

# Internet Addiction, Fatigue, and Sleep Problems Among Adolescent Students: a Large-Scale Study

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**Abstract** The aim of the present study was to examine the association between Internet addiction (IA), fatigue, and sleep problems among university students. A total of 3000 Turkish students aged 18 to 25 years were approached and 2350 students (78.3%) participated in this cross-sectional study from April 2017 to September 2017 in public and private universities in Istanbul. Data were collected via a structured questionnaire including socio-demographic details, lifestyle and dietary habits, Internet Addiction Test (IAT), Fatigue Scale, and Epworth Sleepiness Scale (ESS). Descriptive statistics, multivariate, and factorial analyses were performed. The overall prevalence of IA among the studied population was 17.7%. There were significant differences between gender, family income, father's occupation, school performance, frequency and duration of watching television, physical activity, Internet use duration, and sleep duration (all  $p < 0.001$ ). Significant differences were also found between participants with IA and those without IA in having headaches, blurred vision, double vision, hurting eyes, hearing problems, and eating fast food frequently (all  $p < 0.001$ ). Using multivariate regression

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analysis, the duration of Internet use, physical and mental symptoms, headache, hurting eyes, tired eyes, hearing problems, and ESS scores were significantly associated with (and primary predictors of) IA. The present study demonstrated that IA was associated with poor dietary habits, sleep problems, and fatigue symptoms.

**Keywords** Excessive Internet use · Sleep disorders · Fatigue · Internet addiction

Access to the Internet via smartphones, tablets, and laptop computers have made it possible for anyone to enjoy many work and leisure activities regardless of time and physical location. Internet misuse among children and adolescents has become a widespread major public health concern worldwide (Kuss et al. 2014; Bener and Bhugra 2013). The phenomenon of Internet addiction was first described in a number of papers in the mid- to late-1990s by Griffiths and Young (Griffiths 1996, 1998; Young 1996). The topic immediately gained more attention and has become a highly researched area. Specific types of Internet use, such as online socializing, gaming, gambling, and sex, can lead to pathological behavior (Griffiths 1998; Young and Rogers 1998; Müller et al. 2015; Kim et al. 2016). One type of problematic Internet use is Internet gaming disorder (IGD) and has been included in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as an emerging area that requires further evidence before being included in the main text (American Psychiatric Association 2013).

Several studies have established that in particular children and adolescents have problems and/or are becoming addicted to playing online games, in much the same way as adults become addicted to alcohol or drug or gambling (Griffiths 1998; Young 1996; Ko et al. 2008). Several studies have demonstrated that individuals can become addicted to online activities, particularly those that have psychological and emotional problems such as depression, anxiety, loneliness, distraction, and lack of sleep (Griffiths 1998; Bener and Bhugra 2013; Demirci et al. 2015; Rehbein et al. 2015; Lam 2014). Moreover, excessive and/or problematic Internet use can lead to physical health issues such as dry eyes; carpal tunnel syndrome; repetitive motion injuries; wrist, neck, back, and shoulder pain; migraine headaches; and numbness and pain in the thumb, index, and middle fingers (Park et al. 2013).

Several studies have documented adverse effects of IA among adolescents such as irregular dietary habits (Bener et al. 2010, 2011), physical inactivity, lack of adequate sleep (Choi et al. 2009; Canan et al. 2013; Ekinçi et al. 2014), increased depression, loneliness, and social anxiety (Caplan 2007; Celik et al. 2014). These detrimental social and health effects are still being debated within the psychological, psychiatric, and medical communities. The primary aim of the present study was to examine the association between IA, fatigue, and sleep problems among university students.

## Methods

**Participants and Procedure** The present cross-sectional study comprised students aged 18 to 25 years, studying in five Istanbul Government and Trust universities (Turkey). Ethical clearance for the study was given by the Istanbul Medipol University, International School of Medicine. A multi-stage stratified random sampling technique was used and university students were selected randomly. Urban and semi-urban areas were proportionally represented by stratification. Data were collected during the period April

2017 to September 2017. The questionnaires were handed out to the students at five different universities. Although 3000 students were approached, 2350 students participated in the study (response rate of 78.3%). Istanbul is a cosmopolitan city, so the sample represents all parts of Turkey. Furthermore, the value of Kaiser-Meyer-Olkin measure of sampling adequacy was found  $0.91 > 0.6$ , so the sample size was deemed good enough for all the statistical tests carried out. Content validity, face validity, and reliability of the questionnaire were tested among 148 participants. A high level of validity and high degree of repeatability was found ( $\text{kappa} = 0.85 > 0.8$ ).

**Measures** The questionnaire comprised five sections. The first section included socio-demographic details of the students; the second section concerned lifestyle habits, extra physical activities, and several disorders; the third section comprised the Fatigue Scale; the fourth section comprised the Epworth Sleep Scale; the final section concerned Internet use and included Young's Internet Addiction Test (Young 2004).

We used the Turkish translation of Young's Internet Addiction Test (IAT) developed by Cakır Balta and Horzum (2008). IAT comprises 20 questions to determine the level of addiction as mildly, moderately, or severely. It is evaluated on a scale up to 100: up to 49 is categorized as normal, 50–79 is categorized as problematic, and 80–100 is categorized as significantly problematic. Items were rated on a 6-point scale where 0 = does not apply, 1 = rarely, and 5 = always. The internal consistency (Cronbach's alpha) for the 20 items using the responses of all participants was 0.89. On the other hand, people were considered as Internet addicted if they use the Internet more than 35 h/week in Aslan's study (Aslan and Yazici 2016). For the purposes of this study, students were regarded as having Internet addiction if they fulfilled all of the following two inclusion criteria: an IAT score  $> 65$  and Internet viewing of  $\geq 5$  h/day.

The Fatigue Scale comprises 14 items that determine widely seen physical and mental fatigue symptoms (Chalder et al. 1993). The 4-point Likert scale was applied where 1 = better than usual, 2 = no more than usual, 3 = worse than usual, and 4 = much worse than usual. Cronbach's alpha for physical fatigue items (1–8) was 0.85; and for mental fatigue items (9–14) was 0.82. The Epworth Sleepiness Scale (ESS) is used to assess average daytime sleepiness (Johns 2000). The validated ESS comprises 8 items scored on a 24-point scale. Scores ranging from between 1 and 10 are normal and scores between 11 and 24 are considered to be abnormal. Epworth score varies in the range of 0–24:  $< 10$  denotes normal; 10–15 moderate impairment, and 16–24 severe impairment (Johns 2000). Cronbach's alpha for the ESS was 0.88 in the present study.

**Data Analysis** Factor analysis was used for data reduction purposes. It is a statistical method to reduce numerous variables into lower numbers of factors, which are more understandable (Thompson 2004). Confirmatory factor analysis was used to determine the factor structure of the IAT. Student's *t* tests were performed to test the significance of differences between mean values of two continuous variables while the Mann-Whitney test was used for non-parametric data. Chi-square and Fisher's exact tests (two-tailed) were used to establish for differences in proportions of categorical variables between two or more groups. Multiple regression analysis was performed with stepwise selection, because of having detailed steps, to estimate IA score on several predictor variables in the dataset. Statistical significance was accepted at the  $p < 0.05$  level.

## Results

Factor analysis was applied on participants' responses in order to determine the psychometric features of the Internet Addiction Test (IAT). Confirmatory factor analysis (CFA) was performed on the dataset ( $N=2350$ ). Table 1 indicates the socio-demographic characteristics of the sample participants. Of these, 43.1% were males and 56.9% were females. The overall prevalence of IA among participants was 17.7%. The proportion of IA was significantly higher among males (54.2%) compared to females (45.8%;  $p < 0.001$ ). There were significant differences between gender, family income, father occupation, school performance, frequency

**Table 1** Socio-demographics characteristics of the studied students ( $N=2350$ )

Variables	IA $N=415$	NA $N=1935$	Test value	$p$ value
Age (mean $\pm$ SD)	20.98 $\pm$ 1.81	20.91 $\pm$ 1.91	0.662	0.433
Gender				
Male	225(54.2)	789(40.8)	25.169	<0.001
Female	190(45.8)	1146(59.2)		
Age group in years				
$\leq 20$	175(42.2)	849(43.9)	0.759	0.358
$> 20$	240(57.8)	1086(56.1)		
Family income				
< \$ 1.000	19(4.6)	427(22.1)	93.436	<0.001
\$1.000–1.999	145(34.9)	617(31.9)		
\$2.000–2.999	123(29.6)	573(29.6)		
> \$3.000	128(30.8)	318(16.4)		
Father education				
Primary	98(23.6)	438(22.6)	10.746	0.030
Intermediate	92(22.2)	363(18.8)		
Secondary	122(29.4)	515(26.6)		
University	103(24.8)	619(32.0)		
Father occupation				
Not working	40(9.6)	211(10.9)	81.898	<0.001
Sedentary/professional	118(28.4)	496(25.6)		
Manual	61(14.7)	666(34.4)		
Businessman	99(23.9)	315(16.3)		
Government officer	97(23.4)	247(12.8)		
Rank in school exam				
Very good	110(26.5)	411(21.2)	36.613	<0.001
Good	173(40.7)	966(48.1)		
Average	95(22.4)	540(26.9)		
Poor	43(10.1)	80(4.0)		
Frequency of watching TV				
Never	18(4.3)	122(6.3)	47.481	<0.001
Rarely	69(16.6)	612(31.6)		
Sometimes	119(28.7)	629(32.5)		
Always	209(50.4)	572(29.6)		
Physical activity				
Yes	179(43.1)	1058(54.7)	38.486	<0.001
No	236(56.9)	877(45.3)		
	Mean $\pm$ SD	Mean $\pm$ SD		
No of bedrooms at your home	3.48 $\pm$ 1.01	3.62 $\pm$ 1.09	-4.155	0.016
No of people are living at home	5.60 $\pm$ 2.08	4.82 $\pm$ 1.86	7.403	<0.001
Hours of internet use/day	4.45 $\pm$ 1.65	3.86 $\pm$ 1.73	-11.896	<0.001
Sleeping duration/day	6.06 $\pm$ 1.10	6.84 $\pm$ 1.35	-12.575	<0.001
TV watching in hours/day	2.03 $\pm$ 1.11	1.82 $\pm$ 1.25	-10.493	<0.001

and duration of watching television, and physical activity ( $p < 0.001$ ). Those with IA had significantly less hours of sleep ( $6.06 \pm 1.10$  vs.  $6.84 \pm 1.35$ ;  $p < 0.001$ ) compared to those without IA. Those with IA had significantly high number of hours' Internet use ( $4.45 \pm 1.65$  vs.  $3.86 \pm 1.73$ ;  $p < 0.001$ ) as compared to those without IA.

Table 2 denotes confirmatory factor analysis of IAT. The variables comprised four factors that had an eigenvalue greater than 1. Factor 1 related to nine variables (Q10, Q11, Q12, Q13, Q15, Q17, Q18, Q19, Q20) and concern behavioral attitudes with and without Internet. The variance for factor 1 was 19.52. Factor 2 comprised seven variables (Q3, Q4, Q5, Q6, Q7, Q8, Q9). These concern the effects of being online. The variance for factor 2 was 16.49. Factor 3 comprised two variables (Q14, Q16) and concern controlling time when online. Factor 4 comprised two variables (Q1, Q2) and concerned the spending of more time online. In Fig. 1, as a result of reliability analysis, Cronbach's alpha of the scale was satisfactory (factor 1 = 18.76, factor 2 = 13.65, factor 3 = 12.18, factor 4 = 10.56). Figure was drawn by using AMOS, and all standardized values have to be smaller than 1. The CFA provided the following results:  $\chi^2 = 11.53$  ( $p < 0.001$ ), root mean square error of approximation (RMSEA) = 0.06 with the criteria of  $< 0.08$  (Stevens 2001), goodness of fit index (GFI) = 0.92 ( $\geq 0.9$ ) (Hair et al. 2010), comparative fit index (CFI) = 0.88 ( $\geq 0.9$ ) (Hair et al. 2010), adjusted goodness of fit index (AGFI) = 0.91 ( $\geq 0.9$ ), standardized root mean square residual (SRMR) = 0.07 ( $\leq 0.05$ ) (Schermelleh-Engel and Moosbrugger 2003), normed fit index (NFI) = 0.88 ( $\geq 0.9$ ), and non-normed fit index (NNFI) = 0.87 ( $\geq 0.9$ ) (Schermelleh-Engel and Moosbrugger 2003).

**Table 2** Confirmatory factor analysis of Internet Addiction Test (IAT) ( $N = 2350$ )

Items	Factors				Communality
	1	2	3	4	
q11.How often you go online again	0.716				0.631
q20.How often feel depressed moody nervous when offline	0.683				0.692
q17.Cut down the amount of online time	0.651				0.621
q13.How often snap yell or act annoyed when online	0.647				0.671
q12.How often feel without internet would be boring, empty and joyless	0.638				0.442
q15.How often feel pre-occupied with the internet when offline	0.600				0.665
q19.How often spend more time online over going out with others	0.534				0.683
q18.How often try to hide online time	0.531				0.642
q10.How often do you block out concerning internet user	0.471				0.542
q6.Your grades or school suffer from online		0.712			0.716
q8.Job performance or productivity suffer from online		0.703			0.652
q9.Become defensive or secretive concerning online		0.622			0.704
q7.How often checking your email		0.620			0.428
q3.Excitement of internet with your partner		0.538			0.612
q5.Others complain about the amount of online time		0.502			0.610
q4.New relationship online users		0.455			0.593
q16.How often saying a few minutes more			0.718		0.517
q14.How often lose sleep due to late login			0.609		0.421
q1.Stay online longer				0.745	0.554
q2.Spend more time online				0.672	0.704
Variance extracted	18.76	13.65	12.18	10.56	
Construct reliability	0.86	0.79	0.57	0.48	

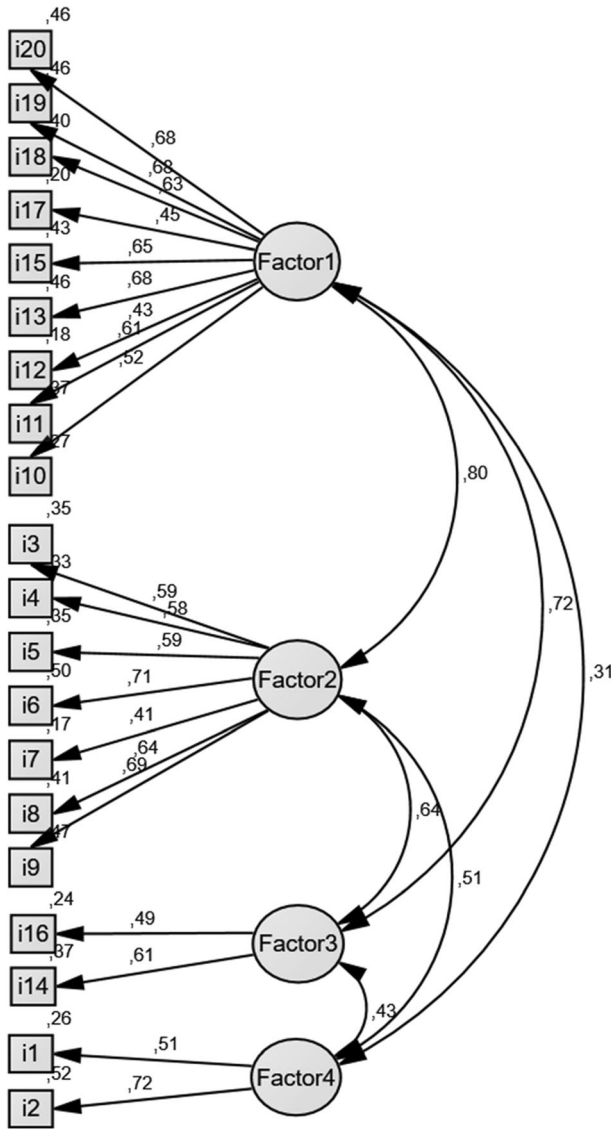


Fig. 1 Standardized scores of four-factor structure of Internet Addiction Scale

Table 3 shows the lifestyle habits, diet, and co-morbid factors comparing Internet-addicted participants with those not addicted. Significant differences were found between IA and non-IA participants in having headaches, blurred vision, double vision, hurting eyes, hearing problems, and eating fast food frequently (all  $p < 0.001$ ). Significantly fewer participants with IA reported having vigorous and moderate activities compared to non-IA participants ( $p < 0.01$ ). Table 4 compares fatigue disorders of those with IA to non-IA participants. Those with IA had significantly higher fatigue disorder scores, especially physical fatigue, due to the significantly high number of hours' Internet use ( $p < 0.001$ ) as compared to non-IA participants. Table 5 shows the multiple linear regression analysis to determine the potential

**Table 3** The characteristics of lifestyle, dietary, and co-morbid factors between Internet addicts and normal students ( $N=2350$ )

Variables	IA $N=415$	Normal $N=1935$	$p$ value *
IAT score (mean $\pm$ SD)	71.28 $\pm$ 5.70	43.80 $\pm$ 12.95	<0.001
Fatigue physical symptoms	21.92 $\pm$ 3.80	19.73 $\pm$ 4.47	<0.001
Fatigue mental symptoms	15.29 $\pm$ 3.34	13.67 $\pm$ 3.73	<0.001
Epworth Sleepiness Score	6.23 $\pm$ 4.21	6.11 $\pm$ 3.75	0.570
Medical-co-morbid factors**	$n$ (%)	$n$ (%)	
Headaches	236(55.5)	1282(63.8)	0.001
Blurred vision	113(26.5)	759(37.7)	<0.001
Double vision	77(18.1)	207(10.3)	<0.001
Eyes hurt	109(25.6)	795(39.6)	<0.001
Eye tire	109(25.6)	467(23.2)	0.287
Dizziness	164(38.5)	754(37.5)	0.678
Any problem with hearing	130(30.5)	343(17.0)	<0.001
The Epworth Sleepiness Scale			
Normal	361(84.9)	1733(86.2)	
Mild	47(11.1)	226(11.2)	0.123
Moderate	11(2.6)	42(2.1)	
Severe	6(1.4)	9(0.4)	
Activities			
Vigorous activity	179(42.1)	1058(52.6)	<0.001
Moderate activity	210(49.4)	1301(64.7)	<0.001
Frequency of eating fast food*			
Daily	114(27.1)	418 (21.7)	
Weekly	142(33.8)	779(40.4)	<0.001
Monthly	100(23.8)	318(16.5)	
Occasionally	64(15.2)	412(21.4)	

\*Two-sided  $p$  values based on Student's  $t$  test

\*\*Not adding to 100%

**Table 4** The comparison of fatigue physical and mental symptoms according Internet addiction and normal subjects ( $N=2350$ )

14-item Fatigue Scale	IA $N=415$	Normal students $N=1935$	$p$ value
Physical symptoms			
1. Do you have problem with tiredness?	2.80 $\pm$ 1.20	2.41 $\pm$ 1.03	<0.001
2. Do you need to rest more?	2.73 $\pm$ 1.24	2.50 $\pm$ 1.01	<0.001
3. Do you feel sleepy or drowsy?	2.71 $\pm$ 2.08	2.43 $\pm$ 1.06	<0.001
4 Do you have problems starting things?	2.67 $\pm$ 1.10	2.50 $\pm$ 1.12	0.031
5. Do you start things without difficulty but get weak as you go on?	2.61 $\pm$ 1.10	2.49 $\pm$ 1.06	<0.001
6. Are you lacking in energy?	2.93 $\pm$ 1.11	2.51 $\pm$ 1.07	<0.001
7. Do you have less strength in your muscle?	2.67 $\pm$ 1.09	2.36 $\pm$ 1.10	<0.001
8. Do you feel weak?	2.81 $\pm$ 1.16	2.52 $\pm$ 1.12	<0.001
Mental symptoms			
9. Do you have difficulty concentrating?	2.53 $\pm$ 1.13	2.41 $\pm$ 0.99	0.023
10. Do you have problems thinking clearly	2.74 $\pm$ 1.08	2.42 $\pm$ 1.12	<0.001
11. Do you make lips of the tongue when speaking?	2.66 $\pm$ 1.16	2.39 $\pm$ 1.10	<0.001
12. Do you find it more difficult to find the correct word?	2.55 $\pm$ 1.27	2.51 $\pm$ 1.13	0.558
13. How is your memory?	2.44 $\pm$ 1.13	2.53 $\pm$ 1.00	0.112
14. Have you lot interest in the things you used to do?	2.60 $\pm$ 1.18	2.48 $\pm$ 1.04	0.040

**Table 5** Multiple stepwise regression analysis predictors for determinants of Internet addiction affect ( $N=2350$ )

Independent variables	<i>B</i>	Standard error	Beta	<i>t</i> test value	<i>p</i> value
Internet use in hours	0.048	0.114	0.008	0.422	<0.001
Sleeping in hours	-3.127	0.221	-0.264	-14.177	0.041
Fatigue physical symptoms	0.236	0.067	0.066	3.549	<0.001
Fatigue mental symptoms	0.652	0.081	0.152	8.001	<0.001
Epworth Sleepiness Score	0.407	0.074	0.098	5.534	<0.001
Mental disorders	-2.590	1.351	-0.034	-1.916	0.038
Headaches	3.115	0.633	0.095	4.919	<0.001
Blurred vision	1.857	0.661	0.056	2.811	0.005
Double vision	-2.204	0.997	-0.044	-2.210	0.027
Eyes hurt	5.338	0.651	0.162	8.195	<0.001
Eye tired	-4.303	0.768	-0.115	-5.606	<0.001
Dizziness	-1.949	0.656	-0.059	-2.973	0.003
Hearing problem	-4.306	0.735	-0.107	-5.860	<0.001

predictors as risk factors for Internet addiction. This analysis demonstrated that the duration of Internet use, physical fatigue, mental symptoms, sleepiness (as assessed using the EES), headaches, hurting eyes, tired eyes, and hearing problems were significantly associated with (and key predictors of) Internet addiction.

## Discussion

The present study clearly demonstrated that IA was related to a wide range of co-morbid factors and poor lifestyle habits. The prevalence of IA in the present Turkish sample (17.7%) is higher than that of China (11%) (Lam et al. 2009), Australia (10.8%) (Choi et al. 2009), Greece (8%) (Siomos et al. 2008), Taiwan (17.1%) (Liu et al. 2017), and the USA (9%) (Caplan 2007). Moreover, IA affects approximately 1.2 to 26.3% of US university students (Li et al. 2015). Although it is difficult to compare the exact prevalence of IA due to the lack of a shared criteria and assessment instrument used, the present study highlights the importance of using a robust psychometrically validated scale. The present study examined the psychometric features of the IA test using factorial analysis.

Researchers have used different terms to describe adverse impacts of excessive Internet use on individuals, including (but not limited to) Internet addiction, Internet addiction disorder, Internet use disorder, Internet dependence, problematic Internet use, and pathological Internet use (Kuss et al. 2014; Griffiths 1998; Choi et al. 2009). A recent cross-sectional study of 1156 students in the Mersin Province of Turkey reported that 175 students (15.1%) were considered as Internet addicts (Şaşmaz et al. 2014). The prevalence rate of Internet addiction was 9.3% in girls and 20.4% in boys ( $p < 0.001$ ), and is therefore in line with findings from the present study. Several studies in Turkey examined the relationship between Internet addiction and depression (Gunay et al. 2018) and anxiety (Seyrek et al. 2017), Internet and sleep problems (Canan et al. 2013; Ekinci et al. 2014; Bhandari et al. 2017), and Internet and loneliness (Celik et al. 2014). Yilmazsoy and Kahraman (2017) found that the level of Internet addiction is related to the duration of Internet usage and the increased duration of Internet usage leads to increase in the level of Internet addiction. This is confirmatory with the present research. Moreover, this is the first study to investigate the relationship between Internet addiction, fatigue, and sleeping problems among young Turkish population.



Nevertheless, a large body of literature suggests that Internet addiction has negative effects on individuals' abilities (Kuss et al. 2014; Griffiths 1996, 1998; Choi et al. 2009; Bener and Bhugra 2013; Niemz et al. 2005), irregular dietary habits (Bener et al. 2010, 2011; Park et al. 2013), physical inactivity (Bener et al. 2010, 2011; Kuss et al. 2014; Griffiths 1996, 1998), and adequate sleep (Canan et al. 2013; Ekinçi et al. 2014; Bhandari et al. 2017). Furthermore, a Korean study reported a significant association between IA, sleep disturbances, fatigue symptoms, and fast food consumption (Kim et al. 2010). The results of the present study concur with these findings. Previous research has also established that computer screen lights can have negative effect on the circadian rhythm and lead to sleep phase delay (Petit et al. 2016). Similarly, IA plays an important role in daytime sleepiness and sleeping disorders (Ferreira et al. 2017) and fatigue (Lin et al. 2013). Another study has also reported that IA has negative impacts on sleep including sleep deprivation and fatigue (Bener et al. 2016).

The present study is not without its limitations. Firstly, common diagnostic criteria for IA differ across studies and the present study used the most widely used measure but arguably the most out-of-date. Secondly, there may be reporting bias by students such as hiding the duration of Internet use due to the self-reported scale (along with other well-known biases common to all self-report methods such as memory recall). Finally, family factors related to IA were not evaluated as potential variables in the present study. Despite these limitations, the present study demonstrated that IA was associated with poor dietary habits, sleep problems, and fatigue symptoms using a relatively large-scale sample. Using confirmatory factor analysis, the study investigated the latent structure of the IAT scale and results support its reliability and validity.

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**Authors' Contributions** AB and EY organized the study, collected data, performed statistical analysis, and wrote the first draft of the article, and contributed to the interpretation of the data and writing the final draft of manuscript. PT, FÇ, EB, and SA collected data, performed statistical analysis, and wrote the first draft of the article. MDG contributed to the interpretation of the data and writing the manuscript.

### Compliance with Ethical Standards

**Informed Consent** Verbal informed consent was obtained for this study due to its nature.

**Conflict of Interest** The authors declare that they have no conflict of interest.

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