

Smartphone Usage Status, Sleep Pattern, Health-Related Quality of Life, and Physical Activity among Adolescents from before to during the COVID-19 Confinement: a Cross-Sectional Study

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Abstract

Background: Finding behavioral changes in youth during the COVID-19 pandemic may provide a better image of the negative impact of quarantine on their mental and physical health. The purpose of the present research was to examine the smartphone usage status, sleep pattern, health-related quality of life, and physical activity among adolescents from before to during the COVID-19 confinement.

Methods: The present study used a descriptive-comparative design. The participants were 384 male and female students aged 16 to 18 years (mean age of 16.84 ± 1.06 years) in grades 11 and 12 from the high-schools of Golestan province, Iran, in 2020. Screen time, sleep pattern, health-related quality of life, and physical activity were measured using standard questionnaires. Paired-Sample t test was employed to compare the means of the constructs of the study from “before” to “during” the COVID-19 pandemic. Independent t test was used to measure gender differences.

Results: Results shed light on the increments in smartphone use and decrements in sleep quality, health-related quality of life, and physical activity among adolescents from “before” to “during” the COVID-19 pandemic (all $P < 0.001$). Girls had significantly higher use of smartphones in both “before” ($P = 0.003$) and “during” ($P < 0.001$) the pandemic compared with boys. However, no other gender differences were found among male and female adolescents (all $P > 0.05$).

Conclusion: The findings of this study revealed the effects of policies related to COVID-19 pandemic on health-related behaviors among adolescents and emphasized the importance of adopting appropriate coping strategies to promote healthy lifestyle during confinement.

Keywords: COVID-19, Physical activity, Sleep, Quality of life, Adolescents

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1. Introduction

Coronavirus (COVID-19) disease started in 2019 in Wuhan, China and spread worldwide in early 2020, through which many people were infected and died. Subsequently, the governments around the world implemented various methods, such as the closure of educational institutions to reduce the incidence of this disease. This has made children and adolescents spend more time at home (1). Although these policies may have reduced the prevalence of the virus, staying at home and social isolation may relieve detrimental impacts on public health. For example, some research demonstrated that social distance seriously changed the mental health and physical activity level of youth during the COVID-19 quarantine (2-7). Gul and Demirci (4)

and De Miranda and colleagues (7) reviewed studies on the prevalence of psychiatric diseases and symptoms in youth during the COVID-19 pandemic and yielded high levels of depression, anxiety, and post-traumatic symptoms among children from all the development phases during the pandemic. Dunton and co-workers (5) reported greater decreases in the physical activity level of children from the pre- to early-COVID-19 periods. Tulchin-Francis and colleagues (6) reported that the physical activity level of children in the United States declined significantly during the pandemic. Specifically, moderate-to-vigorous physical activity decreased while light physical activity remained the same. These findings indicated that COVID-19 pandemic negatively affected physical activity and mental health of children and adolescents.

In addition, some research demonstrated that the COVID-19 confinement also caused some behavioral changes in youth. For example, in Tunisia, Abid and co-workers (8) found that COVID-19-related confinement negatively affected sleep quality and screen time of children. Moreover, girls compared to boys had poorer sleep and higher screen time during the confinement. In Italy, Bruni and colleagues (9) showed a considerable postpone in time of sleep and wake-up in school-age youth during lockdown. Sleep disorders enhanced mostly in children, but not in adolescents. Younger students had an improved occurrence of difficulty falling asleep, tension at bedtime, night awakenings, nightmares, and sleep terrors. In Germany, RavensSieberer and colleagues (10) found that youth experienced significantly lower health-related quality of life during the COVID-19 pandemic compared with prior to the pandemic. Children with low socio-economic popularity and confined living area have been affected more extensively. In Croatia, Dragun and colleagues (11) found that lockdown negatively affected quality of life, happiness, and optimism in adolescents. Moreover, the usage of TV and mobile phone was significantly enhanced during the COVID-19 pandemic in comparison with the pre-lockdown period. In China, Guo and co-workers (12) reported that youth school-students stated enhanced screen time during the lockdown than the time prior to the pandemic.

These studies clearly illustrate that the COVID-19 pandemic negatively affected physical activity behavior, quality of life, screen time, and sleep pattern of youth. It has been illustrated that changing the lifestyle of children and adolescents towards inactivity and excessive use of mobile phones and tablets can have several negative impacts on physical and mental health (13, 14). However, very little research has examined the impact of the COVID-19 confinement on behavioral changes of Iranian youth. It could be crucial to investigate this issue and provide a clear picture of the behavioral changes of Iranian children and adolescents during the COVID-19 pandemic. Furthermore, due to the new mutations in the coronavirus and the lack of global vaccination in the country, studying the behavioral changes of Iranian youth from before to during the COVID-19 pandemic may provide a better image of the negative effects of confinement on their mental and physical health. Therefore, the aim of the present work was to investigate the smartphone usage status, sleep pattern, health-related quality of life, and physical activity among the adolescents of Golestan province, northern Iran, from before to during the COVID-19 pandemic. It was hypothesized that

adolescent students would show higher smartphone use, poorer sleep quality, and lower health-related quality of life and physical activity during the COVID-19 pandemic compared with pre-pandemic period.

2. Methods

The present research applied a cross-sectional design through an online survey. The Ethical Committee of the university approved this research with the code of IR.IAU.AK.REC.1400.001. The students provided written informed consent.

2.1 Participants

The statistical sample of this study included adolescents studying in high school (aged 16 to 18 years old). The sample comprised 384 male and female students (mean age of 16.84 ± 1.06 years) in grades 11 and 12 from the high-schools of Golestan province, Iran, in 2020. The participants were chosen with a convenience sampling method. We reached the participants primarily by contacting the parents and then through social media and telephone.

2.2 Measures

Screen time, sleep pattern, health-related quality of life, and physical activity were measured as dependent variables. Data were gathered from November 2020 until December 2020. The students fulfilled an online questionnaire. The items of the questionnaire were provided in two forms: “before the pandemic” and “during the pandemic”. It comprised of a primary explanation regarding the purpose of the study. The participants were explained that their answers are anonymous and only for research purposes. The questionnaire was electronically created via Google Forms and distributed via social media.

2.2.1 Smartphone Use: Herein, we measured smartphone use (mobile phone or tablet) through asking the adolescents for the time of use during the day and in the last 2 hours before bedtime. To measure screen exposure during the day and night, we summed up durations of utilization of all the instruments.

2.2.2 Sleep Pattern: We measured the sleep quality through Pittsburgh Sleep Quality Index (PSQI) (15), consisting of 19 self-rated questions. The questions are related to usual sleeping habits during the past month. The 19 self-rated items were combined to form seven “component” scores (subjective sleep quality,

sleep latency, sleep duration, sleep efficiency, step disturbances, use of sleep medication, and daytime dysfunction). Each component ranged from 0 (no difficulty) to 3 (severe difficulty) points. The seven component scores were then added to yield a global range of 0 to 21. A PSQI global score of higher than 5 indicates the presence of sleep disorder and higher scores represent worse sleep quality (15). Overall reliability coefficient (Cronbach's alpha) of the PSQI was 0.83 (15). In this paper, we asked nine experts in psychology to confirm the validity of this instrument (CVI=0.90, CVR=0.80). Moreover, we measured the Cronbach's alpha of the PSQI with $\alpha=0.90$.

2.2.3 Health-Related Quality of Life: We measured health-related quality of life with Pediatric Quality of Life Inventory Version 4.0 Generic Core Scales (PedsQL) (16). The scale consisted of 23 questions divided to four subsets: physical, emotional, social, and school functioning. The three latter subsets were considered as psychosocial functioning. All the items were scored based on a 5-point Likert scale from 0 (Never) to 4 (Almost always). The items were scored reversely and linearly transformed to a 0-100 scale as follows: 0=100, 1=75, 2=50, 3=25, 4=0. Maximum score is 100 and minimum score is 0. Reliability of PedsQL was confirmed in healthy population with $\alpha=0.90$ (16). In this study, we asked nine experts in psychology to confirm the validity of this instrument (CVI=0.80, CVR=0.75). Moreover, we measured the Cronbach's alpha of the PedsQL with $\alpha=0.90$.

2.2.4 Physical Activity: Physical activity was measured by use of Physical Activity Behavior in Leisure-Time Scale (17). This scale consisted of three questions scored based on an 8-point Likert scale from zero days (0) to seven days (7). This scale has good validity and reliability with $\alpha=0.92$ (17). In the current

study, nine experts confirmed its validity (CVI=0.88, CVR=0.78) and its reliability was measured to be $\alpha=0.90$.

2.3 Data Analysis

Means and standard deviations were utilized to describe the constructs of the study. Kolmogorov-Smirnov test was employed to assess normality of data. Paired-Sample t test was applied to compare means of the constructs of the study before and during the COVID-19 pandemic. Independent t test was used to measure gender differences. Significance level was set at $P<0.05$.

3. Results

3.1 Sample Description

Means and standard deviations of the age of the boys and girls were 16.68 ± 1.26 and 16.96 ± 1.84 , respectively. Means and standard deviations of the height of the boys and girls respectively were 165.02 ± 10.28 and 164.48 ± 9.20 . In addition, the means and standard deviations of weight of boys and girls were 64.30 ± 10.28 and 62.46 ± 9.40 , respectively. Ethnicity of adolescents were a mix of Fars and Turkmen. All the students lived in urban areas. Results of Kolmogorov-Smirnov tests demonstrated that our data were normally distributed ($P>0.05$).

3.2 Impacts of COVID-19 Confinement on Screen Time

Responses to daily screen time recorded before and during the COVID-19 confinement are given in Table 1. Results of paired-samples t test demonstrated that diurnal exposition has significantly increased from "before" to "during" the pandemic in both boys ($t=-$

Table 1: Means and standard deviations of research variables across "before" and "during" the COVID-19 pandemic

Variables			Overall		Boys		Girls		Gender Difference
			Mean	SD	Mean	SD	Mean	SD	
Screen Time	Diurnal (Hour)	Before	1.12	0.75	1.02	0.77	1.22	0.72	$t=-2.634$ $P=0.009^{**}$
		During	3.30	1.04	3.20	1.02	3.41	1.05	$t=-2.012$ $P=0.045^*$
	Nocturnal (Hour)	Before	0.38	0.22	0.35	0.20	0.40	0.24	$t=-2.028$ $P=0.043^*$
		During	0.94	0.50	0.84	0.48	1.04	0.50	$t=-3.986$ $P<0.001^{***}$
	Global Score (Hour)	Before	1.50	0.83	1.38	0.84	1.63	0.79	$t=-2.965$ $P=0.003^{**}$
		During	4.24	1.11	4.04	1.04	4.45	1.15	$t=-3.687$ $P<0.001^{***}$

Sleep Pattern	Subjective Sleep Quality	Before	0.35	0.60	0.38	0.61	0.33	0.58	t=-0.679 P=0.498
		During	0.94	0.87	0.96	0.87	0.92	0.87	t=-0.466 P=0.641
	Sleep Latency	Before	0.40	0.57	0.41	0.60	0.39	0.55	t=0.352 P=0.725
		During	0.92	0.88	0.95	0.90	0.89	0.86	t=0.635 P=0.526
	Sleep Duration	Before	0.44	0.56	0.44	0.55	0.44	0.57	t=-0.090 P=0.928
		During	1.00	0.90	0.98	0.90	1.01	0.90	t=-0.226 P=0.821
	Habitual Sleep Efficiency	Before	0.37	0.57	0.35	0.56	0.39	0.58	t=-0.533 P=0.594
		During	0.96	0.83	0.98	0.83	0.93	0.83	t=0.610 P=0.542
	Sleep Disturbances	Before	0.39	0.58	0.38	0.58	0.41	0.58	t=-0.613 P=0.541
		During	0.94	0.81	0.90	0.78	0.97	0.84	t=-0.876 P=0.382
	Daytime Dysfunction	Before	0.44	0.58	0.43	0.59	0.46	0.58	t=-0.519 P=0.604
		During	1.05	0.83	1.01	0.80	1.08	0.86	t=-0.859 P=0.391
	Use of Sleeping Medications	Before	0.39	0.56	0.38	0.55	0.40	0.57	t=-0.452 P=0.651
		During	0.94	0.84	0.90	0.82	0.98	0.87	t=-0.964 P=0.336
	Global Score	Before	2.82	3.39	2.79	3.39	2.85	3.41	t=-0.195 P=0.846
		During	6.77	4.45	6.72	4.51	6.82	4.41	t=-0.217 P=0.828
Health-Related Quality of Life	Physical Functioning	Before	78.05	11.25	77.79	11.22	78.31	11.31	t=-0.453 P=0.651
		During	67.67	8.21	67.91	7.90	67.43	8.51	t=0.569 P=0.570
	Emotional Functioning	Before	67.60	13.40	65.93	12.23	69.27	14.31	t=-2.453 P=0.015*
		During	43.05	16.13	42.65	15.93	43.46	16.36	t=-0.490 P=0.625
	Social Functioning	Before	75.06	15.78	73.80	15.37	76.32	16.12	t=-1.571 P=0.117
		During	63.81	11.82	63.20	10.91	64.42	12.76	t=-1.014 P=0.311
	School Functioning	Before	70.14	14.89	69.76	15.03	70.52	14.78	t=-0.496 P=0.620
		During	57.76	13.22	57.42	13.00	58.09	13.46	t=-0.501 P=0.617
	Global Score	Before	74.49	9.37	73.81	9.20	75.17	9.51	t=-1.426 P=0.155
		During	61.27	7.40	61.16	7.10	61.38	7.71	t=-0.281 P=0.779
	Physical Activity	Before	1.80	0.67	1.82	0.70	1.78	0.62	t=1.091 P=0.276
		During	1.25	0.44	1.25	0.44	1.26	0.44	t=-0.269 P=0.788

*P<0.05, **P<0.01, ***P<0.001

52.22, $P < 0.001$) and girls ($t = -47.79$, $P < 0.001$). Moreover, independent t test found that the girls had significantly higher diurnal exposition in both “before” ($P = 0.009$) and “during” ($P = 0.045$) the pandemic compared with the boys. In addition, the results of paired-samples t test reported that nocturnal exposition has significantly increased from “before” to “during” the pandemic in both boys ($t = -12.06$, $P < 0.001$) and girls ($t = -15.83$, $P < 0.001$). Moreover, independent t test illustrated that the girls had significantly higher nocturnal exposition in both “before” ($P = 0.043$) and “during” ($P < 0.001$) the pandemic compared with the boys. Finally, the results of paired-samples t test implied that the global use of smartphone has significantly increased from “before” to “during” the pandemic in both boys ($t = -52.68$, $P < 0.001$) and girls ($t = -45.29$, $P < 0.001$). Moreover, independent t test revealed that the girls had significantly higher global use of smartphone in both “before” ($P = 0.003$) and “during” ($P < 0.001$) the pandemic compared with the boys.

3.3 Effect of COVID-19 Confinement on Sleep Pattern

Responses to sleep pattern recorded before and during the confinement are illustrated in Table 1. Results of paired-samples t tests showed that both boys and girls were significantly and negatively affected by the pandemic in global sleep quality ($t = -12.74$, $P < 0.001$ and $t = -12.08$, $P < 0.001$, respectively for boys and girls) and all the related components, including subjective sleep quality ($t = -9.79$, $P < 0.001$ and $t = -9.71$, $P < 0.001$, respectively for boys and girls), sleep latency ($t = -8.56$, $P < 0.001$ and $t = -8.66$, $P < 0.001$, respectively for boys and girls), sleep duration ($t = -8.62$, $P < 0.001$ and $t = -8.13$, $P < 0.001$, respectively for boys and girls), sleep efficiency ($t = -10.03$, $P < 0.001$ and $t = -8.34$, $P < 0.001$, respectively for boys and girls), sleep disturbances ($t = -8.51$, $P < 0.001$ and $t = -8.13$, $P < 0.001$, respectively for boys and girls), use of sleep medication ($t = -8.14$, $P < 0.001$ and $t = -8.10$, $P < 0.001$, respectively for boys and girls), and daytime dysfunction ($t = -8.98$, $P < 0.001$ and $t = -8.94$, $P < 0.001$, respectively for boys and girls). Moreover, independent t tests found no significant differences between the boys and girls in both before and during the pandemic regarding global sleep quality and all the related components, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction (all $P > 0.05$).

3.4 Effect of COVID-19 Confinement on Health-Related Quality of Life

Responses to health-related quality of life recorded

before and during the confinement are presented in Table 1. Results of paired-samples t tests implied that both boys and girls were significantly and negatively affected by the pandemic in global health-related quality of life ($t = 26.04$, $P < 0.001$ and $t = 27.06$, $P < 0.001$, respectively for boys and girls) and all the related components, including physical ($t = 17.68$, $P < 0.001$ and $t = -17.65$, $P < 0.001$, respectively for boys and girls), emotional ($t = 18.25$, $P < 0.001$ and $t = 18.02$, $P < 0.001$, respectively for boys and girls), social ($t = -15.68$, $P < 0.001$ and $t = 19.96$, $P < 0.001$, respectively for boys and girls), and school functioning ($t = 20.46$, $P < 0.001$ and $t = 17.51$, $P < 0.001$, respectively for boys and girls). Moreover, independent t tests depicted no significant differences between boys and girls in both before and during the pandemic regarding global sleep quality and physical, social, and school functioning (all $P > 0.05$). However, girls reported significantly higher emotional functioning than boys before the pandemic ($P = 0.015$).

3.5 Effect of COVID-19 Confinement on Physical Activity

Responses to physical activity recorded before and during the confinement are represented in Table 1. Results of paired-samples t test showed that physical activity has significantly decreased from “before” to “during” the pandemic in both boys ($t = 9.75$, $P < 0.001$) and girls ($t = 9.12$, $P < 0.001$). Moreover, independent t test found no significant differences between boys and girls in “before” ($P = 0.276$) and “during” ($P = 0.788$) the pandemic.

4. Discussion

This study indicated that confinement related to COVID-19 pandemic increased smartphone usage, disturbed sleep quality, and decreased health-related quality of life and physical activity level of adolescents. These behavioral changes are quite understandable on account of numerous changes, such as increased stress, fear of death of family members, school closures, or social distancing in daily life of adolescents due to the pandemic.

Regarding the smartphone use, we found that both diurnal and nocturnal expositions significantly increased among adolescents from “before” to “during” the COVID-19 pandemic. The present findings confirm our hypothesis and are in line with the results of previous research (8, 12), stating that screen time has significantly increased among adolescents from “before” to “during” the COVID-19 pandemic. The worrying findings of this study shed light on the serious

outcomes for adolescents' health due to the COVID-19 pandemic. Moreover, our findings revealed that girls had significantly higher diurnal and nocturnal expositions in both "before" and "during" the COVID-19 pandemic compared with boys. However, previous studies demonstrated controversial results regarding gender differences in screen time, where some studies found higher screen time among boys (8), while some other studies reported higher screen time among girls (12). These discrepancies might be because of cultural, social, economic, and family conditions among various study samples (18, 19). The results of this study highlight further research works to examine various factors that affect the adolescents' use of smartphone.

Regarding the sleep pattern, we found that the COVID-19 pandemic has significantly and negatively affected global sleep quality and all the related components, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. These findings indicated that the adolescents in the present work had a lower quality of sleep during the COVID-19 pandemic than before the COVID-19 pandemic. The present findings confirm our hypothesis and are in line with the results of previous studies (8, 9, 12) reporting that sleep quality has significantly decreased among adolescents from "before" to "during" the COVID-19 pandemic. Based on our findings concerning a higher use of smartphone before going to bed, it might be possible that the enhancement of the smartphone use at night had distracted the sleep of the adolescents in this research. Due to influence of poor sleep quality on the high level of negative psychological well-being (8, 9), it is necessary to control the usage of smartphones among adolescents particularly prior to the sleep. Moreover, our findings revealed no gender differences in both "before" and "during" the COVID-19 pandemic compared with boys concerning global sleep quality and all the related components, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. These findings are not in accordance with those of previous studies showing a favor for boys regarding better sleep quality during confinement (8, 9). These discrepancies might be on account of different stressful situations and pressure of confinements among various study samples (18, 20). Further studies should aim to focus on examining different causes influencing adolescents' sleep pattern.

Concerning the health-related quality of life, our findings implied that the global health-related quality of life and all the related components, including physical, emotional, social, and school functioning, have significantly decreased from "before" to "during" the COVID-19 pandemic. These findings clearly demonstrated that the adolescents in the present research perceived lower health-related quality of life due to the COVID-19 pandemic. The present findings confirm our hypothesis and are in line with the results of previous studies (10, 11) reporting lower health-related quality of life in adolescents "during" the COVID-19 pandemic compared with "before" the pandemic. This decrement is quite understandable on account of numerous changes, such as increased stress, fear of death of family members, school closures, or social distancing in the daily life of adolescents due to the pandemic. Due to influence of COVID-19 pandemic on perceived health-related quality of life among adolescents, it is necessary to adopt appropriate coping strategies to improve the perception of quality of life in this population. Furthermore, no significant differences were observed between boys and girls in both before and during the COVID-19 pandemic regarding health-related quality of life. These findings are not in accordance with those of previous studies indicating that boys had relatively better perceived quality of life than girls during confinement (21). These discrepancies might be because of different prevention strategies adopted by parents and families among various study samples (18-20). Further studies should aim to focus on examining the different causes influencing adolescents' health-related quality of life. Accordingly, it is necessary to adopt the appropriate coping strategies to promote healthy lifestyle ones during confinement among this population. To cope with such detrimental effects, WHO proposed children and adolescents to "be active and stay healthy at home". Numerous studies have shown that regular physical activity promotes children' and adolescents' well-being (22-24). Hence, it is necessary to find methods to promote the participation of children and adolescents in physical activity during the pandemic. In this regard, autonomy and motivation may play important roles in promoting the participation of children and adolescents in physical activity (25-27).

Concerning the physical activity, it should first be stated that all the adolescents had a small level of physical activity in both "before" and specifically "during" the COVID-19 pandemic. The findings of this study revealed that the level of physical activity in

adolescents has significantly decreased from “before” to “during” the COVID-19 pandemic. The present findings confirm our hypothesis and are consistent with the results of previous research (1, 3) reporting lower levels of physical activity among adolescents “during” the COVID-19 pandemic compared with “before” the pandemic. This decrement is quite understandable because of school closure, home confinement, and the lack of opportunities for activities, such as physical education or organized sports. In addition, there were not any significant differences between boys and girls in both before and during the COVID-19 pandemic regarding physical activity. These findings are not in accordance with those of previous studies observing that boys had relatively higher levels of physical activity than girls during confinement (3). These discrepancies might be because of different cultural and socio-economic status among various study samples (19).

As a limitation of this study, it can be said that we did not assess the social-economic status of the participants; therefore, further research should focus on socio-economic status as a possible influential factor for the effects of COVID-19 pandemic on behavioral changes. As another limitation of this study, we can state that our data were collected through self-reports, which may have self-reporting bias. Additionally, we applied a convenience sampling method, which sometimes gives biased results. Finally, we employed a cross-sectional design based on adolescents reports, not following the change of adolescents’ behavior over time from “before” to “during” the COVID-19 pandemic.

5. Conclusion

The present research revealed several important behavioral changes among the adolescents from “before” to “during” the COVID-19 pandemic. Parents and health care experts must be informed about these possible risks related to COVID-19 pandemic. Based on these findings, it is necessary to adopt appropriate coping strategies to promote healthy lifestyle ones during confinement among this population. To cope with such detrimental effects, WHO proposed children and adolescents to “be active and stay healthy at home”. Hence, it is necessary to find methods to promote the participation of children and adolescents in physical activity during the pandemic. Here, motivational factors may play an important role in increasing physical activity level of students.

Ethical Approval

The Ethical Committee of the university approved

this research with the code of IR.IAU.AK.REC.1400.001. The subjects voluntarily attended in this study and written informed consent was provided from the subjects and their parents.

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Conflicts of interest: None declared.

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