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The Relationship between Night Time Technology Use and Glycemic Control among Jordanian Adolescents with Type-1 Diabetes Mellitus: A Cross-sectional Study in Jordanian Hospitals

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ABSTRACT

Background: Much less research has been conducted on technology usage at night after nine PM and its relationship with glycemic control among diabetic patients, especially Jordanian adolescents with type-1 diabetes mellitus. However, a study conducted among Turkish adolescents with type-1 diabetes mellitus found that daily electronic media use was higher among adolescents with poor glycemic control. ***Purpose*****:** Examining the relationship between night time technology use index after nine PM and HbA1c levels among adolescents with type-1 diabetes mellitus. ***Methods*****:** A cross-sectional study was conducted including 96 adolescents with type-1 diabetes mellitus, aged from 13 years to 18 years, who were selected from three public hospitals and one university hospital in Jordan. A modified self-administered questionnaire was used, called Adolescent Sleep, Caffeine Intake and Technology Use (ASCT) tool. Descriptive analysis was conducted to describe sample characteristics and pairwise Pearson correlation was applied to determine the association between the technology use index and HbA1c level. ***Results*****:** Out of 190 participants, 96 adolescents having type-1 diabetes mellitus participated in the research which was conducted within the time frame from May 18, 2021 to October 18, 2021. The mean age was 14.7±1.7 years. The HbA1c level had a mean value of 9.3% with a ±2.3% deviation. The findings revealed that the technology use index was correlated with glycemic control (r= 0.22, p= 0.03). ***Conclusion*****:** This study highlights a significant relationship between increased night-time technology use and poorer glycemic control among Jordanian adolescents with type-1 diabetes mellitus. These findings underscore the need for raising the awareness among adolescents and healthcare providers. Future research, including experimental and longitudinal studies, is recommended to further explore the impact of night-time technology use on diabetes mellitus management and to support its integration into clinical counseling and care strategies. ***Implications for Nursing*****:** This study could contribute to the creation of guidelines that raise the awareness among nurses and adolescents about improving modifiable lifestyle factors, especially technology use and modifying the hours consumed after nine PM to achieve good accurate outcomes in glycemic control.

Keywords: Adolescents, Glycemic control, HbA1c, Night-time technology use, Technology index, Type-1 diabetes mellitus.

What does this paper add?

1. Modifying the hours spent with technology activities after nine PM could serve as an effective target for improving glycemic control in adolescents with

type-1 diabetes mellitus.
2. Night-time technology use after nine PM is identified as a trigger factor associated with poor glycemic control.
3. Emphasizing the importance of studying adolescents, a group that often has high technology usage and unique challenges in managing type-1 diabetes mellitus.

Introduction

Most adolescents diagnosed with type-1 diabetes mellitus, were according to many studies, between 13 years and 17 years of age (Patel et al., 2019; Schnurbein et al., 2017; Silva et al., 2021). According to Rose et al. (2021), males were found to be more than females living with type-1 diabetes mellitus.

Regarding the type of insulin administration technique, the use of insulin pumps was more common than multiple insulin injections among adolescents with type-1 diabetes mellitus (Frye et al., 2019; Patel et al., 2019). Type-1 diabetes mellitus had lasted for more than one year in the adolescents studied (Bergner et al., 2018; Fortins et al., 2019; Patel et al., 2019; Rose et al., 2021; Schnurbein et al., 2017; Silva et al., 2021).

Despite the recommendation for adolescents with type-1 diabetes mellitus by the American Diabetes Association that achieving optimal glycemic control requires an HbA1c level below 7.5% (Chiang et al., 2018), only 20.9% of Jordanian teenagers under the age of 18 years achieved good glycemic control measured by HbA1c level (Alassaf et al., 2019). Furthermore, among all age groups, adolescents within the 15-18-year range have the highest HbA1c level, with an approximate level of 9.3% (Foster et al., 2019). Rigorous diabetes management that incorporates all aspects of lifestyle should be done to achieve appropriate HbA1c levels (Phelan et al., 2018).

Adolescents shouldn't, according to the American Academy of Pediatrics, use technological devices or screens before one hour of their sleep time (Hill et al., 2016). Therefore, night-time technology use index is defined as an indicator for frequency and duration for usage of electronic devices, such as television, computer and so on, at night after 9 PM (Machado et al., 2024; Saylor et al., 2019). Regarding American adolescent individuals affected by type-1 diabetes mellitus, most of the types of electronic devices used at night were cell phones, as well as the devices present in the bedroom during the sleeping time (Patel et al., 2019). The use of technology would lead to an insufficient sleep duration and a reciprocal relationship was found (Mazzer et al., 2018). Further, technology devices turned on in the bedroom at night would have bad influences on sleep, especially within the adolescent population affected by type-1 diabetes mellitus (Patel et al., 2019).

Poor glycemic control is reflected by the HbA1c level, which is the best available measure for glycemic-control assessment (Chehregosha et al., 2019). It could result from frequent communication with friends *via* technology and electronic media, such as using WhatsApp and Facebook chats (Yetim et al., 2018). In Turkey, researchers found that using the computer by adolescents diagnosed with type-1 diabetes mellitus for over two hours per day for the purpose of studying was an independent predictive factor for poor glycemic control (Yetim et al., 2018). However, the relationship between utilization of electronic media after 9 PM and glycemic control has not yet been thoroughly investigated in previous research. Among Indian adolescents, a proportion of those who viewed television longer than two hours daily was diabetic, and some of them were susceptible to diabetes and had impaired fasting glucose (Dewan, 2017). So, a gap remains in understanding the association between digital-device usage and HbA1c level in adolescents diagnosed with type-1 diabetes mellitus. Furthermore, an increasing body of literature explored the relationship between screen time and the possibility of developing type-2 diabetes mellitus. A large British cross-sectional study found higher insulin resistance to be a marker pertaining to type-2 diabetes mellitus, which was associated with spending more time in front of the television and other technology devices among children aged between nine years and ten years (Nightingale et al., 2017).

While a gap still exists in understanding the association of night-time technology use with HbA1c levels among adolescents who have type-1 diabetes mellitus, an American cross-sectional research found that the index of technology uses after nine PM was approximately 0.8 within the college-aged population with type-1 diabetes mellitus (Saylor et al., 2019). As the technology use index was higher, the usage of technology devices would be more (Calamaro et al., 2009; Saylor et al., 2019). However, there appeared to be a fairly strong evidence according to Saylor et al. (2019), who found no association between night-time technology use index and glycemic control evaluated through HbA1c levels among adults with a diagnosis of type-1 diabetes mellitus. There is a research gap in exploring the relationship between night-time technology use after 9 PM and HbA1c measurements in adolescents diagnosed with type-1 diabetes mellitus.

To date, no existing studies have provided a quantification of the number of hours after nine PM spent in activities using technological devices as well as the relationship between technology use index and glycemic control in teenagers managing type-1 diabetes mellitus. So, the present study is the first research that intends to highlight the effects of night-time technology use on glycemic control evaluated by HbA1c levels in Jordanian adolescents affected by type-1 diabetes mellitus. We, therefore, examined the relationship between night-time technology use index after nine PM and glycated hemoglobin measurements in teenagers managing type-1 diabetes mellitus. We propose that night-time technology use index after nine PM is associated with an increase in glycemic control. Also, we aimed to characterize the socio-demographic characteristics of the sample, including age, gender, method of insulin administration, and years of diagnosis with type-1 diabetes mellitus.

The findings of this study could be used to create guidelines aimed at raising the awareness among both healthcare professionals and adolescents who have type-1 diabetes mellitus, focusing on improving modifiable lifestyle factors, especially technology use, to achieve proper glycemic control results. Further intervening research as well as educational programs to improve the HbA1c should be encouraged. In addition, this research may fill the gap in identifying the trigger factors associated with this vulnerable group of population in Jordan.

Methods

Study Design, Sampling and Settings

A cross-sectional design was used using a convenience, non-probability sampling method which consists of recruiting all individuals from the accessible population who fulfill the eligibility criteria within a defined period of data collection.

The participants were recruited from four major hospitals in Jordan to complete a self-administered questionnaire (Calamaro et al., 2009; Saylor et al., 2019), between May 18, 2021 and October 18, 2021. Three hospitals were public Ministry of Health-affiliated hospitals which are situated in Amman, the capital of Jordan, and Irbid, a large city in the northern part of Jordan, while the fourth hospital was a university affiliated hospital in Irbid. These hospitals were selected, because they are the major available healthcare centers in the central and northern regions of Jordan and receive referral cases from all regions of the Kingdom. The participants met the inclusion criteria, including being an adolescent between the ages of 13 years and 18 years, type-1 diabetes mellitus diagnosis for a minimum of one year, and having the latest HbA1c measurement taken and documented within a maximum of three months in their medical records. Participants who had one of the complications of type-1 diabetes mellitus, such as diabetic ketoacidosis, retinopathy, nephropathy and so on, were excluded.

This study had no specific limitations on the number of participants. All adolescent patients who had type-1 diabetes mellitus at the selected hospitals were invited to join during the data collection period once they met the inclusion criteria. The analysis power was set to 0.8, utilizing a medium effect size and the significant alpha level was set to 0.05 (Cohen, 1992). The minimum necessary sample size was calculated to be 91 participants (Cohen, 1992). An extra sample of 9 participants was initially determined to account for potential attrition; however, only 5 additional participants were available. The final sample for the current study consisted of 96 adolescents diagnosed with type-1 diabetes mellitus.

Ethical Considerations and Data Collection Procedure

After receiving ethical approval from the Institutional Review Board at Jordan University of Science and Technology (Ref No. 13/139/2021) to collect the data from the selected hospitals and then from the Ministry of Health and King Abdullah hospital, the investigator met the directors of the hospitals and after that, met the directors of departments, including pediatric units, pediatric clinics and endocrine clinics in the selected hospitals to take agreement from the supervisors of units for data collection. Then, the parents and their adolescents were met in the outpatient clinics at the selected hospitals to sign the consent form which was outlining the aim and giving further details about the study written in Arabic language and then complete the questionnaire after checking their eligibility and informing them that their participation is completely voluntary. Confidentiality and anonymity were also assured. Also, the participants were notified of their right to withdraw from the study at any point without facing any repercussions. Unique codes were allocated to the questionnaire in place of names, and no data sharing was used. In addition, the investigator explained the nature of the study, its purpose, risks, and benefits. A sufficient number of participants was recruited to complete the data collection.

Measure

Glycemic control was assessed based on the normal HbA1c level specified by each setting from which data was collected. The researcher obtained the most recent HbA1c reading from the past three months in the patients' medical files.

Instrument

The instrument which was used is called the Adolescent Sleep, Caffeine Intake, and Technology Use (ASCT) questionnaire (Calamaro et al., 2009; Saylor et al., 2019). The tool was initially created for adolescents (Calamaro et al., 2009), and then used in another study (Saylor et al., 2019). With approval, it was modified for early young adults with certain adjustments. Approval was obtained from the authors of the instrument to use it in the current study and modifications were carried out with the permission of the authors. A back-translation approach was employed to verify that both the original English version and the Arabic translation of the instrument measured and assessed the same concepts. The translated version was re-translated into the first language of the original instrument. Also, through conducting a pilot study, the translated version of the questionnaire was assessed for its clarity and understanding by the participants. Face validity and content validity of the translated version of the instrument were assessed, reviewed and verified by two expert panels who had a long experience in the field of research. The experts examined the items for clarity, relevance, comprehensiveness and ease of understanding. The content validity index for the instrument's items was calculated to be 0.84. Based on Davis (1992), a content validity index of 0.80 or higher is deemed acceptable by two experts.

A pilot study was performed on 20 Jordanian adolescents with type-1 diabetes mellitus to establish the internal consistency reliability of the instrument. It was found that the Cronbach's alpha for the items was 0.71, and the study sample spent about five minutes or less filling the instrument. The instrument consists of two sections. The first section contains the socio-demographical data, which included four items: age, gender, method of insulin administration, either through subcutaneous injection or an insulin pump, and the duration of type-1 diabetes mellitus diagnosis, being whether one year or longer. The second section had four items that included types of questions, ranging from dichotomous questions (yes/no) to multiple-choice questions, to be answered by the participants. Participants have been asked about the average amount of time in hours/minutes in which they used all types of technological devices (television, computer, I-pad, cell phone, MP3 player, and DVD) after nine PM (Calamaro et al., 2009; Saylor et al., 2019). The night-time technology use index was calculated by dividing the overall number of hours spent on all activities using technological devices after nine PM by the total hours since nine PM to six AM, which were nine (Calamaro et al., 2009).

Statistical Analysis

Descriptive statistics, including means, standard deviations, frequencies, and percentages, were employed to describe night-time technology use, (HbA1c) level, and all socio-demographical data. Pearson correlation coefficient was applied to evaluate the relationship between the night-time technology use index and HbA1c. All analyses were performed with the Statistical Package for Social Sciences (SPSS), version 23.0, using α (P-value) set at less than 0.05 to identify a statistically significant relationship.

Results

Sample Socio-demographic Characteristics

Out of the study sample members who had the opportunity to participate in the study, 96 adolescents (62 girls and 34 boys) with type-1 diabetes mellitus filled out the questionnaire and their parents allowed them to participate in the study. No missing data was identified prior to conducting the analysis. After Shapiro-Wilk test and Kolmogorov-Smirnov test were applied for normality check, the data was found to be normally distributed. The participants had a mean age of

14.7 ±1.7 years, with ages ranging from 13 years to 18 years. Of the total participants, 62 (64.6%) were females, whereas the remaining 34 (35.4%) were males. The HbA1c level had a mean of 9.3%, with a standard deviation of 2.3%. Only a few participants reached glycemic control levels below 7.5% (n=18, 18.8%). Table 1 illustrates the socio-demographic characteristics of the participants.

Table 1. The socio-demographic characteristics of participants (N= 96)

Characteristics	Frequency	Percentage (%)
Females	62	64.6%
Males	34	35.4%
Subcutaneous insulin injection	92	95.8%
Insulin pump usage	4	4.2%
One year of diagnosis	15	15.6%
More than one year of diagnosis	81	84.4%
Abnormal HbA1c level	91	94.8%
Normal HbA1c level	5	5.2%

Night-time Technology Use Characteristics

All participants in the sample used some kind of technology after nine PM at night except one participant. 81 participants (84.4%) had a tablet (iPod) or an MP3 player, while few participants had a computer in their bedroom (n= 27, 28.1%) and 30 participants (31.3%) had a television in their bedroom. On average, participants were engaged in three (ranging from 0 to 6) technology activities after nine PM.

Overall, 60 adolescents (62.5%) reported watching television after nine pm, with mean hours each night after nine PM being 0.8 ±0.8. After nine PM, 26 adolescents (27.1%) reported text messaging with friends in about a mean of hours of 0.2 ±0.3 hours. Also, 62 participants (64.6%) spent 0.6 ±0.6 hours each night using online social media (Facebook, Twitter, … etc.). Table 2 summarizes the activities after nine PM and their characteristics among participants.

Table 2. The activities after 9 pm and their characteristics among Jordanian adolescents with type-1 diabetes mellitus (N= 96)

Activity	Frequency, (%)[1]	Hours spent with activity[2]
Watching television	60 (62.5%)	0.8 ±0.8 hours
Text messaging with friends	26 (27.1%)	0.2 ±0.3 hours
Online with friends (social media)	62 (64.6%)	0.6 ±0.6 hours
Talking on phone	10 (10.4%)	0.1 ±0.2 hours
Playing computer games	33 (34.4%)	0.4 ±0.6 hours
Watching DVD/video	21 (21.9%)	0.2 ±0.5 hours
Listening to music/podcast	20 (20.8%)	0.2 ±0.4 hours
Completing homework via technology	28 (29.2%)	0.3 ±0.6 hours
Others	23 (24%)	0.3 ±0.5 hours

[1] Number of participants engaged in activity after 9 pm and their percentage. [2] Mean of hours and their standard deviations.

The overall mean number of hours spent for all activities performed after nine PM was 3.1 ±1.5 hours. So, the multi-tasking index, which was calculated as the mean of the overall time spent on all activities divided by nine (the total hours between 9 PM and 6 AM) (Calamaro et al., 2009; Saylor et al., 2019), was 0.3 ±0.2, which was equal to spending 3.1 hours on a single activity or dividing the time among three activities, each lasting approximately 1 hour and 2 minutes. Some participants spent one hour watching television (n= 27, 28.1%), texting messages with friends (n= 7, 7.3%), talking on the phone (n= 4, 4.2%), playing computer games (n= 17, 17.2%), watching videos (n= 12, 12.5%), listening to music and podcast (n= 11, 11.5%), completing their homework *via* technology (n= 15, 15.6%) and spent their time on other activities for one hour after nine PM (n= 12, 12.5%). Furthermore, 50 participants (52.1%) used several types of technology for about two hours after nine PM. Only three participants (3.1%) reported up to three hours after nine PM watching television and 27 adolescents (28.1%) reported up to two hours watching television. Regarding online talking with friends on social media (Facebook, Twitter, … etc.), most of them spent one hour after nine PM (n= 31, 32.3%) and some of them spent up to two hours (n= 8, 8.3%).

Night-time Technology Use and Glycemic Control

The Pearson correlation coefficient (Pearson's r) was applied to assess the presence of a statistically significant relationship between night-time technology use index and glycemic control. The night-time technology use index exhibited a weak, but significant, positive relationship with the HbA1c level ($r= 0.22$, $p= 0.03$). This implies that as technology use index after nine PM increased among adolescents with type-1 diabetes mellitus, glycemic control level assessed by HbA1c would be increased.

Discussion

Type-1 diabetes mellitus is a rising global health issue affecting children and adolescents (Mobasseri et al., 2020). The purpose of our study was to explore the relationship between night-time technology use index and glycemic control evaluated by HbA1c levels in adolescents with type-1 diabetes mellitus. Based on our current knowledge, reliable data on this issue is unavailable for Jordanian adolescents with type-1 diabetes mellitus. Novel results were found stating that according to the pairwise correlation (Pearson's *r*), a significant positive relationship existed between night-time technology use index and glycemic control in Jordanian adolescents with type-1 diabetes mellitus. Evidence is sparse regarding night-time technology use index and its influence on glycemic control among adolescents diagnosed with type-1 diabetes mellitus, worldwide and especially in Jordan.

In this study, adolescents with type-1 diabetes mellitus had a mean age of 14.7 ±1.7 years, with ages ranging from 13 years to 18 years. This result wasn't consistent with the results of many other studies (Patel et al., 2019; Schnurbein et al., 2017; Silva et al., 2021). The proportion of female participants in our study exceeded a half, aligning with the results of previous studies (Patel et al., 2019). In contrast, other research had shown that males were more likely than females to be affected by type-1 diabetes mellitus (Dewan, 2017; Rose et al., 2021).

The subcutaneous insulin injection technique was utilized more frequently than the insulin pump in the current study, which is in line with a multi-center study conducted in Germany which found that insulin pump usage was less frequent than insulin injection (Schnurbein et al., 2017). A possible reason for this finding could be financial constraints, given that the participants were from diverse provinces and rural regions. However, our results didn't match many studies which indicated that insulin pump usage among adolescents with type-1 diabetes mellitus was more prevalent than the use of multiple-dose insulin injection (Frye et al., 2019; Patel et al., 2019). Several studies found that the duration of diabetes mellitus exceeded one year (Bergner et al., 2018; Fortins et al., 2019; Patel et al., 2019; Rose et al., 2021; Schnurbein et al., 2017; Silva et al., 2021), the same as the current study finding among adolescents diagnosed with type-1 diabetes mellitus.

Most adolescents in the current research used some forms of technology that were approximately similar to those used in previous studies (Dewan, 2017; Nightingale et al., 2017; Yetim et al., 2018). As our study, previous studies (Bradbury et al., 2019; Dewan, 2017; Nightingale et al., 2017; Yetim et al., 2018) found that adolescents owned in their bedrooms MP3 players, computers, and other technology screens. Patel et al. (2019) revealed in their study that adolescents with type-1 diabetes mellitus owned on average one powered-on device, mostly a cell phone, in the bedroom. Our study showed that three technological activities were performed by adolescents after nine PM.

No previous study has examined the number of hours which were spent in front of technology screens after nine PM and its relationship with glycemic control. Recent data by Bradbury et al. (2019) demonstrated that American adolescents spent 1.97 hours daily in front of the television, played video games for 1.48 hours daily, used social media for 1.36 hours daily, talked on their telephones for 0.59 hour daily, as well as used the computer for school and homework for 0.58 hour daily. In contrast, our Jordanian adolescents spent 0.8 hour after nine PM watching television, 0.2 hour text messaging with friends, 0.6 hour using social media, 0.1 hour talking on the phone, 0.4 hour playing computer games, 0.2 hour listening to music, and 0.3 hour completing their homework after nine PM daily. Since the comparison was based on the entire day for American adolescents, as mentioned in Bradbury study, their screen times were higher than those of Jordanian adolescents.

The recommendations of the American Academy of Pediatrics contradict the result of the current study, in which adolescents within the age range from 13 years to 18 years shouldn't spend their time on television, using the computer and so on at least one hour before bedtime (Guram & Heinz, 2017). An Indian study agreed with our result, which found that adolescents aged from 10 years to 19 years spent two hours and more watching television, using computers, as well as other types of technology (Dewan, 2017). Moreover, 19.43% of adolescents spent more than two hours watching television according to (Dewan, 2017) results, in contrast to our study, and 28.1% of adolescents spent more than two hours on television after nine PM. This may be because Jordanian adolescents are engaged in other activities during the day time. Furthermore, our study revealed that 52.1% of adolescents used several types of technology after nine PM, whereas Nightingale et al. (2017) found that 28% of British children aged from nine years to ten years spent one to two hours and 13% of children spent two to three hours performing activities in front of technology devices. One possible cause for this discrepancy is that the British children in the previous study were younger than the Jordanian adolescents in the current study.

Saylor et al. (2019) elucidated in their study on adults with type-1 diabetes mellitus that the technology use index was 0.88 ±0.48, in contrast to our study. Despite this, no relationship was found between technology use index and glycemic control evaluated by HbA1c levels in adults with type-1 diabetes mellitus (Saylor et al., 2019), in contrast to our study results. This difference may be attributed to different populations examined.

The results of Dewan (2017) were consistent with those of our study, stating that watching television for more than two hours was associated with impaired glucose levels in diabetic patients. Nightengale et al. (2017) also supported our study results, reporting that spending three hours and more daily in front of technology devices is associated with higher levels of type-2 diabetes mellitus markers and that children became more at risk for type-2 diabetes mellitus. Moreover, using electronic media for talking with friends *via* WhatsApp and Facebook was a predictor of poor glycemic control evaluated by HbA1c levels above 8% in Turkish adolescents diagnosed with type-1 diabetes mellitus (Yetim et al., 2018). But, compared to our study findings, Yetim et al. (2018) showed that using the computer for homework completion for more than two hours would be considered a benefit for adolescents with poor glycemic control. So, using the computer for academic performance could be more beneficial than using it for others purposes.

The American Diabetes Association suggests that, for adolescents with type-1 diabetes mellitus, the HbA1c level should be kept below 7.5% to indicate proper glycemic control (Chiang et al., 2018). The results of the current study are inconsistent with the guidelines set by the American Diabetes Association. The results of this study align with a major landmark study conducted by Foster et al. (2019) in the United States on patients with type-1 diabetes mellitus aged from 1 year to 93 years. The study found that the HbA1c level among adolescents with type-1 diabetes mellitus who participated in the study was 9.3% (Foster et al., 2019). Furthermore, our study showed that most adolescents had HbA1c levels above the normal range, with only 18.8% achieving glycemic control with HbA1c levels less than 7.5%. These findings align with those of a Jordanian study that similarly reported only 20.9% of adolescents with type-1 diabetes mellitus reaching HbA1c levels less than 7.5%, indicating good glycemic control (Alassaf et al., 2019). Another recent Jordanian study showed that adolescents with type-1 diabetes mellitus aged approximately 14 years had poor glycemic control indicated by HbA1c levels ranging between 8% and 10% (Malkawi et al., 2024).

Strengths and Limitations

It is worth mentioning that our study has many strengths, in which we were able to address several aspects of technology used at night systematically by using a validated questionnaire. In addition, objective measurements from medical files of patients for levels of HbA1c were performed. Moreover, data collection was carried out in different regions in Jordan in its north and center, which included adolescents with type-1 diabetes mellitus and belonged to different governorates.

Despite the importance and strengths of our study results, limitations were found in this study. As noted, adolescents with type-1 diabetes mellitus filled out a self-reported survey, in which recall bias to the answers of questions could have occurred. Also, there were no objective measurements, where our measurements just depend on subjective responses. So, experimental studies are recommended and real-time measurements and monitoring of usage of technology devices should be conducted to obtain objective real findings. Another limitation is that a cross-sectional design was used in this study, which involved a small convenient sample. So, the generalizability of the results would be at risk and causal inferences can't be made. Therefore, longitudinal and qualitative studies are recommended to better understand the role of technology devices used at night and their impact on glycemic control among those with type-1 diabetes mellitus so that causal inferences can be suggested. Furthermore, the time of data collection was considered unlucky, because the world was still affected by Covid-19 pandemic in all aspects of life at the time of data collection, especially and this may be one of the reasons that led to the small sample size and the refusal of some participants and their parents to complete the survey. As a consequence, the replication of the study is recommended with different age groups, in addition to incorporating other regions and health care centers to increase the sample size and improve the generalizability of the findings.

Implications for Nursing

The findings of the current research offer valuable insights for clinical practice and healthcare providers. During clinical visits for adolescents with a diagnosis of type-1 diabetes mellitus, health care providers should integrate the daily technology use, especially at night, into their plan of diabetes mellitus management, taking into account the effects on HbA1c levels, as demonstrated by this study. Also, faculty members in diverse universities and colleges of nursing and other related medical fields should start developing curricula and educational policies to teach their medical students the diverse aspects of type-1 diabetes mellitus, especially regarding daily habits and activities.

Conclusion

Our study found a positive relationship between night-time technology use index and glycemic control in adolescents with type-1 diabetes mellitus, whose mean age was 14.7±1.7 years, being mostly females. Poor glycemic control was associated with increased hours of technology use after 9 PM. This study may help increase the awareness among adolescents with a diagnosis of type-1 diabetes mellitus and healthcare practitioners in hospital settings. Therefore, health care professionals should be mindful of the potential impact of using technology devices at night on glycemic control and consider guiding patients and their families on how to manage their screen times.

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Conflict of Interests

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