to other majors (7.31 $\pm$ 3.57).

Sleep quality, chronotype, and SA scores did not differ significantly by academic level, yet juniors scored significantly higher on the EAT scale (20.33 $\pm$ 16.83 vs. 17.14 $\pm$ 13.38; p = 0.02), indicating serious ED risk. Similarly, students with lower CGPA had

Table 2
Associations between smartphone addiction risk (dependent variable), chronotype, sleep quality, and eating disorders risk using the Chi-square test.

Variable		Smartphone addiction risk n = 310, n (%)	No smartphone addiction risk n = 242, n (%)	*P*-value
Chronotype	Morningness	22 (7.1)	30 (12.4)	0.002
	Intermediate	165 (53.2)	148 (61.2)	
	Eveningness	123 (39.7)	64 (26.4)	
Sleep quality	Poor	277 (89.4)	170 (70.3)	<0.001
	Good	33 (10.6)	72 (29.7)	
Risk of eating disorders	Yes	114 (36.8)	95 (39.3)	0.55
	No	196 (63.2)	147 (60.7)	

Table 3

Associations between eating disorder risk (as dependent variable), eveningness chronotype, and sleep quality using the Chi-square test.

Variables		Disordered eating attitudes n = 209 n (%)	Normal eating attitudes n = 343 n (%)	P value
Chronotype	Morningness	20 (9.6)	32 (9.3)	0.816
	Intermediate	115 (55.0)	198 (57.7)	
	Eveningness	74 (35.4)	113 (32.9)	
Sleep Quality	Poor	180 (86.1)	267 (77.8)	0.016
	Good	29 (13.9)	76 (22.2)	

significantly higher EAT scores (20.73 ± 16.59 vs. 17.98 ± 14.78; $p = 0.048$). Likewise, students spending ≥5000 AED monthly showed significantly higher EAT scores (22.65 ± 17.63 vs. 18.25 ± 14.97; $p = 0.012$). Regarding smoking status, smokers had higher sleep quality scores and lower MEQ scores, indicating poorer sleep quality and leaning more towards eveningness (9.53 ± 3.56 and 43.03 ± 8.31, respectively). Muslim participants showed significantly higher SA risk than non-Muslims (35.17 ± 12.05 vs. 27.00 ± 13.37, $p = 0.03$). EAT scores differed significantly ($p = 0.02$) with participant's BMI, with the highest risk being in the obese category (23.19 ± 12.58), followed by overweight (19.12 ± 15.28) and underweight (18.92 ± 17.54) categories, and the lowest within normal BMI category (17.34 ± 15.05).

Overall, all the stratified groups had poor sleep quality (scores: >5) and were of an intermediate chronotype (scores: 42–58). Meanwhile, students who are GCC nationals, have a CGPA ≤3, spend ≥5000 AED, are juniors, and/or are of obese BMI all presented serious ED risk (scores: >20) significantly compared to their counterparts. Similarly, single and/or Muslim students presented serious SA risk (scores: ≥32 (i.e.: average between male and female cut-offs)). Both sexes also crossed the SA risk cut-off although they are significantly different.

Table 5 illustrates linear regression analysis using EAT-26 score as the dependent variable. Model (1) shows that EAT score was positively associated with sleep quality score (B = 0.87; 95% CI: 0.49–1.26; $p < 0.001$) and negatively associated with SAS score (B = −0.13; 95%CI: 0.24 to −0.02; $p = 0.018$). After adjustment for age and sex (model 2), the sleep quality and SAS scores remained to have the same significant relationships with the EAT-26 score. Meanwhile, age and sex did not have a significant relationship with the EAT-26 score. The sleep quality score presents to be the best predictor for the EAT score.

4. Discussion

The current study identified a high prevalence of poor sleep quality, and SA and ED risk among university students in the UAE and is thought to be the first of its type conducted in the UAE and GCC.

The demographics stratification against the different parameters showed that all stratified groups had poor sleep quality; however, students who are female, a study in health sciences or medical-related colleges, or smoke had significantly poorer sleep quality. Similarly, all groups fit into the intermediate chronotype, but singles and smokers scored more toward an evening chronotype. Meanwhile, significant-high ED risk was reported particularly among UAE and GCC nationals, junior students, those with lower CGPA, and obese students. Meanwhile, females, singles, and Muslims faced higher SA risk.

SA's prevalence among our university students aligns with similar studies' rates on university students in Lebanon (49%) [47] and KSA (82.5%) [4]. Smartphones' multi-functionality, ease of use, portability, and social media applications could be attributed as potential drivers for their compulsive habitual use [48]. Additionally, students may use their smartphones as means of escapism to cope with academic/psychosocial stress [49].

SA risk was the highest in singles, followed by married, and divorced or widowed students, with singles crossing the cut-off. Likewise in a study conducted on Nigerian students, being single increased the prevalence of SA by an odds of 5.809 in comparison with those married [50]. Marriage may impose additional responsibilities compared to a single life that allows more time for leisure like navigating the internet.

Poor sleep quality and high prevalence correspond with a previous study done on college students in KSA [24]. It can be also attributed to experienced psychological distress, depression [51], and excessive caffeine usage by university students [35,52,53]; factors that were not assessed in our study. Similarly, the higher prevalence of poor sleep quality in females aligns with the afore-mentioned study [24] and can be related to women's higher reports of anxiety disorders and stress [54,55].

Although our participants' predominant chronotype was overall intermediate, a higher percentage of evening compared to morning chronotypes was reported (33.9% vs. 9.4%, respectively). Our participants' evening chronotype prevalence is higher compared to similar studies conducted on college students in Brazil (27%) and the USA (20.8%) [25,26]. Eveningness among college students could be similarly explained by their crowded schedule, need for distraction-free environments, and prevalent caffeinated beverage consumption which may shift their circadian rhythm towards eveningness [35,53].

The result of poorer sleep quality relating to higher SA aligns with the literature [11,56], as a study on university students in KSA reported similar results [24]. Likewise, chronotype and SA risk were significantly associated, which is evident by a higher representation of evening chronotype in those with SA risk compared to those with no SA risk. These associations can be possibly explained by melatonin level disruption by smartphones' blue light, which leads to impairment of sleep quality [57], and/or shifting chronotype towards eveningness i.e. inducing later bedtimes [14,15,58]. Conversely, eveningness has been associated with high impulsivity and hypothetically may increase addiction proneness [14,59].

Table 4

Comparison of the mean scores of sleep quality, chronotype, eating disorder risk, and smartphone addiction risk according to different socio-demographic characteristics.

	Global Sleep Quality (PSQI)	*P* value	MEQ Score	*P* value	EAT-26 Score	*P* value	SAS-SV Score	*P* value
Sex								
Female (n = 439)	7.94 ± 3.59	**<0.001**	46.10 ± 9.26	0.51	19.16 ± 15.62	0.49	35.76 ± 11.92	**0.005**
Male (n = 113)	6.43 ± 3.16		46.75 ± 9.81		18.04 ± 14.71		32.16 ± 12.46	
Marital Status								
Single (n = 515)	7.69 ± 3.52	0.10	45.97 ± 9.34	**0.01**	18.89 ± 15.57	0.85	35.31 ± 12.18	**0.03**
Married (n = 37)	6.70 ± 3.74		49.83 ± 9.08		19.37 ± 14.09		30.91 ± 10.31	
Nationality[a]								
UAE nationals and GCC (n = 272)	7.66 ± 3.81	0.97	47.01 ± 9.30	0.06	20.95 ± 16.28	**0.01**	35.48 ± 12.35	0.51
Non-Arab (n = 69)	7.65 ± 3.08		46.91 ± 9.27		17.01 ± 14.47		33.62 ± 12.91	
Arab non-GCC (n = 211)	7.58 ± 3.37		45.01 ± 9.41		16.95 ± 14.41		34.89 ± 11.53	
College Major								
Health sciences-related majors (n = 205)	8.17 ± 3.48	**0.006**	45.38 ± 9.25	0.09	18.25 ± 15.81	0.43	34.68 ± 11.15	0.61
Others (n = 347)	7.31 ± 3.57		46.74 ± 9.42		19.33 ± 15.27		35.22 ± 12.65	
Academic Level								
Junior students (n = 309)	7.72 ± 3.71	0.49	46.21 ± 9.66	0.95	20.33 ± 16.83	**0.02**	34.71 ± 12.17	0.49
Senior students (n = 243)	7.51 ± 3.36		46.25 ± 9.01		17.14 ± 13.38		35.41 ± 12.04	
CGPA								
CGPA ≤3 (n = 190)	7.67 ± 3.61	0.81	46.14 ± 9.78	0.87	20.73 ± 16.59	**0.048**	34.09 ± 11.82	0.19
CGPA >3 (n = 362)	7.60 ± 3.53		46.28 ± 9.16		17.98 ± 14.78		35.51 ± 12.24	
Money Spent Monthly								
<5000 AED (n = 467)	7.57 ± 7.95	0.36	46.25 ± 9.28	0.93	18.25 ± 14.97	**0.012**	34.70 ± 12.16	0.14
≥5000 AED (n = 85)	7.95 ± 3.76		46.15 ± 9.94		22.65 ± 17.63		36.82 ± 11.72	
Living with/without Family								
With family (n = 522)	7.60 ± 3.58	0.52	46.30 ± 9.26	0.49	18.65 ± 15.45	0.08	34.86 ± 12.09	0.19
Without family (n = 30)	8.03 ± 3.23		45.10 ± 11.26		23.73 ± 15.40		37.80 ± 12.40	
Smoking Status								
Smoking (n = 32)	9.53 ± 3.56	**0.002**	43.03 ± 8.31	**0.05**	22.09 ± 16.08	0.23	35.44 ± 11.09	0.84
Non-smoking (n = 520)	7.51 ± 3.50		46.43 ± 9.41		18.73 ± 14.43		35.00 ± 12.18	
Religion								
Muslim (n = 542)	7.63 ± 3.56	0.87	46.22 ± 9.37	0.79	19.03 ± 15.50	0.26	35.17 ± 12.05	**0.03**
Non-Muslim (n = 10)	7.80 ± 3.82		47.00 ± 9.72		13.50 ± 14.60		27.00 ± 13.37	
BMI (kg/m²)†								
Underweight (n = 59)	7.50 ± 3.23	0.60	47.08 ± 9.95	0.77	18.92 ± 17.54	**0.02**	35.34 ± 13.25	0.99
Normal (n = 276)	7.68 ± 3.79		46.31 ± 9.66		17.34 ± 15.05		35.06 ± 11.80	
Overweight (n = 130)	7.30 ± 3.47		45.77 ± 9.06		19.12 ± 15.28		34.82 ± 12.46	
Obese (n = 81)	7.96 ± 3.09		45.65 ± 9.49		23.19 ± 12.58		35.30 ± 12.05	

MEQ: Morningness-Eveningness Questionnaire, EAT-26: Eating Attitudes Test – 26 Items, SAS – SV: Smartphone Addiction Scale – Short Version, GCC: Gulf Cooperation Council countries, CGPA: Cumulative Grade Point Average; BMI: Body Mass Index; AED: Arab Emirates Dirham.

[a] One-Way Analysis of Variance (ANOVA) test was applied.

Table 5
Linear Regression Analysis Using EAT-26 Score as the dependent variable.

Variables	Model 1 (Unadjusted)				Model 2 (Adjusted for age and sex)			
	B	p-value	95% CI		B	p-value	95% CI	
			Lower	Upper			Lower	Upper
Sleep quality Score	0.87	<0.001	0.49	1.26	0.87	<0.001	0.48	1.26
Chronotype score	1.25	0.09	−0.02	0.27	0.11	0.14	−0.03	0.25
SAS Score	−0.13	0.018	−0.24	−0.02	−0.13	0.018	−0.24	−0.02
Age	–	–	–	–	0.25	0.057	−0.007	0.49
Sex	–	–	–	–	−0.83	0.61	−4.07	2.41

EAT-26 Eating Attitude Test – 26; SAS Score: Smartphone Addiction Scale score; CI: confidence interval.

Concerning ED risk, ED's prevalence was similar to those documented in other countries, such as 29.4% of female university students in Saudi Arabia [27] and 23% among medical students in Pakistan [28]. Perceived stress from hectic college schedules, and getting accustomed to independent living can account for the risk of developing ED among university students [60].

With GCC countries welcoming multiple ethnicities, this is the first study to our knowledge that stratified ED risk among GCC Arabs, Non-GCC Arabs, and non-Arabs. The mean EAT-26 scores of only GCC nationals presented serious ED risk, which could be due to the observed Western acculturation of Western beauty standards in GCC countries [61] that may have increased body-related shame [62]. Similarly, obese individuals are reported to have higher ED symptomology [63] due to perceived weight concerns.

Dysregulated circadian rhythms of appetite-regulating hormones can play an important role in ED behavior [64]. Conversely, nocturnal purging/binge-eating might impair sleep quality by affecting sleep onset time and/or blood electrolytes before sleep [17], shifting the circadian rhythm preference towards eveningness [19]. Nonetheless, ED risk was independent of the chronotype category similar to Kandeger et al.'s study [65]; however, this finding did not match that of Natale et al. study [19]. Unlike Natale et al., we have used EAT-26 test, which is only a screening tool and not a diagnostic tool for ED, thereby possibly altering our result's dissociation accuracy and causing this discrepancy. ED risk, however, was correlated with sleep quality, which was also reported in studies on adolescent and college students [66,67]. Poor sleep quality and sleep deprivation may induce a higher impulsivity rate, which plays a role in ED (such as night purging and/or binging) [22,68]. Moreover, age and sex had no significant associations with ED risk, which may imply that there is no particular trend between the two sexes and different age groups toward ED risk among university students in the UAE.

We hypothesized that increased SA was associated with higher ED risk, mediated by impaired sleep quality and evening chronotype. However, we did not find any link between SA and ED risks. In contrast, Fatma et al. (2020) found an association between the two and suggested that it was mediated by social media-driven body dissatisfaction [12]. Compared to the aforementioned study, we used different versions of EAT and SAS tests, on different ethnicities. Surprisingly, the correlation between EAT and SAS scores is significant, yet with a negative effect of SA risk on the risk of ED. This could be due to our usage of non-diagnostic but rather screening tools for ED risk (EAT-26) and SA (SAS-SV), and the presence of self-reporting bias that might have skewed the results. Further studies with proper diagnoses are needed to investigate the association between ED and SA.

The synchrony found among these four main outcomes in this study (evening chronotype, poor sleep quality, and SA and ED risks) implies that healthier lifestyle behaviors are clustering among one group of university students, while unhealthy behaviors are clustering among another group. Thus, we can infer that many lifestyle behaviors are interrelated, and maybe co-exist in one group of people with shared characteristics, and may result in combined, similar health effects on that particular group of people [69].

Raising awareness of the circadian typology and its potential impact on daytime functioning may motivate students to better plan their study schedules for optimal daytime performance [70]. Educational sessions on minimizing SA and improving sleep quality by practicing sound sleep hygiene, such as maintaining regular sleep and wake time [71], ensuring a quiet and comfortable environment [71], and reducing smartphone usage at bedtime [72] may also be beneficial. Other lifestyle changes such as having adequate exercise may also help with SA [73].

5. Strengths and limitations

This study tested various variables' effects and assessed potential correlations between themselves and between a wide array of demographic characteristics, providing a solid foundation for future research opportunities. Despite our study's large sample size, our findings cannot be generalized to all UAE students as participants were recruited majorly from one university in the UAE. Given the length of our distributed questionnaire, it was difficult to additionally assess the possible confounders of our findings, such as the perceived stress, nutritional intake, and physical activity. Our study's observational nature makes it difficult to establish causality or confirm some associations (of such SA and ED risks). Therefore, well-designed longitudinal studies are warranted to help attest to such associations. Additionally, response bias may have affected the accuracy of results, as it was a self-reported and memory-based questionnaire. This study was also conducted during the COVID-19 pandemic, which alone represents a stressor and might have exacerbated the measured risks and sleep patterns of the students. Lastly, we focused on university students in the UAE; further cross-country comparative studies, which account for other cultures and different age groups will provide more conclusive findings.

6. Conclusion

Poor sleep quality, ED risk, and SA risk were highly prevalent among university students in the UAE. Mean scores of GCC nationals, juniors, obese students, and students with low CGPA particularly presented high ED risk. ED risk was independent of the chronotype category, yet dependent on sleep quality. Meanwhile, SA risk was associated with both poor sleep quality and evening chronotype. Unlike our hypothesis, smartphone addiction and eating disorders risks were not significantly associated. Nonetheless, screening and awareness campaigns for this population are needed to lower their smartphone usage, improve their sleep quality, and reduce their risk of developing ED.

Author contribution statement

Hayder Hasan: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Katia Abu Shihab: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Zohreh Mohammad: Performed the experiments; Wrote the paper.

Hafsa Jahan: Performed the experiments; Wrote the paper.

Ayla Coussa: Analyzed and interpreted the data; Wrote the paper.

MoezAlIslam Ezzat Faris: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no competing interests.

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