Associations of Smartphone Addiction, Chronotype, Sleep Quality, and Risk Of Eating Disorders Among University Students: A Cross-Sectional Study

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Abstract

Purpose

With smartphone addiction's (SA) increasing prevalence among young adults, there is a growing concern about its adverse effects on distorted dietary and lifestyle behaviors, including disturbed sleeping and eating patterns. We aim to study the prevalence of SA risk, poor sleeping quality, evening chronotype, and eating disorders (ED) risk among university students in the UAE. We also aim 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 using the convenience sampling technique. 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. The risk of SA 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 ($p < 0.001$), but not with chronotype or SA risk. Poor sleep quality predicted best ED risk.

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, along with sleep quality predicting risks of ED.

Introduction

Nowadays, smartphones are an indispensable part of a person's life [1]; as they have become an integral part of facilitating daily life. In the United Arab Emirates (UAE), 92% of the population uses smartphones [2], yet excessive usage and dependency can turn problematic with compulsive overuse and be labeled as smartphone addiction (SA) [3–5]. With SA's increasing prevalence [6], there is also a growing concern about its adverse effects and possible associations with other prevalent distorted dietary and lifestyle behaviors, such as poor sleeping [7], disturbed eating patterns [8, 9], and an eveningness preference [10].

College students are known to have poor sleep patterns, which could be due to their hectic university schedules; however, it was recently suggested to be also associated with increased smartphone usage and its resulting sleep-impairing effects [7]. In addition, the endogenous circadian clock, also known as chronotype, is impacted by the different technology devices' usage (such as mobile phones and computer screens) [10, 11]. Three forms of

chronotype differ in behavioral, biological, and psychological variables: 1) morningness - those who wake up early in the morning and are exhausted in the early evening hours; 2) eveningness - those who sleep late at night and wake up late the next day; and 3) intermediate - 'neither type'. The evening chronotype has been associated with extensive smartphone usage [10, 12].

Poor sleep quality and evening chronotype may be also associated with eating disorders (ED) [13–15]. ED represents abnormal or disturbed eating habits, which include anorexia nervosa, bulimia, and binge eating [16]. The prevalence of ED among college students in the UAE is 24.6% [17], and 10.5% among medical students according to a global meta-analysis [18]. Several studies have shown that ED-diagnosed individuals score higher on insomnia and sleep disturbances scales [13, 14], and are more likely to categorize as evening chronotype, compared to controls [15].

Due to similar associated factors with ED and SA, including poor sleep quality, evening chronotype, impulsivity [19], comfort-seeking related to emotional dysregulation, and disturbed self-body image (secondary to social media influence) [9], a possible relationship between these two risks can hence be suspected [8], on which the literature remains limited. With a rising prevalence of SA and ED in the Middle East, further evidence is needed to explore the associations between these two distortions. Thus, we aimed to investigate the prevalence of SA, poor sleep quality, evening chronotype, and ED among university students in the UAE; and explore the associations between them, with an emphasis on addressing the relationship between SA and ED risks.

Materials And Methods

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 (UoS), a national university in the UAE with an ethnically diverse student population. A self-administered online questionnaire was sent by e-mail and/or promoted on social media platforms. Inclusion criteria embraced all Arabic and English speaking university students, who were registered during the academic year of 2020-2021 Spring semester. The Research Ethics Committee at the University of Sharjah, Sharjah, UAE (REC-21-02-24-01-S), approved the study and it was performed in line with the principles of the Declaration of Helsinki.

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 request for the informed consent; second to fifth for 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), amount of money spent monthly, current living situation, smoking status, and self-reported height and weight. From the self-reported heights and weights, the body mass index (BMI, kg/m²) was calculated, that 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.

The PSQI is a validated 19-items questionnaire to assess sleep quality over the past month, and evaluate the following factors: subjective sleep quality, latency, duration, efficiency, disturbances, use of sleep medication, and

daytime dysfunction [20, 21]. 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 a score ≤ 5 for good sleep quality. The MEQ is also a validated 19-items questionnaire, which measures chronotype or circadian peak time [22]. The score ranges from 16-86 and indicates 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). The EAT-26, a reduced version of EAT-40, measures disturbed eating attitudes and symptoms [23, 24] by evaluating dieting, bulimia and food preoccupation risks, and the 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, was used to evaluate SA risk. [25, 26]. It considers six components: daily life disturbances, positive anticipation, withdrawal, cyberspace-oriented relationship, tolerance, and overuse. The rating of answers is based on the Likert scale of 1 to 6, with (1) strongly disagree and (6) strongly agree, and the total score ranges from 10-60. A total score of ≥ 31 for males and ≥ 33 for females indicates high SA risk.

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 Chi-square test was used to explore the association between categorical variables. An independent *t*-test was used 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 $P < 0.05$.

Results

Table 1 presents the sociodemographic characteristics of the study participants. 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 ± 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 from other colleges (62.9%). Concerning the academic level, 56% were junior students (freshmen to year 2) and 44% were seniors, and 65.6% of students had a cumulative grade point average (CGPA) >3 (very good-excellent). The majority of participants reported a monthly income of $<5,000$ Arab Emirates Dirham (AED) (84.6%), identified as non-smokers (94.2%), and were living with their families (94.6%). Half of the participants (50%) had a body mass index (BMI) within the normal range, 23.6% were overweight, 10.7% were underweight, and 14.7% were obese. Regarding the sleeping quality and chronotype preference, 71% reported poor sleep quality, with 33.9% belonging to the evening chronotype. Close to two-fourth of participants (37.9%) had a risk of ED and 56.2% presented a risk of SA.

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 Sciences and Medical Related 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)	
<5,000	467 (84.6%)
≥ 5,000	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%)

Variables	n (%)
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 (<18.5)	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	

Table 2 illustrates the association between SA risk, chronotype, sleep quality, and ED risk. A significant association was seen between the risk of SA and the chronotype ($p=0.002$). Although the majority of those with SA risks and without belonged to intermediate chronotype (53.2% and 61.2% respectively), 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 the risk of SA and sleep quality, where 89.4% of those who had 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.

Table 2

Associations between smartphone addiction risk (dependent variable), with chronotype, sleep quality, and eating disorders risk using 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)	

Associations between ED risk, with 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 were more likely to report poor sleep quality (80.4%) compared to those without ED risk (65.3%).

Table 3

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

Variables		Disordered eating attitudes n=209 n(%)	Normal eating attitudes n=343 n(%)	P value
Chronotype	Morningness	20 (38.5)	32 (61.5)	0.816
	Intermediate	115 (36.7)	198 (63.3)	
	Eveningness	74 (39.6)	113 (60.4)	
Sleep Quality	Poor	180 (40.3)	267 (59.7)	0.016
	Good	29 (27.6)	76 (72.4)	

Comparison of the scores of sleep quality, chronotype, ED risk, and SA risk according to different sociodemographic characteristics are presented in Table 4. Females scored significantly higher on both global sleep quality (PSQI) (7.94 ± 3.59), indicating poorer sleep quality compared to males ($6.436.43\pm3.16$ and 32.16 ± 12.46 , respectively). Although both were within the intermediate category, married participants scored significantly higher towards the morningness compared to single participants (49.83 ± 9.08 vs. 45.97 , $p=0.01$); additionally, married students had significantly lower SA risk (30.91 ± 10.31 vs. 35.31 ± 12.18 , $p=0.03$). UAE and GCC national (20.95 ± 16.28) students had significantly ($p=0.01$) higher EAT scores compared to other Arab and non-Arab students (17.01 ± 14.47 and 16.95 ± 14.41 , respectively). Regarding the college major, students in health-sciences scored significantly higher on the sleep quality scale, indicating poorer sleep (8.17 ± 3.48 ; $p=0.006$)

compared to other majors (7.31 ± 3.57), however, no significant differences were found regarding chronotype, ED, and SA risks.

Sleep quality, chronotype, and SA scores did not differ significantly by academic level, yet juniors scored significantly higher on the EAT scale (20.33 ± 16.83 vs. 17.14 ± 13.38 ; $p=0.02$). Similarly, students with lower CGPA had significantly higher EAT scores (20.73 ± 16.59 vs. 17.98 ± 14.78 ; $p=0.048$). Likewise, students spending $\geq 5,000$ 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 , $p=0.03$). The 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). Sleep quality, chronotype, and SA risk scores were not significantly different among the BMI classifications.

Table 4

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

	Global Sleep Quality (PSQI)	<i>P</i> value	MEQ Score	<i>P</i> value	EAT-26 Score	<i>P</i> value	SAS-SV Score	<i>P</i> 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								
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

	Global Sleep Quality (PSQI)	<i>P</i> value	MEQ Score	<i>P</i> value	EAT-26 Score	<i>P</i> value	SAS-SV Score	<i>P</i> value
CGPA >3 (n=362)	7.60±3.53		46.28±9.16		17.98±14.78		35.51±12.24	
Money Spent Monthly								
<5,000 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
≥ 5,000 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/m ²)								
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								

Table 5 illustrates linear regression analysis using EAT-26 score as the dependent variable. The 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 – -0.02 ; $p = 0.018$), even after adjustment for age and sex. The sleep quality score seems to be the best predictor for the EAT score.

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

Variables	Unadjusted				Adjusted			
	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
SAS-SV: Smartphone Addiction Scale – Short Version; CI: confidence interval								

Discussion

The current study identified a high prevalence of poor sleep quality, and SA and ED risk among university students in the UAE.

According to our results, students who are female, in health sciences or medical-related colleges, or who smoke tend to have poorer sleep quality. Moreover, singles and smokers scored more as an eveningness chronotype. Meanwhile, higher ED risk was reported among UAE and GCC nationals, junior students, those with lower CGPA, and obese students. Furthermore, females, singles, and Muslims faced higher SA risk.

SA's prevalence among our university students aligns with the rates reported by similar studies on university students in Lebanon (49%) [27] and KSA (82.5%) [3]. Smartphones' multi-functionality, ease of use, portability, social media applications could be attributed as potential drivers for their compulsive habitual use [28]. Additionally, students may use their smartphones as means of escapism to cope with academic/psychosocial stress [29].

Some of our participants' sociodemographic characteristics were associated with SA risk. With regard to marital status, SA risk was the highest in singles, followed by married, and divorced or widowed students. A possible explanation can be that marriage and having a family impose additional responsibilities compared to the single life, which allows less time to do activities alone, like navigating the internet. A study conducted on Nigerian students presented similar findings, in which being single increased the prevalence of SA by an odds of 5.809 in comparison with those married [30].

This study's reported high poor sleep quality rate closely corresponds with a previous study done upon college students in KSA [31]. Similarly, the higher prevalence of poor sleep quality in females aligns with the aforementioned study [31] and can be related to women's higher reports of anxiety disorders and stress [32, 33]. Poor sleep quality can be also attributed to other factors, including psychological distress and depression in university students [34], and excessive caffeine usage [35–37] – factors that were not assessed in our study. Although our participants' predominant chronotype was 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%) [38, 39]. The trend of eveningness among college students could be similarly explained by their crowded schedules and needs to find distraction-free environments to complete their academic tasks. Additionally, the prevalent stimulant beverages (such as coffee and energy drinks) consumption can also prolong their circadian rhythm and shift it towards eveningness [36, 37].

This study's finding of poorer sleep quality relating to higher SA aligns with the literature [7, 40], and can be explained by the fact that excessive smartphone usage before sleep is possibly impairing the normal sleeping pattern and sleep quality [41]. Similar results were reported in a KSA study conducted on university students [31]. Likewise, we found an association between chronotype and SA risk, which is evident by a higher representation of the evening chronotype in those with SA risk compared to those with no SA risk. This can be explained by melatonin's level disruption by smartphone's blue light [11, 42], inducing later bedtimes or shifting chronotype towards eveningness [10]. Conversely, eveningness has been associated with high impulsivity and hypothetically may increase addiction proneness [10, 43].

Concerning ED risk, the majority of participants reported normal eating behaviors, and the rate of ED was similar to those documented in other countries, such as 29.4% in female university students in Saudi Arabia [44] and 23% among medical students in Pakistan [45]. Perceived stress by adjustments to a new environment, hectic college schedules, and getting accustomed to independent living for those living in dorms or without families can account for the risk of developing ED among university students [46]. Dysregulated circadian rhythm of appetite-regulating and food intake hormones can play an important role in ED behavior [47]. Conversely, nocturnal purging/ binge-eating might impair sleep quality by affecting sleep onset time and/or blood electrolytes before sleep [13], shifting the circadian rhythm preference towards eveningness [15]. Nonetheless, the risk of ED was found independent of the chronotype category similar to Kandeger et al.'s study [48]; however, this finding did not match that of Natale et al. study [15]. 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 was however correlated with sleep quality, which was also reported in studies on adolescent and college students [49, 50]. An additional explanation is that poor sleep quality and sleep deprivation induce a higher rate of impulsivity, which plays a role in ED (such as night purging and/or binging) [19, 51].

We speculated that increased SA was associated with higher ED risk, mediated by factors, like impaired sleep quality and evening chronotype. Contrary to our hypothesis, 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 [8]. Compared to the aforementioned study, we used different versions of EAT and SAS tests and different ethnicities were studied. Given our usage of non-diagnostic but rather screening tools of ED risk (EAT-26) and SA (SAS-SV), further well-designed 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 components of healthier lifestyle behaviors are clustering among one group of university students, while unhealthy behaviors are clustering among another group. This is part of the fact that many of the 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 [52].

An awareness program on the circadian typology and its potential impact on daytime functioning will help students in better planning their study schedules for optimal daytime performance [53]. Students could also benefit from tips on minimizing SA and improving sleep quality by practicing sound sleep hygiene, such as maintaining regular sleep and wake time [54], ensuring a quiet and comfortable environment [54], and reducing smartphone usage at bedtime [55].

Strengths and Limitations

This study tested the effects of various variables 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 only from one university in the UAE. Given the observational nature of our study, it was difficult to confirm some of the well-known associations between the different risks (of such SA and ED risks) and confer causality. Therefore, well-designed longitudinal studies are warranted to help attest to such associations. In addition, response bias may have affected the accuracy of results, as it was self-reported and memory-based questionnaire. It is also important to note that this study was conducted during the COVID-19 pandemic, which on its own represents a stressor and may have aggravated the measured risks and sleep patterns of students. Lastly, we focused on university students in the UAE; further cross-country comparative studies, which take into account other cultures and different age groups will provide more conclusive findings.

Conclusion

In conclusion, poor sleep quality, ED risk, and SA risk were highly prevalent among our university students. We found that ED risk was independent of the chronotype category, yet it was dependent on the sleep quality. SA risk was associated with both poor sleep quality and evening chronotype. Therefore, awareness campaigns may be needed to be geared to this population to improve their sleep quality and reduce their usage time of smartphones.

What is already known on this subject?

Literature shows that poor sleep quality, evening chronotype, and risk of developing ED and/or SA are prevalent among adolescents and young adults. Poor sleep quality and evening chronotype are shown to be bi-directionally associated with ED and SA through prior studies. Lastly, literature shows that sleep quality can predict the risk of ED.

What does this study add?

The study identified a high prevalence of poor sleep quality, SA risk, and ED risk among university students in the UAE. The study also further studied the possible relationship between ED and SA risks, which is scarcely investigated; yet no association was found in contrast to the single prior study done on this subject. This points out the need for further research on this relationship. The associations between poor sleep quality and both risks of SA and ED, and the association between evening chronotype and SA risk were promoted which emphasizes the need for preventive public health measures.

Declarations

There is no conflict of interest or financial disclosure to declare.

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Conflicts of interest:

Authors declare no conflicts of interest.

Authors' contributions:

Conceptualization, MF, HH; Methodology, MF, HH; Software, HH; Validation, MF, HH; Formal analysis, HH, KA, ZM; Investigation, KA, ZM, HJ MF; Resources, HH, KA, ZM; Data Curation, KA, ZM; Writing - Original Draft, AC, KA, ZM, HJ; Writing - Review & Editing; AC, HH, MF, KA; Visualization, HH; Supervision, MF, HH; Project administration, MF, HH

Data availability

Data of this study are available on request from the corresponding author.

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