Original Article

The impact of COVID-19-induced distance learning on physical activity and dietary habits of female students in the Qassim Region

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Abstract

Background: The COVID-19 pandemic has profoundly affected the physical activity (PA) levels and dietary habits of individuals, particularly children and adolescents in Saudi Arabia, owing to widespread closures and social distancing measures, including school closures. **Methods:** A cross-sectional study was conducted to assess the impact of distance learning (DL) on PA and dietary habits among public middle school girls during the pandemic. The Arab Teens Lifestyle Questionnaire (ATLS) was used to assess habitual PA, sedentary behavior, and dietary habits. **Results:** A total of 300 middle school female students, with an average age of 14 years, participated in the study. The results indicated a generally low level of PA among students during DL and after school reopening, with a significant decrease in specific types of PA, such as walking and stair climbing during DL. However, after schools reopened, there was a significant increase in students' participation in activities such as swimming, dancing, and housework ($P < 0.05$). Moreover, sleep hours and TV-watching time increased compared to the DL period. Despite the prevalence of students frequently consuming soft drinks, sugary treats, fried and fast foods, as well as sweets and chocolates during the lockdown, middle school girls also consumed a lot of fruits and vegetables. **Conclusion:** Assessing students' habitual PA and dietary habits during the lockdown may provide insights into their future health and well-being post-pandemic. This assessment can help in identifying strategies to redirect current PA levels to maintain health and prevent potential long-term health implications.

Keywords: COVID-19, dietary habits, distance learning, health, middle school girls, physical activity

Introduction

The Coronavirus-19 (COVID-19) emerged as an epidemic in Wuhan, China, in December 2019, quickly evolving into a global pandemic. The COVID-19 pandemic has had a devastating impact worldwide, claiming the lives of over 4.55 million individuals.[1] The World Health Organization (WHO) declared a pandemic in 2020,[2] leading to significant disruptions in health systems, economies, and social dynamics. Governments, including Saudi Arabia (KSA), have implemented strict laws and measures to control the spread of the virus.[3] Despite these efforts, the Ministry of Health reported 326,930 a staggering confirmed cases of COVID-19 in KSA by the end of 2020,[1] highlighting the significant public health challenges posed by the pandemic. During the COVID-19 pandemic, KAS authorities implemented localized lockdowns, leading to the closure of educational institutions.[4] This change forced a shift from traditional education to distance learning (DL) to prevent the spread of the virus and maintain educational continuity.[5] These features have affected daily life, potentially changing behaviors such as food consumption and physical activity (PA) routines.[6-8] PA is pivotal

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Received: 26-03-2024 **Revised:** 12-05-2024
Accepted: 16-05-2024 **Published:** 09-12-2024

Access this article online

Quick Response Code:

Website: http://journals.lww.com/JFMPC

DOI: 10.4103/jfmpc.jfmpc_496_24

How to cite this article: Almujaydil MS. The impact of COVID-19-induced distance learning on physical activity and dietary habits of female students in the Qassim region. J Family Med Prim Care 2024;13:5536-43.

for children's health and overall well-being.[9] Research indicates that adequate levels PA during childhood yield numerous benefits, including improved cardiometabolic and musculoskeletal health, enhanced academic performance, cognitive function, and mental well-being.[10] Conversely, insufficient PA and sedentary behavior are correlated with elevated risks of high blood pressure, obesity, and cardiovascular diseases.[11] Alarmingly, a substantial proportion (81%) of adolescents between the ages of 11 and 17 worldwide are inactive, with prevalence varying across races, regions, and countries.[12]

Failure to adhere to PA guidelines is a global health concern linked to an increased risk of mortality.[13] Katzmarzyk *et al.*[14] elucidated the substantial health burden associated with inadequate PA, with hypertension alone contributing to a notable percentage of global mortality. WHO guidelines underscore the importance of daily moderate to vigorous PA, recommending that children aged 6 to 17 engage in at least 1 hour of such activity to enhance health and mitigate chronic disease risks.[15] Therefore, it is crucial to continue promoting and facilitating PA among children and adolescents, particularly in light of changing landscape of education and public health challenges during COVID-19 pandemic.

The shift to e-learning or lockdown measures has led to potential changes in students' eating habits, especially during adolescence, a critical period for growth and development. Prolonged periods indoors and easy access to food may increase the risk of eating disorders and excessive consumption.[16] Elevated body mass index (BMI) has been linked to the consumption of energy-dense foods high in sugar and fat.[17,18] Studies have shown that extended confinement can lead to increased screen time and poor dietary choices.[19] Research has shown that isolation measures significantly reduce PA and promote unhealthy dietary habits among adults worldwide, including in KAS.[8,20-23] However, studies focusing on children and adolescents are limited.[24-27] Consequently, there is a notable gap in understanding how PA levels and dietary behaviors are impacted among young individuals during quarantine. Thus, this study investigates the effects of DL on PA behaviors and dietary habits during the COVID-19 lockdown, specifically among middle school females in KAS. By focusing on this demographic group, the study aims to provide insights into the challenges and changes in lifestyle behaviors experienced by adolescents during periods of enforced isolation and remote learning. Understanding these dynamics is crucial for informing interventions and support mechanisms aimed at encouraging healthful habits and mitigating the adverse effects of prolonged lockdown measures on youth well-being.

Methodology

Study design and participants

A cross-sectional study was undertaken on middle school girls residing in Onaiza Governorate, Qassim, during the academic year 2021, encompassing two distinct periods: DL and post-school reopening. The sample population was randomly selected after a comprehensive count of female students in Onaiza Governmental Schools for the middle stage, utilizing statistics from the Onaiza Governorate Education Department. According to official records (Ministry of Education, 2021, https://edu.moe.gov.sa/Onaiza/webserv/Pages/default.aspx, accessed on 2 July 2021), approximately 4,234 female students were enrolled in these schools. The inclusion criteria specified the participation of female school students exclusively, while those who omitted any questionnaire responses were excluded from the study.

The sample size was determined using Thompson's approach,[28] with a confidence level of 95% and a significance level (*P* value) of 0.05. Students with chronic illnesses or disabilities were excluded from participation. Ultimately, a total of 300 students were recruited to participate in the study.

Ethical consideration

Questionnaire

The study utilized the validated Arab Teens Lifestyle Study Questionnaire (2018-ATLS), developed by Al-Hazzaa *et al.*,[29] for data collection. An additional question was included to assess participants' perspectives on their role in addressing weight gain and obesity, based on a study by Al-Salem.[30] The questionnaire comprises four sections: (1) permission form and survey objectives, (2) personal and medical history, (3) PA, and (4) dietary habits. This comprehensive questionnaire aimed to gather detailed information on participants' lifestyles and attitudes toward obesity. By using this approach, researchers could investigate factors contributing to weight gain and obesity among the study population.

Demographic and health information

The study incorporated several demographic variables, including age, family income, number of family members, educational attainment of parents and the presence of obese or overweight family members. Additionally, participants' general health status was assessed. These factors provide crucial context for understanding participants' backgrounds and socioeconomic status. Additionally, they allow for a thorough examination of potential influences on participants' health behaviors and outcomes.

Physical activity

The questionnaire gathered data on students' PA, including the types, duration, and intensity of various sports and activities undertaken during a week. Moderate-intensity PA encompassed activities like walking, swimming, dancing, and household chores, while vigorous-intensity PA involved stair jogging, climbing, running, weight training, and self-defense. Metabolic energy turnover (MET) units were employed to measure the activity intensity. Total activity was expressed in MET minutes per week by multiplying the MET value of each activity by the number of minutes spent on it each week.[31] Activity levels were categorized as follows: less than 1680 MET min/week for inactivity, 1680 to 2519 MET min/week for moderate activity, and over 2520 MET min/week for high activity

levels. Sedentary behavior data were collected, including the number of hours spent watching TV, playing video games, and using computers and the Internet. These assessments provide insights into students' activity patterns and sedentary behaviors, helping understand their lifestyle habits and overall health.

Dietary habits

The ATLS questionnaire includes questions about participants' dietary habits, such as breakfast consumption, fruit and vegetable intake, soft drink, and energy drink, as well as fast food, sweets, and dairy product consumption. Participants are asked about all the previous criteria.

Anthropometric measurement

In November 2021, following the reopening of schools, anthropometric measurements, including weight, height, waist circumference (WC), and hip circumference (HC) were obtained during the first week by a trained investigator. Body weight and fat percentage were assessed with precision within 100 grams using a calibrated portable scale (Tanita), with participants wearing light clothing and being barefoot. Body length was measured with a calibrated measuring rod. BMI was calculated by dividing weight by the square of height and was categorized according to WHO reference standards.[32] WC and HC were measured following Norton and Olds,[33] using a non-stretchable measuring tape. The waist-to-hip ratio (WHR = WC/HC) calculated to assess body fat distribution, with values categorized as follows: <0.75 considered normal, 0.75 to 0.80 indicative of low risk, 0.81 to 0.85 signaling moderate risk, and over 0.86 suggesting high risk.[34] Standardized procedures ensure accurate assessment of participants' health status.

Data analysis

The data were analyzed using the IBM SPSS Statistics 25.0 software package (SPSS Inc., Chicago, IL, USA). Descriptive statistics were utilized to present the results showing means ± standard deviations for continuous variables and percentages for categorical data. A paired *t*-test was conducted to compare the differences in PA data before and after the reopening of schools. Additionally, the Chi-square test was utilized to analyze questionnaire responses. Significant differences were determined at a significance level of $P < 0.05$.

Results

Sociodemographic characteristics

A total of 300 schoolgirls, with an average age of 13.57 ± 1.07, participated in this study. Table 1 provides an overview of the demographic and health characteristics of middle school girls. Notably, more than half (50%) of the total sample had a bachelor's degree as their highest level of parental education, with only 12% holding a postgraduate degree and a minority not completing high school.

In terms of monthly income status, the majority (53.3%) of students reported an income range between 10000 to 20000 riyals, while 24.7% reported a monthly income of less than 10000 riyals. Regarding periods status, most middle school girls were generally healthy, with 7.1% reporting cardiovascular disease, 2.3% diabetes, and 6.4% experiencing respiratory problems, potentially attributable to the prevalence of Coronavirus during the study period. However, a small percentage (2%) reported other diseases.

Table 1: Demographic and health characteristics of the middle school girls (*n*=300)

Variables	*n*	%
Age (years Mean±SD)	13.57±1.07	
Father's education level		
Primary school	40	13.3
High school	70	23.3
Bachelor	153	51.0
Postgraduate	37	12.3
Mother's education level*		
Primary school	33	11.0
High school	74	24.7
Undergraduate	157	52.3
Postgraduate	36	12.0
Income level (month)		
<10000 SAR	74	24.7
10000-15000 SAR	108	36.0
20000-25000 SAR	52	17.3
25001-30000 SAR	19	6.3
>30000 SAR	47	15.7
Health status*		
No	260	86.7
Cardiovascular disease	5	1.7
Diabetes	7	2.3
Respiratory diseases	19	6.4
Other	9	2

1Number (%) SD: Standard Deviation, SAR: Saudi Riyals

Anthropometric measurements

Table 2 presents the anthropometric measurements of middle school girls, providing valuable insights into their health profiles. The mean BMI of students was 21.3 ± 5.04 kg/m^2, with over half (56%) classified as obese, 24% within the normal weight range, and only 20% classified as underweight. Furthermore, although 63% of students reported no obesity cases within their families, a significant proportion reported having one or two cases of obesity, at rates of 37% and 32%, respectively. In terms of anthropometrics, the mean waist and hip measurements were 75.36 cm and 90.51 cm, respectively. Additionally, the mean body fat percentage was 30.9 ± 8.4. Assessing the WHR for early health risk assessment revealed that 34% of students fell into the high health risk range, while 32% were classified as moderate risk, with only 6.7% falling within the normal range.

The students' habitual physical activity during distance learning and after reopening school

Table 3 compares the level of PA during the DL period and after returning to school. The results reveal a low level of PA

among students, indicated by the obtained numbers and MET values. On average, students participated in sports activities only two days per week. However, there was a significant increase in PA during the school study period, with statistically significant differences in walking and stair climbing ($P < 0.05$). Conversely, there was a significant decrease in time spent swimming and doing housework ($P < 0.05$) during the school period compared to DL. While other sports did not exhibit statistical changes ($P > 0.05$), dancing was more prevalent during DL. Despite these statistical differences, the METs values in both cases remained below the required activity level.

Figure 1 depicts the variation in sleep hours among middle school girls during DL and after school reopening. A significant difference in sleep hours was observed ($P < 0.05$), with the mean number of sleep hours being higher during school (5.99 ± 2.02) compared to DL (4.13 ± 2.00). However, there was no statistically significant difference in the time spent watching TV and using the internet [Figure 2]. While the mean METs-min/week of vigorous-intensity PA was higher in all measurements compared to moderate-intensity PA ($P > 0.05$; Table 4).

Dietary habits during distance learning among middle school girls

The dietary habits of middle school girls during DL are summarized in Table 5. The data shows that 38.7% of students have breakfast daily, while 33% have it 2–3 times a week. Only 14.7% reported never eating breakfast. Approximately, 54% of students drink soft and sugary drinks 2–3 times a week, with 16.7% consuming them daily. Similarly, more than half of the students (51.7% and 56.6%) eat vegetables and fruits 2–3 times a week, while 23.3% and 17.7% consume them daily. A small percentage of students reported never eating vegetables and fruits. Around 39% of students consume them 2–3 times a week, followed by 32.7% who consume them daily, while 10% reported never consuming dairy products. About 66.6% of students eat fried food 2–3 times a week, with 12.3% indulging daily. In terms of sweets or chocolate, 25.7% consume them daily, while almost half reported 2–3 times a week. Only 3% never eat sweets or chocolate. Additionally, 70% of students reported never drinking energy drinks, with 22% consuming them 2–3 times a week and only 3% daily. When it comes to fast food, 73.7% of students eat it 2–3 times a week, followed by 15.3% consuming it 4–5 times a week, and only 6% admitting to daily consumption.

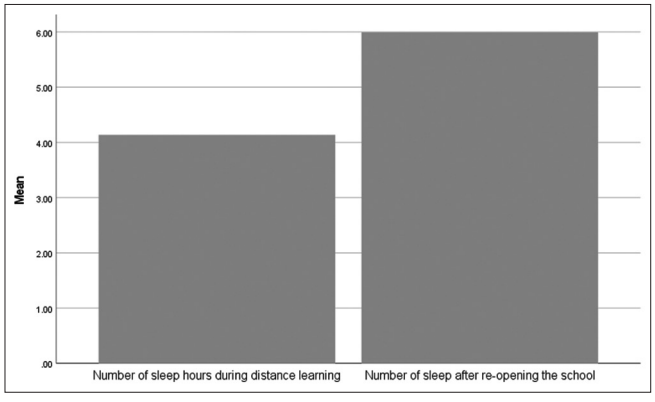

Figure 1: Sleep hours during learning distance and after reopening the school among middle school girls. Paired *t*-test at $P < 0.05$)

Discussion

The COVID-19 pandemic has brought about significant health and social challenges in the 21st century. Restrictions on movement, sports, and recreation have disrupted individuals' sense of freedom. Pre-pandemic data indicated a prevalence of low PA among the Saudi population compared to others,[35] particularly among children and adolescents.[36]

The government-imposed rules and precautions in KAS and elsewhere may significantly limit PA opportunities.[37] These measures could have long-term negative effects on the health of children and adolescents,[38] given that PA is crucial for physical and mental well-being and impacts the quality of life of

Table 2: Anthropometric measurements of the middle school girls (*n*=300)

Variables	*n*	%
BMI (kg/m^2, Mean±SD)	21.3±5.04	
BMI classes*		
Underweight	60	20
Normal	72	24
Obesity	168	56
Obese and overweight (Family member)*		
Yes	111	37
WC (cm, Mean±SD)	75.36±10.67	
HC (cm, Mean±SD)	90.51±10.6	
WHR		
Normal	20	6.7
Low Risk	81	27
Moderate risk	97	32.3
High risk	102	34
Fat percentage (Mean±SD)	30.9±8.4	

*Number (%) SD: Standard Deviation, BMI: Body Mass Index, WC: Waist Circumference, HC: Hip Circumference, WHR: Waist Hips Ratio

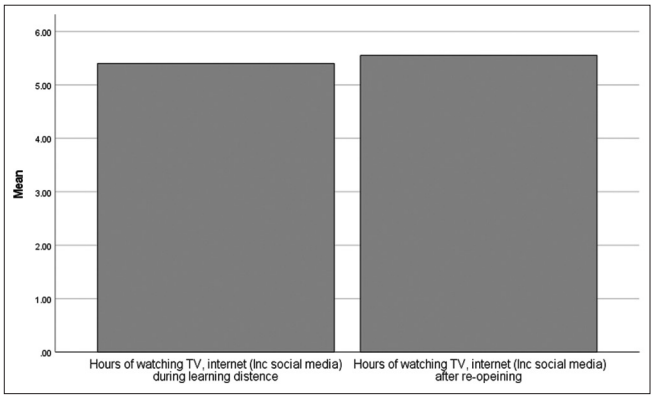

Figure 2: Hours of watching TV, the internet (social media) during learning distance and after reopening the school among middle school girls. Paired *t*-test at $P < 0.05$

Table 3: Physical activity during distance learning and after of the middle school girls (*n*=300)

Variables	Mean±SD		Sig*
	Distance learning	Re-open school	
Walking	610.54±389.92	912.60±523.48	0.002
Climbing the stairs	10.13±9.04	12.19±9.31	<0.001
Jogging or running	578.94±279.41	738.40±283.36	0.920
Riding a regular bike, a home stationary bike, or both	367.83±132.08	331.02±97.95	0.115
Swimming	632.93±210.26	488.28±110.24	<0.001
moderate-intensity, non-strenuous PA	324.53±101.53	238.44±66.29	0.052
high-intensity PA	598.63±242.00	575.88±217.79	0.428
Practice self-defence	377.02±94.66	348.10±94.43	0.989
Swedish, weight training	159.65±37.72	234.99±48.92	0.326
Housework	647.21±438.06	596.72±377.44	0.006
Dancing	1038.22±504.88	960.60±457.00	0.127

*P<0.05, SD: Standard Deviation, minutes/day

Table 4: METs during distance learning According to anthropometric variables

Variables	Mean±SD		Test	Sig*
	METs-min/ week of Moderate – intensity PA[1]	METs-min/ week of Vigorous – intensity PA[2]		
BMI				
Underweight	996.75±1816.09	1474.40±1845.78		
Normal weight	924.28±1786.11	1416.12±1899.49	0.728	0.39
Obese	792.32±1648	1409.75±1751.32		
WHR				
Normal	1730.77±2940.77	2014±2630.12		
Low Risk	814.43±1406.94	1437.07±1759.98	0.554	0.45
Moderate risk	697.37±1542.82	1260.95±1783.77		
High risk	894.45±1746.22	1453.41±1650.75		
FAT				
Healthy	965.63±1802.18	1367.26±1782.30		
Medium	772.48±1094.87	1718.74±1865.15	0.047	0.82
High	736.97±1781.72	1391.45±1810.04		

*P<0.05, SD: Standard Deviation; PA: Physical Activity, BMI: Body Mass Index, WHR: Waist Hip Ratio. [1]60 min per day ×7 days/week ×4 METs (moderate-intensity PA). [2]60 min per day ×7 days/week ×6 METs (moderate- to vigorous-intensity PA)

schoolchildren.[10] Insufficient PA increases the risk of chronic diseases.[11,39] To our knowledge, this is the first study to assess the impact of COVID-19-related DL on PA levels and food consumption among middle school students in KSA. The study sheds light on how DL affected PA and dietary habits in 300 middle school girls during the pandemic.

DL has resulted in the closure of parks and play areas, leading to prolonged periods of physical inactivity and increased exposure to electronic devices among children.[11,40,41] This shift in habitual behaviors and its impact on students' activities and food consumption during the pandemic have contributed to the rise in obesity and overweight cases among children, as previously reported.[3] This trend is reflected in our study, where 56% of students were classified as obese. Another contributing factor to the increase in BMI is the change in lifestyle patterns driven by fears of the coronavirus. People tend to stock up on various foods, leading to overeating and weight gain, as documented in previous studies[22,37]. In contrast, 24% of participants exhibited a healthy BMI. This could be linked to heightened awareness, with 63.3% of students' parents having completed university and graduate studies, indicating that most students come from well-educated families.

Our study used the cutoff scores of 1680 METs-min/week and 2520 METs-min/week, which correspond to one hour of daily moderate-intensity PA and vigorous-intensity PA, respectively. The results showed a significant decrease in the overall PA score during the pandemic, in line with recent literature discussing the impact of pandemic restrictions on PA levels in children and adolescents.[42,43]

PA is expected to decline during the COVID-19 pandemic, as schools.[44] School routines also encourage movement throughout the day, which is a key strategy to promote PA. It is difficult to maintain these healthy habits at home during COVID-19.[13] Furthermore, restrictions like the closure of playgrounds, parks, and sports facilities to prevent the spread of the virus have further reduced PA levels.[8] The study revealed that returning to school resulted in an increase in PA compared to DL; but it did not reach the recommended levels. This aligns with recent findings from a Dutch study, which showed a decrease in PA during lockdowns and even after schools reopened.[45] Similarly, a national Canadian survey found that only a small percentage of children and adolescents met PA recommendations.[34] Moreover, a survey of South Korean parents indicated a significant decline in children's participation in sports or games during the pandemic.[46] During school closures, there was a significant increase in the MET value of walking and stair climbing, while the MET value of swimming and housework decreased significantly upon school reopening.

The study highlighted that many students often consume high amounts of empty-calorie foods like soft drinks, sugary beverages, fried foods, and fast food, which aligns with findings from other studies.[3,16,18] Female students often skip breakfast and do not consume enough fruits, vegetables, and dairy products[3] This unhealthy eating pattern, combined with low PA, can result

Table 5: Dietary habits during distance learning among middle school girls (*n*=300)

Questions	Variables	During distance	
		n	%
How often do you eat breakfast each week?	Never	44	14.7
	2-3 times	99	33
	4-5 times	41	13.7
	Daily	116	38.7
On average, how many soft drinks and sugary beverages do you consume per week?	Never	24	8
	2-3 times	162	54
	4-5 times	64	21.3
	Daily	50	16.7
On average, how many days a week do you consume vegetables, whether they are locally grown, shared, or shared with others?	Never	26	8.7
	2-3 times	155	51.7
	4-5 times	49	16.3
	Daily	70	23.3
On average, how many days a week do you consume fruits?	Never	29	9.7
	2-3 times	170	56.6
	4-5 times	48	16
	Daily	53	17.7
On average, how many days a week do you consume dairy products?	Never	30	10
	2-3 times	117	39
	4-5 times	55	18.3
	Daily	98	32.7
On average, how many days a week do you consume fried food (french-fries, crisps)?	Never	16	5.3
	2-3 times	200	66.6
	4-5 times	47	15.6
	Daily	37	12.3
On average, how many days a week do you consume sweet or chocolate?	Never	9	3
	2-3 times	149	49.6
	4-5 times	65	21.7
	Daily	77	25.7
On average, how many days a week do you consume fast food?	Never	15	5
	2-3 times	221	73.7
	4-5 times	46	15.3
	Daily	18	6
On average, how many days a week do you drink energy drinks?	Never	210	70
	2-3 times	66	22
	4-5 times	15	5
	Daily	9	3

in weight gain and the development of chronic diseases.[8] It has become evident that distance education tends to prioritize the mental aspect of education, while neglecting physical and health-related aspects. Therefore, efforts should be made to promote PA among students, whether indoors or outdoors, and to raise awareness about healthy nutrition options. This holistic approach is essential for the comprehensive development of students, especially during these unprecedented times.

The study indicates that DL during the pandemic had a significant impact on the PA and dietary habits of middle school girls. These findings can help in developing strategies to improve PA and eating habits among children and adolescents for better health. However, it is important to recognize the limitations of the study, like its cross-sectional design and potential bias from self-reported questionnaire data.

Conclusions

The study highlights the impact of DL on the health of middle school girls in KAS, revealing a decrease in PA and unhealthy eating habits during the pandemic. These findings align with global trends in similar studies, highlighting the widespread impact of educational disruptions on student health. The high prevalence of obesity and unhealthy eating habits among students emphasizes the critical need for proactive interventions. Strategies should focus on promoting PA, encouraging healthy nutrition, and creating a supportive environment for students in schools and the community. To enhance student well-being, it is essential to integrate initiatives into educational policies and public health interventions. The educational sector plays a crucial role in prioritizing students' health and nutritional needs, especially during crises and epidemics. By implementing evidence-based strategies and preemptive measures, we can reduce the negative impact of DL on student health and promote their overall development and resilience in the face of unprecedented challenges.

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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