Journal of Multidisciplinary Healthcare

Dovepress
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ORIGINAL RESEARCH

Association Between Time Spent on Electronic Devices and Body Mass Index in Young Adults

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Objective: To evaluate the association between time spent on electronic devices (TSED) and body mass index in young adults.
Methods: This cross-sectional study was conducted from June to December 2021 on 1877 students (aged 18–22 yrs) from multiple health Colleges of Imam Abdulrahman Bin Faisal University. The main tools of the study were 1) Body mass index (BMI) and an online questionnaire. The subjects were categorized into 3 main groups based on their TSED: 1) Low TSED < 2 hours/day, 2) Medium TSED= 3 to 5 hours/day, 3) Excessive TSED ≥ 6 hours /day. Based on BMI, subjects were categorized into three main groups: Normal and underweight (BMI ≤ 24.9), overweight (BMI > 25–29.9), and obese (BMI > 30).
Results: Participants' average age was 20 ± 2 years. The average BMI was 23.5 k/m^2. The % of students falling into the categories of normal weight, overweight, and obesity was 69.2%, 19.05%, and 11.7% respectively. The average TSED of study participants was 8.2 ± 3.45 hrs /24 hours. 71.15% of participants indicated a TSED of ≥6 hrs/24 hours and 23.71% reported a TSED of 3–5 hrs/24 hours. Only 3.15% of participants reported TSED of ≤2 hrs/24 hours. Although a rise in the mean BMI was observed with an increase in the TSED, but this difference was not statistically significant. The pairwise wise comparison also failed to demonstrate any difference in BMI between different categories of TSED. Furthermore, no significant positive correlation was found between increased BMI and excessive TSED (P = 0.37).
Conclusion: A high percentage of young adults (31.2%) were overweight or obese, but excessive TSED was not significantly associated with increased BMI in this study population. Further studies are recommended to identify the effects of other factors in causing increased BMI in young adults.
Keywords: electronic, devices, young, adults, body mass index

Introduction

The prevalence of electronic devices (ED) ownership as well as the duration of using them is increasing globally.[1] Along with an increase in ED use, there is a worldwide trend of rising cases of overweight and obesity in last two decades.[2] Kingdom of Saudi Arabia (KSA) was ranked the fourteenth-highest country with an obesity rate worldwide in 2016.[3] In the same year, the overall percentage of obesity reached 35% among Saudis.[4] The substantial increase in obesity rates among the Saudi population could be explained by various factors, mainly unhealthy eating habits and sedentary behaviors. One of the biggest causes of sedentary behavior nowadays is the increase in time spent on electronic devices (TSED) which is due to the rise in electronic device ownership .[5–8]

Women in the United States of America (USA) spend an average of 6 to 20 hours per week watching television (TV).[9] More than 85% of university students across Canada own at least one ED, while in South Korea and KSA this

Received: 2 June 2022
Accepted: 14 September 2022
Published: 28 September 2022

percentage raises to 100%.[10–12] USA college students spend an estimate of nine hours per day using their ED,[4] while more than half of university students in Indonesia spend 5 hours or more a day.[13] Students of United Arab Emirates (UAE) use ED for a mean of 7.5 hours daily.[7] Moreover, studies in KSA from universities in Riyadh, Qassim, Jeddah, and Dammam cities have measured the average TSED to be 7.5 hours, 3.5 hours and 8.5 hours respectively.[6,8,14,15] The increase in TSED usage could be explained by its various advantages.

ED show a positive influence on different aspects of life. Easier access is provided for both consumers and sellers via internet commerce.[16,17] Many adults use ED for work-related tasks and educational purposes.[6,10,13,18,19] Laptop classrooms enhance learning by increasing interest, participation, and motivation compared to regular classrooms.[20] To add on, social media is used for sharing information and knowledge among students.[12] Smartphone messages and applications have also shown promising influences on health via promoting preventive behaviors, reducing stress, increasing mindfulness and self-compassion.[21,22] Moreover, wearable devices connected to smartphone applications have helped in monitoring the progress and response of patients.[23,24]

Despite the advantages of ED, it could hurt life. Addiction to smartphones is a phenomenon that is significantly increasing in young adults,[4–8] and has resulted in higher rates of reported low self-esteem[7,25] and high levels of stress.[8,26] Moreover, depressive symptoms are more commonly seen in addictive smartphone users. Smartphones could also be a source of distraction during classes.[12,27] Prolonged TSED is associated with poor academic performance, poor sleep quality, a decrease in sleep time[6,14,15] and greater physical discomfort.[20] TSED encourages sedentary behaviors via various mechanisms.[5,6,9,19,25]

Numerous studies have linked TSED with an increase in body weight by encouraging sedentary behaviors. Prolonged sitting time, decreased physical activity and unhealthy eating habits are the main mechanisms behind weight gain.[5,6,8,9,19,25] Increased time spent viewing TV was significantly associated with increased body weight in adults.[28] There is a 23% increase in obesity risk for every 2 hours per day spent on TV. In addition, women who watched TV for longer hours consumed more calories in the form of red and processed meat, saturated fats, and snacks.[9] About 30% of college students agree that after using a smartphone, they started to eat more junk food and gained more weight.[6] In contrast, other studies suggest that the use of ED helps in losing weight. Mobile health (m-health) technology provides interventions that help in improving the patient's lifestyle via personalized contact.[29,30] Using the total daily steps count application on the mobile phones was also associated with decreased BMI.[31] Besides that, vigorous physical activity was found to be higher among college students who played video games and used various devices connected to their smartphone applications.[32]

Some studies document that increased TSED decreases body weight and hence BMI while other studies suggest that ED use increases body weight . This inconclusive evidence about the effects of TSED on BMI led us to design this study in which we aimed to "investigate the association between TSED and BMI in young adults". We hypothesize that "Increased time spent on electronic devices is positively associated with body mass index in young adults".

Materials and Methods

This was a cross-sectional study conducted on 1877 students (aged 18–22 yrs) from multiple Colleges of Imam Abdulrahman Bin Faisal University, from June till December 2021.

The sample size was calculated by epidemiologic statistics for public health tools software via an online calculator (accessed at: http://epitools.ausvet.com.au/content.php?page=1Proportion&Proportion). The calculation was based on the estimated prevalence of overweight and obesity in a target population of 4000 students who use excessive TSED, where desired precision was 0.02 (2%) and the confidence interval was 0.95 (95%). The sample size was calculated to be 1800. Data was collected by convenience sampling technique, and the response rate was 47.5%, as 1900/4000 students volunteered to participate in the study. A ten minutes briefing session was given in various classrooms to explain the rationale of the study. The willing students were taken to the Physiology lab for anthropometric measurements and to fill out the TSED questionnaire. The confidentiality of the personal information was assured to the subjects. Written informed consent was signed by all the study participants.

The main tools of the study were Body mass index (BMI) and TSED. A questionnaire was designed to find the TSED in the subjects. It was based on information from a few previous studies.[6,8,9,15,18] The questionnaire focused on the information about the average TSED in the last one year. The subjects were categorized into 3 main categories based on their TSED: 1) Less TSED< 2 hours/day, 2) Medium TSED = 3 to 5 hours/day, and 3) Excessive TSED ≥ 6 hours/day. Electronic devices used by the subjects included Television, laptops, iPad, mobiles and video games.

BMI was calculated by the formula=weight in kg/height in m^2. Measurement of Weight was done in kilograms and height in centimeters. All the anthropometric measurements were done in the Physiology lab using standard procedures (light clothing, barefooted, empty bowel and ladder, and a minimum of 3 hours fasting). Based on BMI, subjects were categorized into three main groups: Normal and underweight (BMI ≤ 24.9), overweight and obese (BMI > 25–29.9), and obese (BMI > 30).[33]

Inclusion Criteria

- The health science students between 18 and 22 years who were willing to participate in the study.
- The students who use any electronic device (including television, iPads, mobiles Laptops, and video games) daily, even if they use it for a brief moment.
- Not using any prescription medication for at least the last 3 months.

Exclusion Criteria

The students having:

- Positive family history of obesity.
- Any chronic physical or mental illness, affecting their BMI.

Finally, 24 students were excluded, and 1876 were selected. Shapiro–Wilk test was applied to check the distribution of data, the data was normally distributed.

Ethical approval of the study was taken by the Deanship of Scientific Research (IAU), IRB number = 2021-01-192. This study was conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

The data analysis was done by Statistical Package for Social Sciences (SPSS) for Windows, Version 20.0. Demographic data was determined by descriptive statistics.

One way Anova was used to compare the number of subjects between normal weight, overweight and obese groups in all the 3 categories of TSED. Comparison of mean BMI between 3 Categories of TSED was also done by using one-way ANOVA. A pairwise comparison was carried out by applying the least significant difference (LSD) test. Spearman's correlation was performed to find the association between BMI and TSED. All the statistical tests were conducted at a 95% confidence interval (CI).

Results

The mean age (±SD) of participants was 20 ± 2.8 years. Number of female participants was 1458 (77.6%), whereas the number of male participants was 419 (22.3%). The average BMI was 23.5 kg/m^2. The % of students falling into the categories of normal weight, overweight, and obesity was 69.2%, 19.05% and 11.7% respectively. A statistically significant difference was seen between the BMI of males and females. Males as compared to females had significantly higher BMI. Moreover, a significantly higher number of males as compared to females were falling into the category of overweight and obesity. These parameters are compared between male and female subjects in Table 1.

Table 2 shows that the average TSED was 8.2 ± 3.45 hrs /24 hours. 71.15% of participants indicated that their TSED was ≥6 hrs/24 hrs, 23.71% reported a TSED of 3–5 hrs/24 hours, whereas only 3.15% of the participants had a TSED of ≤2 hrs/24 hours. A comparison of TSED between males and females showed no statistically significant difference, in any of the three groups (p values 0.3, 0.7 and 0.4 respectively) Table 2.

Table 3 shows the distribution of the study subjects based on their body mass index into low, medium, and excessive TSED groups. Data indicated that most of the subjects (3.2%) who used the ED for ≤2 hrs/24 hours fell into the group of

Table 1 Sample Characteristics

	Total n=1877	Male n = 419	Female n = 1458	P-value
Mean Age ±SD	20±2.8	20.2 ±3.3	19.8 ±2.3	0.017
Mean BMI	23.5±5.45	24.6 ±6.1	22.4 ±4.8	< 0.001*
Normal weight	1388 (69.2%)	254 (60.6%)	1134 (77.8%)	< 0.0001
Overweight	319 (19.05%)	95 (22.7%)	224 (15.4%)	0.001*
Obese	170 (11.7%)	70 (16.7%)	100 (6.7%)	< 0.0001*

Note: *Signifies that P value is < 0.05.

Table 2 Information About "Time Spent on Electronic Devices"

Time Spent on Electronic Devices	Total n=1835	Males n = 416	Females n = 1457	P-value
≤ 2 hrs/24 hours	53(3.15%)	15 (3.6%)	38 (2.6%)	0.3
3–5 hrs/24 hours	450 (23.71%)	97 (23.2%)	353 (24.2%)	0.7
≥ 6 hrs/24 hours	1332 (71.5%)	304 (72.5%)	1028 (70.5%)	0.4

Table 3 Distribution of the Study Subjects Based on Body Mass Index into Low, Medium, and Excessive "Time Spent on Electronic Devices Groups"

"Time Spent on Electronic Devices Groups".	Normal Weight	Overweight	Obese	P-value
≤ 2 hrs/24 hours	44 (3.2%)	8 (2.6%)	1 (0.6%)	0.060
3–5 hrs/24 hours	338 (24.9%)	73 (23.5%)	39 (23.1%)	0.6
≥ 6 hrs/24 hours	973 (71.8%)	230 (74%)	129 (76.3%)	0.2

normal weight vs 2.6% in overweight and 0.6% in the obese group, but the difference was not statistically significant (P = 0.06). Moreover, it was analyzed that with an increased TSED of ≥6 hrs/24, the percentage of students falling into the obese group was greater than the % of students in the overweight normal-weight group (76.3% vs 74% and 71.8% respectively). But the difference was not statistically significant (P = 0.2).

A comparison of mean body mass index between the three categories of TSED is shown in Table 4. A rise in the mean BMI was observed with an increase in the TSED, but this difference was not statistically significant. Therefore, a pairwise comparison was carried out by applying the least significant difference (LSD) test Table 5. LSD also failed to show any significant difference in the BMI between various categories of TSED.

Table 4 Comparison of Mean Body Mass Index Between Various Categories of "Time Spent on Electronic Devices"

Time Spent on Electronic Devices	Total	Mean ±SD BMI	(Min-Max)	P-value
≤ 2 hrs/24 hours	53	21.7 ±3.3	(15.6–30.4)	0.156
3–5 hrs/24 hours	450	22.8 ±5.4	(14–59.8)	
≥ 6 hrs/24 hours	1332	23 ±5.2	(14.5–58.2)	

Table 5 Pairwise Comparison by LSD Test

Time Spent on Electronic Devices	P-Value	95%CI(LL-UL)
Low TSED Versus Medium TSED	0.146	− 2.6–0.4
Low TSED versus Excessive TSED	0.087	− 2.7–0.2

Table 6 Correlation of Body Mass Index with Screen Usage Time Using Spearman Correlation. (n = 1877)

	BMI	P-value (OR, 95% CI)
Screen usage time	0.021 (r)*	0.37 (1.03, 0.6–1.5)

Note: *Signifies that P value is < 0.05.

Spearman rank correlation coefficient showed a positive correlation between BMI and TSED 0.021 (r)* but the P-value was not found to be statistically significant (p = 0.37) Table 6.

Discussion

The average TSED among young individuals in our study was 8.5 hours/day. This figure is slightly lower than the TSED of US college students, who spend an average of 9 hours each day in front of the ED.[4] On the other hand, both Indonesian and UAE college students had less TSED when compared to our results reaching 5 and 7.5 hours respectively.[7,13] Finally, the TSED of this study was almost similar to another study conducted in Dammam KSA where the average TSED was 8.5 hours/day, whereas a study conducted in Jeddah indicated a lower TSED of 3.5 hours daily.[14,15] Decreased physical activity and increased sedentary behavior in the past few years are the major contributors to an increased TSED in young adults.[5–9]

Although a high percentage of our study population was overweight/obese (31.2%), but no significant correlation was found between excessive TSED and increased BMI in these young adults. Almost similar results have been reported by Chinapaw et.al in their systemic review, indicating that there is insufficient evidence to support the hypothesis that excessive TSED is related to higher BMI.[34] Must et al found that increased BMI was unrelated to excessive TSED, but was strongly related to parental body weight.[35] Kalirathinam et al were also not able to identify any association between TSED and body mass index among university students.[36]

The possible explanation for these findings may be the fact that there are multifactorial determinants of BMI. And dietary intake, genetics, sleeping habit and physical activity may be the main contributors to controlling BMI, rather than the TSED.[37] Although the young adults have a high TSED, but as our study population included health science students who are more health-conscious and they use various applications in their mobiles that aid weight reduction and maintenance.[29–32] This may be one of the reasons for the insignificant association between TSED and BMI in our study population.

Our data is contradictory to the findings of some other studies, which provide a positive association between TSED and BMI.[5,6,38,39] These contradictory results can be explained by the difference in subjects' age, study population, sample size, and confounding factors. As, the targeted population in the current study focused on young adults between 16 and 22 years, whereas the participants of Lio et al were 30 to and 59 years old, and Fable et al targeted a younger population of 9–15 years.[38,39] These comparisons may provide an insight into the finding that excessive TSED during childhood or in the later years of life may have a stronger impact on BMI as compared to its effects on young adults.

The main strength of this study is that we recruited a large sample size. All the students were called to the physiology lab and our study participants were health college students who filled the questionnaire with great interest and accuracy. Moreover, the measurement of height and weight was done in the lab with the same machine for all the subjects, which helped to avoid the inaccuracy of self-reported data where the subjects can over or underestimate their height and weight.

Although our study recruited a large sample size to explore a relationship between TSED and BMI. However, there are several limitations of the present study; for instance, it was a cross-sectional study, so it was not possible to conclude a causative relationship between TSED and BMI. Therefore, we suggest future longitudinal studies to fill this gap. Moreover, the effects of other confounding factors on BMI, such as age, unhealthy eating habits and decreased physical activity were not considered. Although we excluded the students who had a positive family history of obesity and various chronic illnesses, but our exclusion criteria were only based on the history, and no Physical examination or investigations were performed.

As the results of this study indicate that a high percentage of young adults (31.2%) were overweight or obese, but excessive TSED was not significantly associated with increased BMI in this study population. Therefore, we recommend further studies to identify the effects of other factors in causing increased BMI in young adults, to reduce the burden of overweight and obesity and its associated future complications.

Conclusion

This study concluded that the average TSED in young adults was 8.2 ± 3.45 hrs /24 hours. 71.5% of the study participants used ED for more than ≥6 hrs/24 hours, whereas only 3.15% used the ED for ≤2 hrs/24 hours. Although a high % of young adults were overweight/obese (31.2%). But no significant positive correlation was found between excessive TSED and increased BMI.

Data Sharing Statement

Data can be obtained from the corresponding author on request.

Ethics Approval

The study was ethically approved by the Deanship of scientific research, IAU, ethical approval number IRB-2021-01-192.

Consent for Publication

The authors give consent to publish the whole content of the article.

Acknowledgments

The authors are thankful to Prof. Sohail Afaq (PhD English, Full Professor and Ielts examiner in British council, Saudi Arabia), and Mr. Usman Rafique (Information systems and cloud analyst in London) for their English editing services.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This was nonfunded research.

Disclosure

The authors report no conflicts of interest in relation to this work.

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