Journal of Pharmacy

ORIGINAL ARTICLE Open Access

# A comparative study: Impact of screen time on sleep quality among university students and school children

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## ABSTRACT

**Introduction:** Screen time has been found to affect sleep quality negatively. Despite numerous studies proving that poor sleep quality and excessive screen time is prevalent among school children and university students, a comparative study on both age groups is yet to be explored extensively so far. This study focused more on school-aged children and university students, as they are often associated with sleep deprivation. The main objectives are to assess the association between screen time and sleep quality among schoolchildren and university students and to compare the effects of screen time on sleep quality between both age groups. **Method:** This study was conducted in Kulliyyah of Pharmacy, IIUM Kuantan, and six primary schools around Kuantan involving 100 undergraduate pharmacy students and 100 primary schoolchildren aged 10 to 12 years old. The participants were assessed using a self-administered online questionnaire consisting of demographic background, electronic device use, and Pittsburgh Sleep Quality Index (PSQI). The result was analysed using SPSS 23.0 software— descriptive analysis and Chi-Square test to determine the association between duration of screen time and sleep quality. **Results:** The mean duration of screen time among the participants is 5.5 hours (± 0.102). 56.5% participants have poor sleep quality. The PSQI score for UG students is significantly higher (mean score 6.7 ± 2.741) compared to children (mean score 5.54 ± 2.812) respectively (*p* value=0.001). The duration of screen time is weakly related to sleep quality. However, respondents with excessive screen time of more than 12 hours have a higher mean PSQI score. **Conclusion:** The findings revealed that majority respondents have poor sleep quality, independent of screen time. Further research with larger sample size is suggested for clearer comprehensive results.

## ARTICLE HISTORY:

Received: 9 June 2022
Accepted: 31 January 2023
Published: 31 January 2023

## KEYWORDS:

Screen time, quality of sleep, PSQI, pharmacy students, school children

## HOW TO CITE THIS ARTICLE:

Mohd Kamaruzihan, N. Q. & Soe, M. K. (2023). A comparative study: impact of screen time on sleep quality among university students and school children. Journal of Pharmacy, 3(1). 75-85

doi: 10.31436/jop.v3i1.176

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## Introduction

It is a common phenomenon to see people carrying their smartphones everywhere, including going to the bed. The term “screen time” is referred to the activities done in front of a screen, such as watching television, working on a computer and laptop, or playing video games, which also includes spending time on social media (Kaneshiro Neil, 2019). Excessive screen time can be defined as the time spent in front of the screen for more than recommended. The recommended screen time is ideally 2 hours per day but it may vary according to the demographic background such as age group and occupation (LeBlanc et al., 2017).

Excessive screen time is often associated with short sleep duration and poor sleep quality. For example, university students often use laptops to do their assignments until late at night. Adolescents often use smartphones to access social media and to play games. According to a study done by Bhat et al. (2018), younger participants use electronic social media before bedtime more than older participants (Bhat et al., 2018). This finding is associated with insomnia and sleep disturbance on the particular group of population. According to Ohayon et al. (2017) on the National Sleep Foundation’s sleep quality recommendation, several key indicators for good sleep quality include sleep latency of up to 15 minutes, fewer awakenings, and reduced wake after the sleep onset (Ohayon et al., 2017). The recommended sleep duration for schoolchildren aged 6-13, teenagers aged 14-17, and young adults aged 18-25 according to the National Sleep Foundation is 9-11 hours, 8-10 hours, and 7- 9 hours respectively (National Sleep Foundation Recommends New Sleep Times | Sleep Foundation, 2015). Hence, the recommended sleep duration is longer for younger ages. However, not all are aware of the importance of maintaining a good sleep quality that is essential for growing children and truly practicing it.

This study mainly focuses on school-aged children and university students that are categorised as young adults as they are often associated with sleep deprivation and poor sleep quality. A study done among college students at King Abdulaziz University on the relationship between sleep quality and the level of Internet addiction resulted in 54.4% of the participants having poor sleep quality (Abdulrahman Khayat et al., 2018). Students were well-aware of the importance of getting optimal sleep duration and quality, but very few were actually practising it or making it a priority habit (Dowdell & Clayton, 2019). This might lead to several consequences that may affect their health and academic performance. One factor that may influence sleep quality is excessive screen time, which is supported by many studies. Night-time phone usage is commonly associated with sleep quality where first-year university students reported having a very short duration of sleep compared to the recommendations (Whipps et al., 2018). The presence of smartphones nearby before sleep might disturb their sleep pattern. Moreover, a previous study found that sleep deprivation was caused by media device use, whereby 38.4% students agreed that the major cause of their sleep deprivation was internet addiction (Ranasinghe et al., 2018). As there are many studies proving that poor sleep quality and excessive screen time are prevalent among schoolchildren and university students, it is important to determine the association between them and whether excessive screen time influences their sleep quality in a negative way. This study aims to assess the association between the duration of screen time and sleep quality among schoolchildren and university students, to determine the effects of excessive screen time on sleep quality, and to compare the effects of a longer duration of screen time on sleep quality between schoolchildren and university students. The hypotheses suggested in this study is excessive screen time causes poor sleep quality in schoolchildren and university students.

## Methodology

A cross-sectional study was conducted quantitatively among schoolchildren aged ten to twelve years old from primary schools in Kuantan and undergraduate pharmacy students in IIUM Kuantan Campus. The participants were assessed using a close-ended questionnaire, which consists of the demographic background of the participants, electronic device use, and the Pittsburgh Sleep Quality Index (PSQI). There are seven components in the PSQI which are subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. The questionnaire was provided in English and Malay. After receiving approval from IIUM Research Ethics Committee, this study was subsequently approved by the Ministry of Education and Pahang State Education Department. The survey was distributed by their respective teacher to the primary school students with the permission of the school headmasters. Parental consent was needed for schoolchildren to participate in this study. All participants were required to submit their consent form before answering the survey and their participation was voluntary. The result was analysed using SPSS 23.0 software— descriptive analysis and Chi-Square test to determine the association between screen times and sleep quality and to compare the result between schoolchildren and university students. The sample size was calculated with 95% confidence interval, 80% power and 0.29 odds ratio, the minimum recommended sample size is 98. Therefore, 200 (100 primary schoolchildren and 100 university students) were selected randomly as study subjects.

***1. Inclusion criteria***

1. Primary school children aged 10 to 12 years old, studying in a school in Kuantan, Pahang, able to write and understand English or Malay language, consented by their parents or guardian.

2. Undergraduate pharmacy students currently studying in Year 1, 2, 3, or 4 in Kulliyyah of Pharmacy, able to read and understand English.

3. Participation in both populations is voluntary.

***2. Exclusion criteria***

1. Children with significant physical and mental disabilities or chronic illness, age below 9 and above 12, or did not receive consent from their parents.

2. Students from other Kulliyyah in IIUM Kuantan, postgraduate students, students who cannot read nor understand English, students with chronic illness and physical or mental disabilities.

## Results

***1. Demographic background***

Table 1 shows the descriptive statistics of the socio-demographic factors for both students and children. The mean age for the undergraduate (UG) students and children is 20.60 (±1.303) and 11.13 (±0.825) years old, respectively. 100% participants from the university are Malay while 91% from the school and minority of them are from other races.

The calculated mean BMI for both groups are 21.33 (UG students) and 19.23 (children). The basal metabolic rate (BMR) is calculated from the formula shown in Figure 1.

The mean BMR for UG students is 1411.33 (±168.07) kcal per day while for children is 1233.71 (±161.99) kcal per day. Majority of the UG students are lightly active (47%) while majority of the children are moderately active (40%). Total calorie requirement is calculated from the formula shown in Figure 2 with the calculated mean of 1859.97 (±281.08) kcal for UG students and 1738.18 (±311.03) kcal for children.

Table 1: Socio-demographic factors of participants

| Socio-demographic factors | | UG Students | Children |
|---|---|---|---|
| | | n (%) | n (%) |
| Age* (years) | | 20.60 (±1.30) | 11.13 (±0.83) |
| Gender | Male | 26 (26.0) | 46 (46.0) |
| | Female | 74 (74.0) | 54 (54.0) |
| Race | Malay | 100 (100.0) | 91 (91.0) |
| | Chinese | 0 | 2 (2.0) |
| | India | 0 | 6 (6.0) |
| | Others (Melanau) | 0 | 1 (1.0) |
| BMI* | | 21.33 (±3.90) | 19.23 (±4.68) |
| Height* (cm) | | 159.23 (±8.12) | 142.44 (±13.03) |
| Weight* (kg) | | 54.10 (±3.90) | 39.10 (±11.21) |
| BMR* | | 1411.33 (±168.07) | 1233.71 (±161.99) |
| Activity factor level | Sedentary | 43 (43%) | 26 (26%) |
| | Lightly active | 47 (47%) | 32 (32%) |
| | Moderately active | 10 (10%) | 40 (40%) |
| | Very active | 0 | 2 (2%) |
| | Extremely active | 0 | 0 |
| TCR* (kcal) | | 1859.97 (±281.08) | 1738.18 (±311.03) |

Notes: *Expressed in means ± SD
Abbreviations: BMI, body mass index; BMR, basal metabolic rate; TCR, total calorie requirement; PSQI, Pittsburgh Sleep Quality Index.

As for the activity factor level, 47% of UG students are lightly active followed by 43% sedentary and 10% moderately active. Meanwhile, 40% of schoolchildren are moderately active followed by 32% lightly active, 26% sedentary, and 2% very active.

$$\begin{aligned} BMRmen &= 66.5 + (13.75 \text{ x weight in kg}) \\ &\quad + (5.003 \text{ x height in cm}) \\ &\quad - (6.775 \text{ x age in years}) \end{aligned}$$

$$\begin{aligned} BMRwomen &= 655.1 + (9.563 \text{ x weight in kg}) \\ &\quad + (1.850 \text{ x height in cm}) \\ &\quad - (4.676 \text{ x age in years}) \end{aligned}$$

Figure 1: Harris-Benedict equation for calculation of BMR

Total Caloric Requirements (TCR) = BMR x Activity Factor

- Little/ no exercise: BMR x 1.2
- Light exercise: BMR x 1.375
- Moderate exercise (3-5 days/week): BMR x 1.55
- Very active (6-7 days/week): BMR x 1.725
- Extra active (very active and physical job): BMR x 1.9

Figure 2: Calculation for TCR

***2. Pattern of smartphone usage***

The most used electronic devices among the participants are smartphones (81%), followed by computer/laptop (10%), tablet/iPad (4.5%), television (4%), and video games (0.5%) (Table 2). All UG students own a smartphone while 81% of schoolchildren own it. The mean age of first using smartphone for UG students is 13 years old, while for children is 8 years old. UG students spend average time using smartphone more than children do, which is 5-6 hours per day and 3-4 hours per day, respectively.

Most children spend more than 2 hours on electronic devices for academic purposes, but most UG students spend more than 2 hours for social media and entertainment. Other purposes of using electronic devices mentioned by the participants from the survey are online shopping, work-related purpose, reading e-books and online news, searching information, and communication. Majority of UG students (98%) and children (57%) used smartphone in the last hour before bedtime.

Most of UG students take smartphones to bed with them (88%) while majority of children (60%) are not. In addition, majority use smartphone as alarm clock, to text message and browse social media before sleep.

Table 2: Pattern of smartphone usage among participants

| Questions | | UG Students n (%) | Children n (%) | Total % |
|---|---|---|---|---|
| What type of electronic devices you use the most? | Smartphone | 84 (42%) | 78 (39%) | 81.0 |
| | Television | 1 (0.5%) | 7 (3.5%) | 4.0 |
| | Computer/ Laptop | 10 (5%) | 10 (5%) | 10.0 |
| | Tablet/ iPad | 5 (2.5%) | 4 (2%) | 4.5 |
| | Video Games | 0 (0%) | 1 (0.5%) | 0.5 |
| Do you own a smartphone? | Yes | 100 (50%) | 81 (40.5%) | 90.5 |
| | No | 0 (0%) | 19 (9.5%) | 9.5 |
| Age of first using a smartphone* | | 13.81 (±2.39) | 8.8 (±2.53) | |

| | | | | | |
|---|---|---|---|---|---|
| Average time spent per day using smartphone (hours) | | | 5.5 | 3.5 | |
| Purpose of using electronic devices and daily usage | Academic | No use | 0 (0%) | 0 (0%) | 0.0 |
| | | <30 minutes | 12 (6%) | 4 (2%) | 8.0 |
| | | 30 min-1 hours | 20 (10%) | 13 (6.5%) | 16.5 |
| | | 1-2 hours | 20 (10%) | 21 (10.5%) | 20.5 |
| | | >2 hours | 48 (24%) | 62 (31%) | 55.0 |
| | Social Media | No use | 0 (%) | 20(10%) | 10.0 |
| | | <30 minutes | 1 (0.5%) | 17 (8.5%) | 9.0 |
| | | 30 min-1 hours | 13 (6.5%) | 19 (9.5%) | 16.0 |
| | | 1-2 hours | 33 (16.5%) | 29 (14.5%) | 31.0 |
| | | >2 hours | 53 (26.5%) | 15 (7.5%) | 34.0 |
| | Video Games | No use | 47 (23.5%) | 19 (9.5%) | 33.0 |
| | | <30 minutes | 21 (10.5%) | 23 (11.5%) | 22.0 |
| | | 30 min-1 hours | 11 (5.5%) | 24 (12%) | 17.5 |
| | | 1-2 hours | 13 (6.5%) | 20 (10%) | 16.5 |
| | | >2 hours | 8 (4%) | 14 (7%) | 11.0 |
| | Entertainment | No use | 1 (0.5%) | 17 (8.5%) | 9.0 |
| | | <30 minutes | 2 (1%) | 22 (11%) | 12.0 |
| | | 30 min-1 hours | 10 (5%) | 27 (13.5%) | 18.5 |
| | | 1-2 hours | 33 (16.5%) | 21 (10.5%) | 27.0 |
| | | >2 hours | 54 (27%) | 13 (6.5%) | 33.5 |

| | | | | | |
|---|---|---|---|---|---|
| | Others | No use | 41 (20.5%) | 38 (19%) | 39.5 |
| | | <30 minutes | 23 (11.5%) | 30 (15%) | 26.5 |
| | | 30 min-1 hours | 15 (7.5%) | 19 (9.5%) | 17.0 |
| | | 1-2 hours | 13 (6.5%) | 4 (2%) | 8.5 |
| | | >2 hours | 8 (4%) | 9 (4.5%) | 8.5 |
| Electronic devices used in the last hour before bedtime | Smartphone | | 98 (49%) | 57 (28.5%) | 77.5 |
| | Television | | 1 (0.5%) | 44 (22%) | 22.5 |
| | Computer/ Laptop | | 25 (12.5%) | 2 (1%) | 13.5 |
| | Tablet/ iPad | | 12 (6%) | 5 (2.5%) | 8.5 |
| | Video Games | | 3 (1.5%) | 3 (1.5%) | 3.0 |
| Do you take your smartphone and/or tablet to bed with you? | Yes | | 88 (44%) | 40 (20%) | 74.0 |
| | No | | 12 (6%) | 60 (30%) | 26.0 |
| Do you use your smartphone and/or tablet as your alarm clock? | Yes | | 92 (46%) | 60 (30%) | 74.0 |
| | No | | 8 (4%) | 40 (20%) | 24.0 |
| Do you text or use a messaging app before sleep? | Yes | | 57 (28.5%) | 79 (39.5%) | 68.0 |
| | No | | 43 (21.5%) | 21 (10.5%) | 32.0 |
| Do you play games on your smartphone and/or tablet before sleep? | Yes | | 21 (10.5%) | 61 (30.5%) | 41.0 |
| | No | | 79 (39.5%) | 39 (19.5%) | 59.0 |
| Do you use social media on your smartphone before sleep? | Yes | | 92 (46%) | 61 (30.5%) | 76.5 |
| | No | | 8 (4%) | 39 (19.5%) | 23.5 |

Notes: *Expressed in means ± SD

Kamaruzihan & Soe (2023) *Journal of Pharmacy,* 3(1), 75-85

### *3. Sleep quality*

A PSQI score of more than five indicates poor sleep quality. 56.5% participants have poor sleep quality. The mean global score for UG students is higher compared to children where their mean score is 6.73 and 5.54, respectively (Table 3). Other components that are significantly higher among UG students are Component 1 (subjective sleep quality) and Component 7 (daytime dysfunction).

The association of gender, age group (UG students and children), and screen time with sleep quality were determined using Chi-Square Independence test (Table 4). The result shows an association between age group and sleep quality, (p=0.004). Meanwhile, there is no significant association found between gender and screen time with sleep quality.

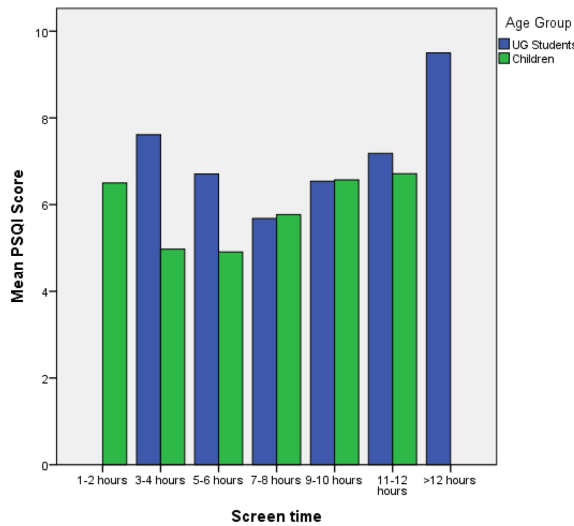


Figure 3: Graph association between screen time and sleep quality.

Table 3: Scores of each component of the Pittsburgh Sleep Quality Index (PSQI) and the Global PSQI Score

| PSQI | UG Students Mean±SD | Children Mean±SD | *P*-value |
|---|---|---|---|
| Component 1: Subjective sleep quality | 1.44 (0.857) | 0.81 (0.775) | .000[a] |
| Component 2: Sleep latency | 1.07 (1.008) | 0.82 (0.821) | .108 |
| Component 3: Sleep duration | 1.57 (0.924) | 1.56 (0.701) | .765 |
| Component 4: Sleep efficiency | 0.32 (0.634) | 0.46 (0.881) | .538 |
| Component 5: Sleep disturbance | 1.05 (0.500) | 1.06 (0.565) | .975 |
| Component 6: Sleep medication | 0.09 (0.473) | 0.09 (0.429) | .749 |
| Component 7: Daytime dysfunction | 1.19 (0.720) | 0.74 (0.705) | .000[a] |
| Global Score | 6.73 (2.741) | 5.54 (2.812) | .001[a] |

[a] Significant at p<0.05

Table 4: Association of gender, age group, and screen time with PSQI sleep quality using Chi-Square test.

| Variables | Pearson Chi-Square Value | df | Asymptomatic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Gender | 0.634[a] | 1 | .426 | .460 | .258 |
| Age group | 8.972[a] | 1 | .004 | .004 | .002 |
| Screen time | 7.825[b] | 6 | .251 | | |

a. 0 cells (0.0%) have expected count less than 5.
b. 2 cells (14.3%) have expected count less than 5. The minimum expected count is 0.87.

***4. Other parameters***

Of 29 respondents who are overweight, 15 of them are having poor sleep quality, while 7 out of 13 respondents who are obese have poor sleep quality. An Eta Coefficient test was used to determine whether there is an association between BMI and sleep quality. Thus, the following null hypothesis was tested:

H0 = There will be no association between BMI and respondents' sleep quality.

There was no significant association between BMI and sleep quality, $\eta = 0.011$. Thus, we cannot reject the null hypothesis and no significant association was found between BMI and respondents' sleep quality.

## Discussion

***1. Pattern of electronic device use***

We found out that most respondents used smartphones the most, followed by computer and laptops. Previous studies showed that smartphones and laptops were the most used electronic devices among UG students and adolescents (Dowdell & Clayton, 2019; Ramesh et al., 2020). While all UG students owned a smartphone, 40.5% children in this study were using their parent's smartphone. In this study, it is observed that UG students spent more screen time compared to the children.

A previous study was conducted on the average time spent on electronic devices among schoolchildren. It was found that they spent 5 hours per day on electronic devices, indicating that children are exposed to excessive screen time (Unplagan et al., 2018). The prevalence of excessive screen time was also undeniably high among university students (Demirci et al., 2015). Most of the respondents in our study spent more than 2 hours on electronic devices for academic purposes, by which the children spent more for academic compared to UG students. This is reasonable in this era of COVID-19 pandemic where all of the teaching and learning method has been switched to online learning. Social media becomes the second lead purpose of using electronic devices which the UG students preceded the children.

Similarly, a study found that social media was used as a reference material to obtain current information in order to stay updated (Nazir et al., 2020). They tend to check their smartphone before sleep, or using it as an alarm (Dowdell & Clayton, 2019; LeBourgeois et al., 2017). Our study observed majority of them take their smartphone to bed, whether as their alarm or to check messaging app and social media before bed, or to play video games. Pharmacists could play an important role in educating the children on the effect of excessive screen time on sleep quality by campaigning at school as a community project. Educating the parents is also important to provide strict control on the children's screen time.

***2. Evaluation of sleep quality***

The mean PSQI global score for UG students and children suggested poor sleep quality for both groups. However, the results were just slightly over the threshold value (PSQI global score >5). This study found that majority of the respondents have poor sleep quality. This result is similar with a study by Ramesh et al. (2020) which found that 43.5% of the participants had good sleep quality while 56.43% of the participants had poor sleep quality. Our study observed a significant difference of the PSQI global score between UG students and children with a higher score among students, indicating UG students have worse sleep quality than children do.

In support with these findings, a study done by Nurismadiana & Lee (2018) on the prevalence of sleep quality among university students in a public university found that the prevalence of the students having poor sleep quality is higher among undergraduate students. Students are sleep deprived due to the tight academic schedule, academic pressure, and lack of supervision from parents (Dowdell & Clayton, 2019).

***3. Sleep quality and screen time, gender, BMI***

There is weak evidence of association between duration of screen time and sleep quality (p=0.251). In support for this finding, previous studies found no significant relation between duration of screen time before bed and sleep quality among medical students (Ramesh et al., 2020; Yeluri et al., 2020). They also found no association between genders, passive screen time, and sleep quality.

However, another study by Hrafnkelsdottir et al. (2020) found that greater screen time was associated with irregular sleep pattern in terms of bedtime, wake time, rest duration, and sleep duration among adolescents. There is no significant relation between daytime dysfunction and screen time in this study. However, respondents with excessive screen time of more than 12 hours have a higher mean PSQI score, specifically for the component of daytime dysfunction. Similar to a previous study, majority of their respondents experienced poor sleep quality and daytime lethargy because of excessive smartphone use at late-night (Syed Nasser et al., 2020).

Daytime sleepiness might affect the student's academic performance because they are unable to focus during the class. Sleep disturbance among adolescents are closely related to excessive screen time (Greever et al., 2017; Tao et al., 2017). Excessive screen time can disturb sleep quality although the exact mechanism is unknown. It is proposed that excessive screen time can disrupt circadian rhythm (Blume et al., 2019; Lely et al., 2014), delay bedtime onset (Dowdell & Clayton, 2019; Ghekiere et al., 2019), reduce sleep duration (Boonluksiri, 2018; Whipps et al., 2018), and increase daytime sleepiness

(Hershner & Chervin, 2014).

This study found no significant difference of sleep quality between genders, which is similar to previous study that found lack of consistency in gender differences concerning sleep quality (Farah et al., 2019). We found weak association in terms of BMI, activity level, and sleep quality, which is not in agreement with previous studies where they found association between sleep quality and BMI specifically in overweight and obese respondents (Krističević et al., 2018; J. Wang et al., 2019). Sleep quality might affect body weight because sleep deprivation leads to hormonal imbalance, which promotes weight gain through the production of leptin and ghrelin, hormones that control appetite (Beccuti & Pannain, 2011).

This study used a self-administered questionnaire to assess the screen time and sleep quality, thus recall bias could not be avoided. In addition, it limits the in-depth interpretation of the data, as the study method is a quantitative study. Further study in assessing qualitative aspects should be conducted to study more on the impacts of excessive screen time on sleep quality and other health-related parameters. Next, since the children need to use recall techniques to answer the questionnaire, bias could not be excluded. COVID-19 pandemic has also put a strain on this research. Data collection is limited to online survey for the participants in Kulliyyah of Pharmacy and limited contact with schoolchildren with strict standard of procedure to prevent the virus transmission. Further similar research with larger sample size focusing on children and adolescents is suggested for clearer comprehensive results.

## Conclusion

Overall, this study found a promising significant finding for the association between duration of screen time and sleep quality among UG students and children. The majority of respondents developed poor sleep quality with a higher prevalence among UG students, specifically in the aspects of subjective sleep quality and daytime dysfunction, but both components are independent of screen time. This study highlights the effects of excessive screen time on sleep quality and the importance of having good sleep quality for the children and university students.

## Conflict of Interest

The authors declare no conflict of interest in the journey of publishing this research article.

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