

# Relationship between Smartphone Screen Time, Physical Activity, and Self-Reported Fatigue among Medical Students

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## ABSTRACT

**Background:** Smartphone use has become an integral part of medical education and daily communication; however, prolonged screen exposure may contribute to sedentary behavior, disturbed sleep, and increased fatigue. Medical students are especially vulnerable due to their hectic schedules, heavy reliance on digital learning platforms and limited access to physical exercise. This study was conducted to find the relationship between the use of smartphones, physical activity and fatigue of medical students.

**Methods:** A cross-sectional analytical study was conducted among 82 undergraduate medical students at Islamabad Medical and Dental College, Islamabad, Pakistan from April 2025 to September 2025. The information was obtained by a structured questionnaire that collected data on demographic characteristics, daily smartphone screen time, physical activity, sleep duration, sedentary behaviour, and fatigue. Smartphone screen time was classified as 0-<3 hours, 3-5 hours, 5-7 hours and >7 hours daily. Physical activity was categorized as low, moderate, or high, and fatigue was measured by a self-report fatigue scale. IBM SPSS Statistics version 25.0 was used for the analysis of the data. One-way ANOVA, chi-square test, Pearson correlation and multiple linear regression were used as indicated. A p value of < 0.05 was regarded statistically significant.

**Results:** The mean age of participants was  $21.8 \pm 1.7$  years, and 44 (53.7%) were female. Mean daily smartphone screen time was  $5.4 \pm 2.0$  hours, while the mean fatigue score was  $21.7 \pm 7.0$ . Fatigue increased progressively across higher screen-time categories, from  $15.8 \pm 4.9$  among students using smartphones for <3 hours/day to  $27.0 \pm 6.1$  among those reporting >7 hours/day ( $p < 0.001$ ). Students with low physical activity had significantly higher fatigue scores than those with moderate or high physical activity ( $p < 0.001$ ). Smartphone screen time showed a positive correlation with fatigue ( $r = 0.51$ ,  $p < 0.001$ ), whereas weekly physical activity ( $r = -0.39$ ,  $p < 0.001$ ) and sleep duration ( $r = -0.34$ ,  $p = 0.002$ ) were inversely associated with fatigue. On multivariable analysis, greater smartphone screen time remained independently associated with higher fatigue, whereas greater physical activity was associated with lower fatigue.

**Conclusion:** Higher smartphone screen time was significantly associated with greater self-reported fatigue among medical students, while higher levels of physical activity were associated with lower fatigue. Promoting balanced smartphone use, regular physical activity, and adequate sleep may help reduce fatigue and improve student well-being.

**Keywords:** Smartphone use; Screen time; Physical activity; Fatigue; Medical students; Sedentary behavior; Sleep

## INTRODUCTION

Smartphones are essential in today's medical education landscape, enabling students to have instant access to their electronic textbooks, clinical guidelines, learning apps, recorded lectures, communication apps, and online academic resources. The impact of their education has grown even more with the increasing scope of digital and blended learning. Meanwhile, university students are also using their smartphones extensively for social networking, entertainment, gaming, communication, etc., leading to excessive screen time. In parallel, smartphones are being used extensively by the university students for social networking, entertainment, gaming, communication, etc., which is resulting in excessive screen time by the students of the university. As a result, there have been worries about the potential physical and mental impacts of too much time spent on a smartphone, especially among today's young adults who have significant academic responsibilities (1-3).

Extended screen time can impact health in a number of interconnected ways. Prolonged smartphone use typically involves sitting for extended periods of time and decreased physical activity, both of which can lead to sedentary behavior and displacement of physical activity. However, excessive screen time may occur during the evening and night time period, which may delay sleep onset and reduce sleep time. Other factors that could disrupt sleep are bright screen exposure, frequent alerts, an overstimulated online environment, and frequent checking. These

factors may all add up to cause daytime fatigue, lack of concentration, decreased motivation, and increased subjective fatigue. In the general population, previous research has shown that too much screen time is linked to sleep problems, emotional stress, decreased attention, musculoskeletal discomfort and academic underperformance among university students (4-6).

Fatigue is a frequent but common ailment among medical students. It can be felt in the body as fatigue, tiredness, lack of energy, inability to focus or complete everyday tasks or academic assignments. Fatigue may be a risk factor for medical education as a consequence of extended periods of study, exams, clinical rotations, altered sleep patterns, psychological stress, and insufficient time for recovery. Excessive tiredness can have a negative impact on learning capacity, schoolwork, emotional health and quality of life. Thus, it is of particular importance to identify modifiable lifestyle factors that can be associated with fatigue in this population (7-9).

Physical activity may play a protective role against fatigue. Frequent physical activity is linked to: better cardiovascular fitness, better sleep, enhanced mood, stress reduction, and improved energy regulation. Adults are recommended to undertake moderate or vigorous physical activity on a regular basis and reduce the amount of sedentary time. But medical students often complain about lack of exercise due to high workload in the curriculum and long study hours. More time with smartphones could also diminish exercise time by displacing other active activities, such as walking, sports, recreation, or planned physical activity. Previous research with university students has shown that physical activity is negatively correlated with problematic smartphone use, and increased activity is correlated with decreased fatigue and increased psychological well-being (10-12).

The association between smartphone use, levels of physical activity and fatigue might thus be interconnected instead of independent. The student who uses his smartphone for prolonged time can be more sedentary, can sleep for less time, can be less active physically, and thus suffer from more fatigue. In contrast,

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pupils who are physically active and get proper sleep might not be as impacted by the detrimental effects of over-exposure to digital devices. Although the use of smart phones among university students has been extensively studied, much work remains to relate screen time, physical activity and fatigue in the context of local educational settings, especially among medical students (13).

The present study was therefore conducted to determine the relationship between smartphone screen time, physical activity, and self-reported fatigue among medical students. It also aimed to examine whether greater daily screen exposure was associated with higher fatigue and whether higher physical activity was associated with lower fatigue. Understanding these relationships may help medical institutions develop practical strategies promoting healthier digital habits, adequate physical activity, improved sleep, and better overall student well-being.

## METHODOLOGY

A cross-sectional analytical study was conducted among undergraduate medical students at Islamabad Medical and Dental College, Islamabad, Pakistan from April 2025 to September 2025. The purpose of the study was to determine the correlation between the amount of screen time the medical students use their smartphones daily and their level of physical activity and fatigue. Students from various academic years were approached to get their representation from different medical education levels. The study included a total of eight-two medical students. Eligibility criteria included being an undergraduate medical student, using a smartphone on a regular basis and agreement to participate in the study, irrespective of gender. Students with a previously diagnosed chronic medical condition that significantly impacts physical activity or fatigue, those taking medications known for causing significant fatigue or sedation and those that failed to complete questionnaires were excluded.

A non-probability sampling technique of consecutive sampling was used to sample participants to obtain the set number of 82 students required for the study. The data were gathered through a self-administered questionnaire that was structured. Prior to the study, the purpose and procedure were explained to the students and they gave consent to participate. The survey gathered data on age, gender, academic year, place of residence, body mass index (BMI), sleep time, caffeine intake, smart phone habits, physical activity, sedentary, and tiredness. Confidentiality was ensured by not using personally identifying information on data collection form. There was no compulsion, and students were told they do not have to participate or suffer any academic or personal penalty for dropping out.

Screen time for the smartphone was defined as the amount of time spent actively using this device during an average day. The use of the built-in digital wellbeing or screen-time function of their smartphone (where available) was encouraged, in addition to memory. The number of hours of smartphone use was recorded daily and then divided into groups and compared with <3 hours, 3–5 hours, 5–7 hours, and >7 hours per day of smartphone use in terms of fatigue levels. There were also some characteristics regarding smartphone usage, such as the use of the smartphone within one hour of going to sleep and smartphones use after bedtime at night. Aside from this, recent studies have been conducted to assess digital screen exposure in university students using a duration-based metric, but it is currently unknown what the universal definition of digital screen overuse is for adults.

Questionnaire items from the World Health Organization Global Physical Activity Questionnaire (GPAQ) were used to assess physical activity. The GPAQ measures physical activity in a variety of domains and also includes sedentary behaviours, which makes it a good tool for measuring physical activity at a population level. Participants indicated the number and amount of moderate physical activity and vigorous physical activity minutes they engage in per week and total minutes were summed to achieve the total minutes of physical activity. Participants were categorized

into low, moderate, or high physical activity level, based on the scoring method in the questionnaire for analysis. Activity level was also recorded as regular exercise, which was defined as exercise on three or more days per week. The Fatigue Assessment Scale (FAS) was a brief (10 item) self-report fatigue scale used to assess overall fatigue. Responses were scored on the prescribed response scale and then summed to provide an overall fatigue score, which will increase in perceived fatigue. Fatigue scores were then classified into clinically meaningful categories (minimal, mild, moderate, severe or very severe) for descriptive analysis.

Data were entered, cleaned, and analyzed using IBM SPSS Statistics version 25.0. The mean and standard deviation were used to summarize continuous variables (age, daily smartphone screen time, weekly level of physical activity, sleep duration, BMI, fatigue score) while frequencies and percentages were used for categorical variables. Prior to inferential analysis, the normality of continuous variables was checked. One-way analysis of variance (ANOVA) was used to compare mean fatigue scores for each of the categories of smartphone screen-time and physical-activity, when the assumptions for parametric analysis could be met. Categorical variables, such as screen-time category, physical activity level and moderate to severe fatigue, were analyzed by the chi-square test or Fisher's exact test as appropriate. Pearson's correlation coefficient was used to explore the relationship between daily screen time, weekly physical activity, sedentary time and fatigue score. Multiple linear regression analysis was then conducted to see if there was an independent relationship between each of these smartphone screen time and physical activity and fatigue, after controlling for potential confounding factors: age, gender, sleep duration, and caffeine consumption. A p value of <0.05 was deemed statistically significant and appropriate 95% confidence intervals were reported when applicable.

## RESULTS

In total, 82 medical students participated in the study. The mean age of the subjects was  $21.8 \pm 1.7$  years (range 19-26). Of the total participants, 44 (53.7%) were female and 38 (46.3%) were male. All academic years were represented with the highest number of students from the third and fourth year. The mean body mass index was  $23.4 \pm 3.1$  kg/m<sup>2</sup>. The mean sleep time reported was  $6.6 \pm 1.2$  hrs of sleep per night and 34 (41.5%) of the students reported sleeping less than 6 hrs of sleep per night.

**Table 1:** Demographic and Lifestyle Characteristics of the Study Participants (n = 82)

| Characteristics              | Frequency n (%) / Mean $\pm$ SD |
|------------------------------|---------------------------------|
| Age, years                   | 21.8 $\pm$ 1.7                  |
| Gender                       | Male 38 (46.3)                  |
|                              | Female 44 (53.7)                |
| Academic year                | First year 14 (17.1)            |
|                              | Second year 15 (18.3)           |
|                              | Third year 18 (22.0)            |
|                              | Fourth year 19 (23.2)           |
|                              | Fifth year 16 (19.5)            |
| BMI, kg/m <sup>2</sup>       | 23.4 $\pm$ 3.1                  |
| Sleep duration, hours/night  | 6.6 $\pm$ 1.2                   |
| Sleep <6 hours/night         | 34 (41.5)                       |
| Regular caffeine consumption | 47 (57.3)                       |
| Hostel residence             | 45 (54.9)                       |
| Day scholar                  | 37 (45.1)                       |

The average daily amount of time spent on a smartphone of the participants was  $5.4 \pm 2.0$  hours. As for the use of the smartphones, only 12 (14.6%) students used them for less than 3 hours a day while 20 (24.4%) used them more than 7 hours a day. Of the 62 participants who used their Smartphones within 1 hour of bedtime, 43 students (52.4%) reported frequent use of Smartphones at night after going to bed. When it comes to

exercise, the average exercise time was  $139.6 \pm 71.8$  minutes per week. Thirty-two (39.0%) students had low physical activity, 30 (36.6%) students had moderate and 20 (24.4%) students had high physical activity. 31 (37.8%) of the participants reported regular exercise (at least every 3 days a week). The mean score for self-reported fatigue was  $21.7 \pm 7.0$ . The defined fatigue classification resulted in 15 students being classified as having had no or minimal fatigue, 25 students as having mild fatigue, 27 students as having moderate fatigue and 15 students as having severe fatigue.

**Table 2: Smartphone Use, Physical Activity, and Fatigue Characteristics among Medical Students**

| Variable                            | Frequency n (%) / Mean $\pm$ SD |
|-------------------------------------|---------------------------------|
| Daily smartphone screen time, hours | $5.4 \pm 2.0$                   |
| <3 hours/day                        | 12 (14.6)                       |
| 3–5 hours/day                       | 24 (29.3)                       |
| 5–7 hours/day                       | 26 (31.7)                       |
| >7 hours/day                        | 20 (24.4)                       |
| Screen-time category                |                                 |
| Smartphone use before bedtime       | 62 (75.6)                       |
| Night-time smartphone use           | 43 (52.4)                       |
| Physical activity, minutes/week     | $139.6 \pm 71.8$                |
| Low                                 | 32 (39.0)                       |
| Moderate                            | 30 (36.6)                       |
| High                                | 20 (24.4)                       |
| Regular exercise $\geq 3$ days/week | 31 (37.8)                       |
| Fatigue score                       | $21.7 \pm 7.0$                  |
| None/minimal                        | 15 (18.3)                       |
| Mild                                | 25 (30.5)                       |
| Moderate                            | 27 (32.9)                       |
| Severe                              | 15 (18.3)                       |
| Fatigue category                    |                                 |

As time on the smartphone screen increased, there was a progressive increase in fatigue. Students who reported using a smartphone for less than 3 hours a day had the lowest mean fatigue score ( $15.8 \pm 4.9$ ), and those who reported using a smartphone more than 7 hours a day had the highest mean fatigue score ( $27.0 \pm 6.1$ ). The mean fatigue scores for the four screen-time groups was statistically different ( $p < 0.001$ ). The percentage of significant fatigue (moderate to severe fatigue) was higher among students that used their smartphones for more than 7 hours per day (80.0%) compared to those that used their smartphone for less than 3 hours per day (4 (33.3%)). There was a statistically significant association between screen-time category and significant fatigue ( $p = 0.006$ ).

**Table 3: Relationship between Daily Smartphone Screen Time and Self-Reported Fatigue**

| Daily screen time                                | n  | Mean fatigue score, Mean $\pm$ SD | Moderate/severe fatigue n (%) | p-value |
|--------------------------------------------------|----|-----------------------------------|-------------------------------|---------|
| <3 hours                                         | 12 | $15.8 \pm 4.9$                    | 4 (33.3)                      |         |
| 3–5 hours                                        | 24 | $19.2 \pm 5.8$                    | 9 (37.5)                      |         |
| 5–7 hours                                        | 26 | $22.9 \pm 6.2$                    | 13 (50.0)                     |         |
| >7 hours                                         | 20 | $27.0 \pm 6.1$                    | 16 (80.0)                     | <0.001* |
| Overall association with moderate/severe fatigue |    |                                   |                               | 0.006†  |

\*One-way ANOVA for mean fatigue scores.

†Chi-square test for categorical fatigue status.

There was a significant relationship between physical activity and fatigue. The mean fatigue scores were  $25.3 \pm 6.4$  for low physical

activity,  $20.6 \pm 5.7$  for moderate physical activity and  $17.6 \pm 5.5$  for high physical activity students. The difference was significant at  $p < 0.001$  level. Students who engaged in moderate or severe levels of fatigue were more common at the low physical activity level (22, 68.8%) than at moderate (14, 46.7%) or high (6, 30.0%) levels. There was a significant association between physical activity level and fatigue category ( $p = 0.012$ ).

**Table 4: Relationship between Physical Activity Level and Self-Reported Fatigue**

| Physical activity level                          | n  | Mean fatigue score, Mean $\pm$ SD | Moderate/severe fatigue n (%) | p-value |
|--------------------------------------------------|----|-----------------------------------|-------------------------------|---------|
| Low                                              | 32 | $25.3 \pm 6.4$                    | 22 (68.8)                     |         |
| Moderate                                         | 30 | $20.6 \pm 5.7$                    | 14 (46.7)                     |         |
| High                                             | 20 | $17.6 \pm 5.5$                    | 6 (30.0)                      | <0.001* |
| Overall association with moderate/severe fatigue |    |                                   |                               | 0.012†  |

\*One-way ANOVA for mean fatigue scores.

†Chi-square test for categorical fatigue status.

Correlation analysis showed a moderate positive correlation between daily smartphone time and fatigue score ( $r = 0.51$ ,  $p < 0.001$ ), suggesting that more time spent on the smartphone was correlated with higher fatigue scores. There were, however, moderate negative correlations between the weekly duration of physical activity and fatigue score ( $r = -0.39$ ,  $p < 0.001$ ). Fatigue also had a negative correlation with sleep duration ( $r = -0.34$ ,  $p = 0.002$ ).

**Table 5: Correlation of smartphone screen time, physical activity, and sleep duration with fatigue score**

| Variable                          | Correlation coefficient (r) | p-value |
|-----------------------------------|-----------------------------|---------|
| Daily smartphone screen time      | 0.51                        | <0.001  |
| Weekly physical activity duration | -0.39                       | <0.001  |
| Sleep duration                    | -0.34                       | 0.002   |
| Sedentary time                    | 0.31                        | 0.005   |

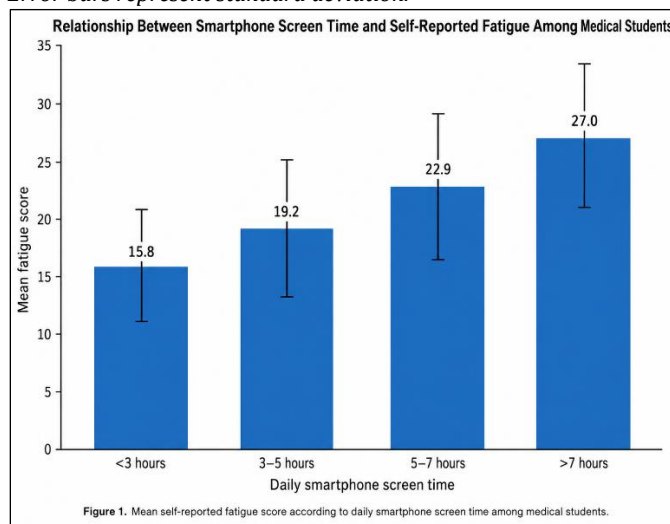
Daily smartphone screen time was still independently associated with higher scores for fatigue in multivariable analysis, after controlling for age, gender, physical activity, sleep duration and caffeine intake ( $\beta = 1.21$ ,  $p < 0.001$ ). Higher levels of weekly physical activity were, however, independently associated with a decrease in fatigue ( $\beta = -0.03$ ,  $p = 0.008$ ), whereas this was not true for any of the other scores. Additionally, a shorter sleep duration was related to higher fatigue ( $\beta = -1.39$ ,  $p = 0.021$ ).

**Table 6: Multivariable Linear Regression Analysis of Factors Associated with Fatigue Score**

| Predictor                           | $\beta$ coefficient | Standard error | p-value |
|-------------------------------------|---------------------|----------------|---------|
| Daily smartphone screen time, hours | 1.21                | 0.29           | <0.001  |
| Physical activity, minutes/week     | -0.03               | 0.01           | 0.008   |
| Sleep duration, hours/night         | -1.39               | 0.59           | 0.021   |
| Age                                 | 0.18                | 0.30           | 0.552   |
| Female gender                       | 0.76                | 0.96           | 0.432   |
| Regular caffeine use                | 1.11                | 0.98           | 0.261   |

Overall, the findings demonstrated that greater daily smartphone screen time was associated with higher self-reported fatigue, whereas greater physical activity was associated with lower fatigue among medical students. Students with prolonged smartphone exposure, low physical activity, and shorter sleep duration appeared to experience the highest fatigue burden.

**Figure 1:** Mean self-reported fatigue score across different categories of daily smartphone screen time among medical students. Error bars represent standard deviation.



## DISCUSSION

The present study explored the relationship between smartphone screen time, physical activity, and self-reported fatigue among medical students. The findings showed a clear pattern in which fatigue increased progressively with longer daily smartphone use. Students using smartphones for less than 3 hours per day had the lowest mean fatigue score, whereas those reporting more than 7 hours of daily screen exposure had the highest fatigue levels. The positive correlation between screen time and fatigue further supports the possibility that prolonged smartphone engagement may contribute to increased physical and mental tiredness among medical students. Recent studies among university populations have similarly reported that excessive screen exposure is associated with adverse health outcomes, including poorer sleep, psychological distress, reduced academic functioning, and sedentary behavior. These findings are particularly important in medical students, who frequently rely on smartphones for both educational and recreational activities and may therefore accumulate substantial daily screen exposure (14).

Several mechanisms may explain the relationship observed between smartphone screen time and fatigue. Excessive smartphone use has been linked to a rise in sedentary living, a lack of physical activity and the usage of it at nighttime, which may disrupt sleep habits. In the current study, about 75% of the participants indicated using a smartphone before bedtime and over 50% indicated using a smartphone after sleeping. Extended or nighttime screen time has been found in studies with students to be correlated with poorer sleep quality and shorter or delayed sleep. Insomnia can then contribute to feeling tired during the day, difficulty focusing and increased fatigue. Furthermore, spending long periods of time looking at small screens, sitting for extended periods and making repetitive postures can cause eye strain and musculoskeletal discomfort, which can also add to the sense of fatigue. Studies among students in universities also have associated heavy smartphone usage with physical complaints like neck and wrist pain (15, 16).

In the present study, physical activity had an inverse relationship with fatigue. There was a small difference in mean fatigue score between the low and high PA groups, with the low PA group reporting the highest amount of fatigue. The duration of physical activity was also negatively correlated with fatigue, and this remained significant after controlling for other factors. These results are similar to those of previous studies among university students, which indicated that a strong negative correlation between physical activity and fatigue. Studies showed that there was a significantly positive correlation between physical activity and reduced fatigue. Recent studies also indicated that more

exercise was linked to fewer study-related fatigue and psychological well-being of college students. The benefits of physical activity may include enhancing cardiovascular fitness, regulation of energy levels, mood, sleep quality and stress management, which can help to decrease fatigue (17, 18).

Smartphone exposure should also be analyzed in conjunction with physical activity and not as completely distinct activities. More time spent on smartphones could be a substitute for other activities such as walking, physical activity, and outdoor tasks. The higher the level of physical activity, the lower the risk of problematic smartphone use, the study reports, which examined the relationship between smartphone addiction and physical activity among university students. Studies with college students have also indicated that exercise could have a positive effect on self-regulation and decrease excessive cell phone reliance. The high rate of smartphone use coupled with a lack of physical activity could therefore contribute to the development of a behavioral cycle that leads to sedentary lifestyle, poor sleep pattern and higher degree of fatigue. This is also reflected in studies showing that extended screen time can take the place of physical activity or good sleep (19).

Another factor that was relevant in the present study was sleep duration, which was found to be significantly inversely related to fatigue. Lower sleep hours were associated with higher fatigue scores in the crude analysis and continued to be associated with fatigue in the adjusted analysis. According to this discovery, at least in part, sleep could account for the link between smartphone and fatigue, especially when smartphones are used immediately before sleep. Medical and university student studies repeatedly show that a high amount of screen time, particularly late in the day, is linked to a decreased quality of sleep. Medical students may be especially susceptible given that their academic workload, exams, clinical duties, and the use of social media or electronic learning all vie for the time needed to get a good night's sleep and exercise. Therefore, it is not so effective to intervene solely on smartphone use, but more so to intervene on increasing the use of other healthy behaviors such as sleep habits, physical activity, or meaningful smartphone use (20).

The results should be interpreted with the following limitations: First, cross-sectional studies do not define causation; thus, no conclusions can be drawn about a direct causality between increased smartphone use and fatigue. Additionally, students who were feeling fatigued may have been less likely to be physically active and thus had more time on their smartphones. Second, the small sample size of 82 students and the fact that they were recruited from a single institution might restrict the generalizability to medical students within other institutions. Third, information about smartphone screen-time was ideally provided via built-in digital tracking systems, but some information was self-reported, and may thus be vulnerable to recall and reporting bias. Fatigue and physical activity were also mainly participant reported. Further, some variables of interest (e.g., psychological stress, depression, exam workload, dietary patterns, and specific usage of the smartphone) were not thoroughly assessed. Further multicenter studies with larger samples, prospective follow-up, objective smartphone-usage measures, physical-activity monitoring using wearable devices, and standardized measures of sleep and psychological well-being are suggested to further elucidate the direction and mechanisms of these associations in future.

## CONCLUSION

The study demonstrated a significant relationship between smartphone screen time, physical activity, and self-reported fatigue among medical students. Greater daily smartphone screen time was associated with progressively higher fatigue scores, whereas higher levels of physical activity were associated with lower fatigue. Shorter sleep duration also contributed to increased fatigue, suggesting that digital behavior, activity patterns, and sleep are closely interconnected. Medical students should

therefore be encouraged to adopt balanced smartphone-use habits, limit unnecessary nighttime screen exposure, maintain adequate sleep, and participate regularly in physical activity. Institutional initiatives promoting digital well-being and active lifestyles may help reduce fatigue and improve the overall well-being of medical students.

### Authors' Contribution

KW, NA: Concept & study design, data collection and drafting of the manuscript.

AN: Data entry, statistical analysis, interpretation of the results.

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