

Original Research

## Impact of the COVID-19 Pandemic Measures on the Number of Meals and the Types of Physical Activity of Adolescents: Cross-Sectional Study in Delhi, India

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**Academic Editor:** Paul J. Arciero

**Special Issue:** [Physical Activity and Nutrition Intervention for Children](#)

*Recent Progress in Nutrition*

2022, volume 2, issue 1

doi:10.21926/rpn.2201010

**Received:** January 10, 2022

**Accepted:** March 20, 2022

**Published:** March 30, 2022

### Abstract

COVID-19 greatly affected the lives of adolescents through restrictions such as less playtime, more screen time, and limited interaction with peers. In this study, we assessed the impact of the COVID-19 pandemic on the dietary and physical activity-related behavior of school students aged 10–16 years. This cross-sectional study was conducted with adolescents recruited from seven randomly selected private schools in Delhi, India, during 2021. A self-administered web-based survey was conducted to evaluate the behavior of the participants before and during the pandemic. Of the 512 students (53% males) who participated in the



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survey, 39% gained weight during the COVID-19 pandemic. There was a significant increase in the number of meals per day ( $p = 0.005$ ) and a reduction in physical activity ( $p = 0.00$ ) compared to the situation before the pandemic. The percentage of students who played indoor board and computer games increased from 13% to 46%. Students's gender ( $p = 0.007$ ) and parents' education (mother:  $p = 0.003$ ; father:  $p = 0.025$ ) were significantly associated with physical activity during the pandemic. Higher socioeconomic status was significantly associated with consumption of more than two meals per day. The students who had working fathers with advanced/professional degrees were three times more likely [AOR 3.24, 95% CI (0.91–11.53)] to be physically active and eat a minimum of three major meals per day [AOR 3.21, 95% CI (1.77–5.81)] during the pandemic compared to those whose fathers were unemployed. This study highlighted the need for innovative strategies for adolescents and parents to adopt and practice a healthy lifestyle, especially during public health crises, such as the COVID-19 pandemic.

### Keywords

COVID-19; adolescents; nutrition; physical activity; behavior; pandemic

## 1. Introduction

The world is facing an unprecedented challenge due to the COVID-19 pandemic. Measures to contain the spread of COVID-19 infection, which can affect all age groups, and to mitigate the risks of the pandemic, include self-isolation, quarantine, wearing a mask, washing hands and maintaining social distance [1]. As a precautionary step, educational institutions were closed, confining school-age children to their homes, posing an unprecedented challenge to their education and natural growth. Movement restrictions affected adolescents through online classes, less playtime, more screen time, and limited interaction with peers. Along with the closure of educational institutions, limited outdoor activities and stockpiling of food due to restricted grocery shopping influenced the overall dietary behavior [2] and physical activity. These measures exposed adolescents to various risk factors, including unhealthy lifestyle habits and mental health issues [3]. Studies conducted in middle-income and high-income countries reported a higher prevalence of inactivity among adolescents, high intake of ultra-processed foods [4], and poor sleep patterns, resulting in anxiety, exhaustion, emotional disturbance, and stress during the pandemic [5]. A sedentary lifestyle with little physical activity, watching television or playing computer games, and consuming foods high in salt, sugar, and fat, and carbonated drinks are determinants of overweight and obesity in adolescents from urban areas [6]. Little is known about the effect of COVID-19 measures on the physical activity and dietary behavior of adolescents in India. Our primary objective was to evaluate the impact of the COVID-19 measures on the dietary behavior and physical activity of adolescents. We hypothesized that significant changes in the diet and physical activity of adolescents occurred during the pandemic.

Measures such as social distancing to contain COVID-19 infection resulted in limited mobility and availability of resources and affected the general well-being and economic conditions of people. A study conducted in Uruguay showed that parental jobs and loss of income are strongly associated

with parents' depressive symptoms, stress, and negative interactions with children [7]. In the same study, participants reported experiencing changes in their daily life due to social distancing measures, including loss of jobs, difficulty in working, and working from home. In another study conducted with families to determine social needs, COVID-19-related concerns, and diet-related behaviors, the respondents expressed concern about their inability to pay bills, rent, and get other basic needs, including access to food because of unemployment due to closure. A study conducted in Australia revealed that economically vulnerable households and people who lost income during the COVID-19 pandemic faced difficulty in purchasing food [8]. Parents with unskilled jobs might not pay much attention to the diet and physical activity of their family members. Therefore, the secondary objective of this study was to determine the factors that influenced physical activity and diet-related behavior among adolescents during the COVID-19 pandemic.

## **2. Methods**

### **2.1 Study Design**

This cross-sectional study was conducted with students from seven private schools in Delhi, India, in 2021. The schools were randomly selected from the list of private schools governed by the Directorate of Education (DoE), Government of National Capital Territory (NCT) of Delhi. This study was limited to students from private schools in Delhi because previous studies in this city showed that the prevalence of overweight and obesity was significantly higher in students of private schools than in students of government schools [9].

### **2.2 Participants**

Students aged 10–16 years from the seven randomly selected schools were invited to participate in the study. They were already being followed as a cohort in a study entitled i-PROMISE [10], while the data were collected retrospectively during the COVID-19 pandemic. A total of 725 students were invited to participate in the survey; 213 of them had to be excluded due to no response/missing values or duplicates. Finally, 512 respondents were included whose data were complete.

### **2.3 Measures**

A self-administered web-based survey was conducted in English. The link to the survey was shared with the schools for dissemination among students. Consent and assent procedures were followed. The survey was adapted from other questionnaires that were previously validated with adolescents and were extensively pilot-tested in India [9, 11]. In previous studies, the survey was conducted in person. The survey assessed dietary knowledge and behavior, including food purchasing behavior and physical activity-related behavior, including the frequency of participation in physical activity for 60 min/day, the frequency of daily meals, the use of available resources for physical activity, duration of screen time, and anthropometric data. The questionnaire was pre-tested with participants from another school. The data were collected through a web-based survey.

## **2.4 Institutional Review Board Statement**

Ethical clearance for the study was obtained from the Public Health Foundation of India Institutional Ethics Committee (PHFI IEC) (TRC-IEC 407/19; 19/10, 2020).

## **2.5 Informed Consent Statement**

Informed consent was obtained from the schools and the parents of the students participating in the study; an informed assent was obtained separately from the students.

## **2.6 Outcome Variables**

The outcome variable to evaluate the diet-related behavior was the 'number of meals during COVID-19', which was assessed through the question: 'How many meals did you eat in a day during the COVID-19 lockdown?' We dichotomized this variable into '2 or less than 2 meals = 0' and 'more than 2 meals = 1'. The second outcome variable, i.e., physical activity, was assessed through the question: 'What activities did you perform during the COVID-19 lockdown period?' The response categories to this question were: 'indoor game', 'outdoor game', 'Physical Training (PT)', 'Yoga', and 'none of the above'. We dichotomized this variable into 'active = 1' and 'not active = 0'. The category 'active' included outdoor games, Yoga, PT, and some indoor games (such as carom board, board games, e.g., ludo), while all other responses were clubbed into the 'not active' category.

Possible effect-modifiers were the variables 'mother's education', 'father's education', 'mother's occupation', 'father's occupation', and 'change in weight during COVID-19'.

## **2.7 Data Analysis**

Descriptive analyses, including exploratory graphs and percentage distribution of categorical variables, were performed to understand the distribution of data. Bivariate analysis was performed using the non-parametric Chi-square test at a level of significance of 5% to assess the association between outcome and exposure variables. Wilcoxon signed-rank test was conducted to determine significant differences in meal consumption ('number of meals taken per day' as an ordinal variable) before and during the COVID-19 pandemic. McNemar's test was performed to determine the differences in the proportion of physical activity of the respondents before and during the COVID-19 pandemic. Bivariate logistic regression models were constructed to determine the strengths of association between predictors (education of mother, education of father, occupation of father, occupation of mother) and the primary outcome variables (meals during the COVID-19 pandemic and physical activity). Related questions (socio-demographic characteristics; frequency of meal and physical activity before and during the COVID-19 pandemic) are provided in Table 1. The age and gender of the participants were treated as the covariates in logistic regression models. We estimated crude, as well as age-adjusted (in continuous form) and gender-adjusted odds ratios (AOR). All statistical analyses were conducted in the Stata software (version-14.0, parallel edition).

**Table 1** The list of questions in the questionnaire.

Socio-demographic characteristics	<p>Q 1 Highest education attained by your mother Advanced professional degree (e.g., PG, PhD, etc.) Graduate Senior Secondary Certificate High School Certificate Middle School Primary School No formal schooling</p> <p>Q 2 Highest education attained by your father Advanced professional degree (e.g., PG, PhD, etc.) Graduate Senior Secondary Certificate High School Certificate Middle School Primary School No formal schooling</p> <p>Q 3 Occupation of your mother (skip if does not apply) Professional (e.g., doctor, nurse, lawyer, engineer, etc.) Semi-professional (technician, assistant, etc.) Clerical, shop owner, farmer Skilled worker (with formal training or certificate) Semi-skilled worker (without any formal training or certificate) Unskilled worker (laborer) Unemployed/homemaker</p> <p>Q 4 Occupation of your father (skip if does not apply) Professional (e.g., doctor, lawyer, engineer, etc.) Semi-professional (technician, assistant, etc.) Clerical, shop owner, farmer Skilled worker (with formal training or certificate) Semi-skilled worker (without any formal training or certificate) Unskilled worker (laborer) Unemployed</p> <p>Q5. What do you think about your weight during the covid-19 lockdown period? a. Gained weight b. Lost weight c. Maintained weight</p>									
Frequency of meals	<p>Q 6 How many meals do you eat in a day?</p> <table border="1"> <thead> <tr> <th data-bbox="596 1912 676 1989">Number of meals</th> <th data-bbox="794 1912 879 1989">Pre-coronavirus times</th> <th data-bbox="1075 1912 1160 1989">During coronavirus times</th> </tr> </thead> <tbody> <tr> <td data-bbox="596 2002 612 2024">1</td> <td></td> <td></td> </tr> <tr> <td data-bbox="596 2040 612 2063">2</td> <td></td> <td></td> </tr> </tbody> </table>	Number of meals	Pre-coronavirus times	During coronavirus times	1			2		
Number of meals	Pre-coronavirus times	During coronavirus times								
1										
2										

	3		
	More than 3		
Physical activity	Q 7 What kind of activities do you perform in the physical education/PT period in school? Mark all that apply		
		Pre- coronavirus times	During coronavirus times
	Outdoor sports which involve running (e.g., football, basketball)		
	Indoor games		
	PT/drill		
	Yoga		
	None of the above		
	Any other, please specify		

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### 3. Results

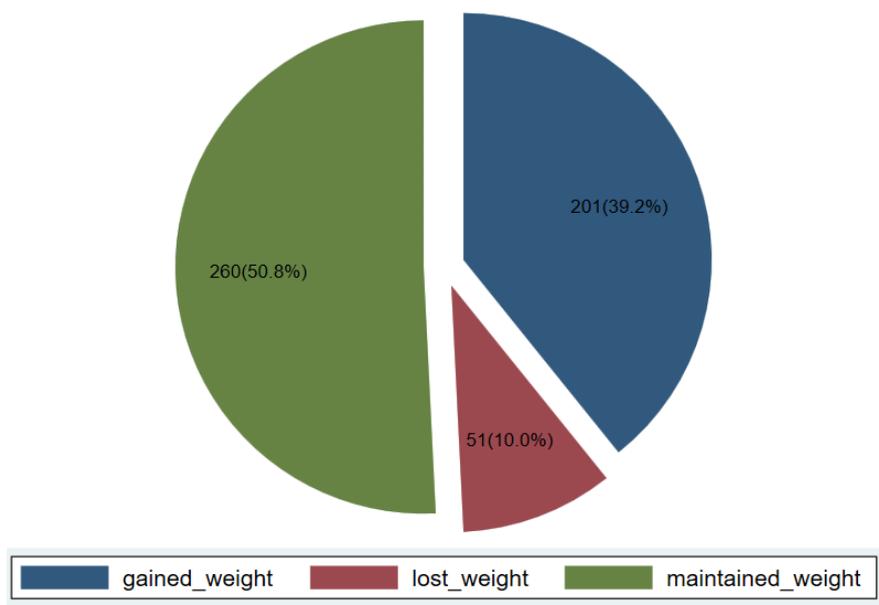
A total of 512 students (52.7% males, 47.3% females) participated in the survey (Table 2). The mean age of the respondents was 12.8 years. About half of the students' mothers were homemakers or housewives (52.3%), while around 44% of the students' fathers were working as professionals in various organizations. Around 2.2% of the students' fathers were unemployed during the COVID-19 lockdown.

**Table 2** The socio-demographic characteristics.

Socio-demographic characteristics	n (%)
Age, mean (SD)	12.8 (0.85)
<b>Gender</b>	
Female	242 (47.3)
Male	270 (52.7)
<b>Highest education (educational level) attained by mother</b>	
<=HSC (primary/secondary/higher)	228 (44.5)
Graduate	196 (38.3)
Advanced/professional degree	88 (17.2)
<b>Highest education (educational level) attained by father</b>	
<=HSC (primary/secondary/higher)	177 (34.6)
Graduate	233 (45.5)
Advanced/professional degree	102 (19.9)
<b>Occupation of mother</b>	
Homemaker or housewives	268 (52.3)
Skilled	27 (5.3)

<b>Professional</b>	85 (16.6)
<b>Other (freelancer/part-time)</b>	132 (25.8)
<b>Occupation of father</b>	
<b>Unemployed</b>	11 (2.2)
<b>Skilled</b>	72 (14.1)
<b>Professional (e.g., doctors, nurses, lawyers, engineers, etc.)</b>	226 (44.1)
<b>Other (freelancer/part-time)</b>	203 (39.6)
<b>Total</b>	<b>512 (100)</b>

We found that approximately half of the students (50.8%) maintained their weight during the COVID-19 pandemic, while 39.2% of the students gained weight (Figure 1). Nearly 10% of the students lost weight during the lockdown.



**Figure 1** The status (self-reported) of the weight of the students during the COVID-19 pandemic, n (%).

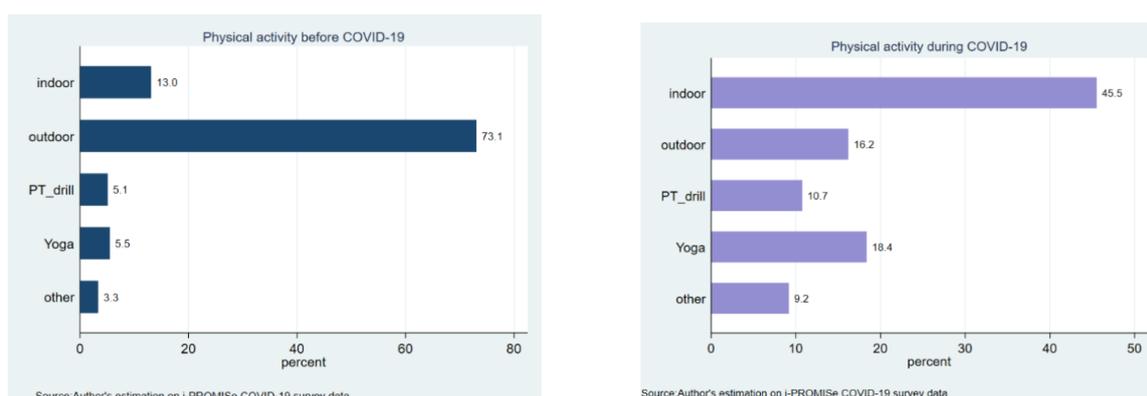
The changes in the meal frequency of the students before and during the COVID-19 pandemic are presented in Table 3. The results of the Wilcoxon signed-rank test showed significant differences in meal consumption (no. of meals/day) before and during the COVID-19 pandemic ( $p = 0.005$ ).

**Table 3** The frequency of meals of the participants before and during the COVID-19 pandemic.

Number of meals taken per day	[Pre-COVID-19]	[During COVID-19]	p-value
	n (%)	n (%)	
1	45 (8.8)	47 (9.1)	<b>p = 0.0054</b>
2	107 (20.9)	92 (18.0)	
3	295 (57.6)	286 (55.9)	

<b>More than 3</b>	65 (12.7)	87 (17.0)
<b>Total</b>	<b>512 (100.0)</b>	<b>512 (100.0)</b>

Most students (73.1%) played outdoor sports before the COVID-19 pandemic (soccer, cricket, etc.), but this proportion dropped to 16% due to lockdown measures during the pandemic. The proportion of students playing indoor games increased from 13% (before the COVID-19 pandemic) to 45.5% (during the COVID-19 pandemic) (Figure 2). About 5.5% of the students performed Yoga before the COVID-19 pandemic, while about three times as many students (18.4%) performed Yoga during the pandemic. The proportion of the students who did PT/drills also increased from 5.1% to 10.7% (during the pandemic). Most students were engaged in less physical activity during the COVID-19 pandemic. The difference in the proportion of physical activity of the respondents before and during the COVID-19 pandemic was statistically significant ( $p = 0.00$ ).



**Figure 2** The physical activity of the participants before and during the COVID-19 pandemic.

Students’ age, mother’s occupation, and father’s occupation were not significantly associated with the intensity of physical activity during the pandemic, while students’ gender ( $p = 0.007$ ), mother’s education ( $p = 0.003$ ), and father’s education ( $p = 0.025$ ) were significantly associated with physical activity during the pandemic. The details are provided in the supplementary files (Table S1 & Table S2).

The results of the logistic regression analysis revealed that the students whose mothers had advanced/professional degrees were more likely [COR 2.39, 95% CI (1.32–4.33)] to eat three or more major meals during the pandemic compared to the students whose mothers only had a higher secondary certificate (HSC), while the adjusted odds ratio [AOR 2.28, 95% CI (1.25–4.15)] indicated almost similar significant results after controlling the effect of age and gender in the regression model (i.e., assuming age and gender as constants in the regression model). Similarly, the students whose fathers had advanced/professional degrees were three times more likely [AOR 3.21, 95% CI (1.77–5.81)] to eat three or more major meals during the pandemic. The students who had professional working fathers were more likely [COR 3.55, 95% CI (1.03–12.16)] to eat more than two meals per day compared to the students whose fathers were unemployed during the pandemic. After adjusting the model with age and gender, the AOR [AOR 3.13, 95% CI (0.90–10.9)] suggested almost similar significant results. The students who reported weight loss were less likely [COR 0.44, 95% CI (0.24–0.81)] to eat a minimum of three major meals in a day compared to those who gained

weight during the pandemic, while after controlling for age and gender variables in the model, the adjusted odds ratio revealed almost similar results [AOR 0.45, 95% CI (0.24–0.85)] (Table 4).

**Table 4** The results of the logistic regression for the factors associated with the frequency of meals during the COVID-19 pandemic.

No. of meals per day (outcome variable)	COR	p-value	[95% Confidence Interval]		AOR	p-value	[95% Confidence Interval]		
<b>Exposure variables</b>									
<b>Highest education (educational level) attained by mother</b>									
<=Higher Certificate (primary/secondary/higher) <sup>®</sup>	1.0				1.0				
Graduate	2.30	0.000	1.48	3.59	2.15	0.001	1.37	3.37	
Advanced/professional degree	2.39	0.004	1.32	4.33	2.28	0.007	1.25	4.15	
<b>Highest education attained by father</b>									
<=HSC (primary/secondary/higher) <sup>®</sup>	1.0				1.0				
Graduate	2.84	0.000	1.84	4.40	2.65	0.000	1.70	4.12	
Advanced/professional degree	3.35	0.000	1.86	6.05	3.21	0.000	1.77	5.81	
<b>Occupation of mother</b>									
Homemaker or housewives <sup>®</sup>	1.0				1.0				
Skilled	0.95	0.916	0.39	2.35	0.90	0.822	0.36	2.24	
Professional	1.69	0.106	0.89	3.19	1.64	0.131	0.86	3.12	
Other (freelancer/part-time)	0.53	0.005	0.34	0.83	0.54	0.008	0.35	0.85	
<b>Occupation of father</b>									
Unemployed <sup>®</sup>	1.0				1.0				
Skilled	3.17	0.086	0.85	11.81	2.80	0.128	0.74	10.62	
Professional	3.55	0.044	1.03	12.16	3.13	0.073	0.90	10.90	
Other (freelancer, part-time)	1.39	0.595	0.41	4.72	1.27	0.700	0.37	4.38	
<b>Change in weight during COVID-19</b>									
Maintained weight <sup>®</sup>	1.0				1.0				
Lost weight	0.44	0.008	0.24	0.81	0.45	0.013	0.24	0.85	
Gained weight	1.48	0.078	0.96	2.28	1.50	0.070	0.97	2.33	

Note: <sup>®</sup>-Reference category; COR: crude odds ratio; AOR: age-adjusted and gender-adjusted odds ratio

The results of the regression analysis showed that students with highly educated parents performed significantly more daily physical activity during the pandemic than those whose parents were less educated. The crude odds ratio [COR 2.33, 95% CI (1.35–4.01)] indicated that the students whose mothers had advanced/professional degrees were two times more likely to be physically active during the COVID-19 pandemic compared to the students whose mothers had a higher secondary certificate (HSC), while the adjusted odds ratio [AOR 2.27, 95% CI (1.32–3.92)] indicated the almost similar significant results after controlling the effect of age and gender in the regression model. The students who had professional working fathers were three times more likely [AOR 3.24, 95% CI (0.91–11.53)] to be physically active compared to those whose fathers were unemployed during the pandemic (Table 5).

**Table 5** The results of the logistic regression for the factors associated with physical activity during the COVID-19 pandemic.

Physical activity (outcome variable)	COR	p-value	[95% Confidence Interval]		AOR	p-value	[95% Confidence Interval]	
<b>Exposure variables</b>								
<b>Highest education attained by mother</b>								
<=HSC (primary/secondary/higher) <sup>®</sup>	1.00							
Graduate	1.62	0.016	1.09	2.41	1.54	0.036	1.03	2.29
Advanced/professional degree	2.33	0.002	1.35	4.01	2.27	0.003	1.32	3.92
<b>Highest education attained by father</b>								
<=HSC (primary/secondary/higher) <sup>®</sup>	1.00							
Graduate	1.55	0.033	1.04	2.31	1.48	0.062	0.98	2.22
Advanced/professional degree	1.89	0.016	1.13	3.16	1.89	0.017	1.12	3.18
<b>Occupation of mother</b>								
Homemaker <sup>®</sup>	1.00							
Skilled	1.03	0.946	0.46	2.30	0.98	0.952	0.43	2.20
Professional (e.g., doctors, nurses, lawyers, engineers, etc.)	1.80	0.031	1.06	3.06	1.70	0.053	0.99	2.90
Other (freelancer, part-time)	1.32	0.206	0.86	2.04	1.31	0.225	0.85	2.03
<b>Occupation of father</b>								
Unemployed <sup>®</sup>	1.00							
Skilled	2.45	0.182	0.66	9.12	2.20	0.243	0.59	8.31

<b>Professional (e.g., doctors, nurses, lawyers, engineers, etc.)</b>	3.59	0.046	1.02	12.67	3.24	0.070	0.91	11.53
<b>Other (freelancer, part-time)</b>	2.64	0.132	0.75	9.29	2.37	0.183	0.67	8.44

Note: ®-Reference category; COR: crude odds ratio; AOR: age-adjusted and gender-adjusted odds ratio

#### 4. Discussion

In this study, about half of the students (50.8%) maintained their weight during the COVID-19 pandemic, while 39.2% of the students gained weight. The proportion of students playing indoor board and computer games increased from 13% (before the COVID-19 pandemic) to 45.5% (during the COVID-19 pandemic). Socio-demographic characteristics (parents' education and occupation) were significantly associated with the consumption of at least three meals per day by the children. The students who had working fathers with advanced/professional degrees were three times more likely [AOR 3.24, 95% CI (0.91–11.53)] to be physically active and eat a minimum of three major meals daily [AOR 3.21, 95% CI (1.77–5.81)] during the pandemic compared to those whose fathers were unemployed during the pandemic.

A cross-sectional study conducted with participants aged 12–16 years in Yazd, Iran, found that sedentary behavior, screen time, overweight/obesity, and lack of physical activity were common in this age group [12]. A study conducted with adults in Spain showed a decrease in daily self-reported physical activity and an increase in sedentary time during COVID-19 confinement, especially in students and previously highly active men [13]. In another study, students reported that the median duration of their sleep was extended by 1.5 h during the lockdown [14]. The results of this study also showed that most of the students played (73.1%) outdoor sports (football, cricket, etc.) before the COVID-19 pandemic, while this proportion decreased considerably due to lockdown-related restrictions caused by the pandemic. The proportion of students playing indoor games increased during the COVID-19 pandemic. Studies conducted in Asian countries [15, 16] also showed a decrease in fruit consumption and physical activity, including exercise among adolescents and adults. Besides the impact on the changes in diet and physical activity due to the COVID-19 pandemic, a systematic review showed the impact on the behavior/psychological state in children/adolescents. The review showed that 79.4% of children were negatively affected by the pandemic, and at least 22.5% of children had a significant fear of COVID-19 [17].

Studies conducted with adolescents in Western countries showed that COVID-19 restrictions influenced their dietary habits, including altered consumption of fried foods, sweet foods, legumes, vegetables, and fruits. Adequate meal intake during the COVID-19 period was differently correlated with variables such as the number of family members at home (as the availability of resources reduced in larger families), watching TV during meals, and education of the mother [18]. Our study showed that the meal intake of participants was significantly associated with their parents' education. The students whose parents were highly educated were significantly more likely to take more than two meals per day during the pandemic compared to those whose parents were less educated.

The educational level of the parents can influence the feeding behavior of family members based on their awareness level and the availability of economic resources. The results of a population-

based study conducted with parents of adolescents indicated that parental access to economic resources may contribute to a parent's decision to employ specific feeding practices [19]. In another study, mothers with low educational attainment showed greater tendency to buy less healthy discounted products while shopping with a poorer quality of diet compared to mothers with higher educational attainment [20]. Our study showed that students whose parents were more educated and employed as skilled workers had at least three major meals in a day and were more likely to be physically active compared to the students whose parents were less educated and employed as less-skilled workers.

A study conducted with 16–19-year-old participants in Latin America found a higher prevalence of inactivity during the pandemic. These adolescents had a high odds ratio (OR 2.98; CI 95% 1.80–4.94) of being inactive, and those adolescents whose mothers had a higher level of education were less active during the lockdown [OR 0.40 (CI 95% 0.20–0.84)] [4].

The factors influencing the behavior of the family included balancing work with childcare/home-schooling and financial instability during the COVID-19 pandemic [21]. A study conducted in Spain during the lockdown period investigating the social inequalities in housing conditions and health-related behaviors among children showed that children from families with low educational levels and financial difficulties were exposed to negative health determinants such as poor dietary patterns, sedentary lifestyle, and less social contact [22]. In our study, the age-and gender-AOR suggested that the students whose mothers had advanced/professional degrees were more likely [AOR 2.27, 95% CI (1.32–3.92)] to be physically active during the COVID-19 pandemic. The less educated parents might have low awareness regarding the importance of being physically active and eating a healthy diet regularly, especially during such public health emergencies. The students who had professional working fathers were three times more likely [AOR 3.24, 95% CI (0.91–11.53)] to be physically active compared to those whose fathers were unemployed during the pandemic, regardless of the age and gender of the students.

Policies to foster a supportive environment focused on the availability, accessibility, and affordability of healthy food options, including restrictions on advertising unhealthy food products, need to be enforced and monitored regularly, especially during such public health emergencies. Innovative strategies involving parents can effectively reinforce the importance of a healthy lifestyle, e.g., by using online platforms. It is imperative to continue studying influential determinants to strengthen multi-factorial strategies to promote healthy living practices among urban Indian adolescents.

## **5. Strengths and Limitations**

The main limitation of this study was that the survey was based on self-reported information, which might lead to over-reporting or under-reporting of data. Other limitations were the possible recall bias of the participants, the cross-sectional design, and the fact that only the students who had access to the internet and who were comfortable completing an online survey using their device (e.g., mobile phone, computer) participated in the survey. Recall bias might have affected the responses, especially those related to the pre-lockdown period. Another limitation was that we could not assess the mental health of the students. A strength of our study was the fact that the survey was conducted during the pandemic. Very few studies have been conducted in India to assess the impact of COVID-19 on the dietary and physical activity-related behavior of adolescents

## **6. Conclusion**

In this study, almost 40% of the students reported weight gain and an increase in their dietary intake to some extent during the COVID-19 pandemic. The percentage of students playing indoor board and computer games also increased during the COVID-19 pandemic. Unhealthy diet and physical inactivity among adolescents worsened during the lockdown. Socio-demographic characteristics, including parents' education and occupation, were significantly associated with the meal intake and physical activity of their children. This study emphasizes the need for interventions, programs, and policies for the benefit of adolescents and parents to adopt and practice a healthy lifestyle, including consumption of nutritious food and greater physical activity, especially during public health emergencies such as the COVID-19 pandemic.

## **Acknowledgments**

We are grateful to the World India Diabetes Foundation (WIDF) for guiding the conceptualisation and implementation of the project. We thank the schools, their teachers, and students for providing support during the data collection for this study.

## **Author Contributions**

CPS, MA, JM, and TR conceptualised the study design and provided guidance to implement the study. TR collected, organised and wrote the manuscript. VKM supported the data analysis with TR under the guidance of CPS and JM. CPS, JM, MA, and NT revised the manuscript critically for intellectual content. All authors approved the final manuscript.

## **Competing Interests**

The authors have declared that no competing interests exist.

## **Additional Materials**

The following additional materials are uploaded at the page of this paper.

1. Table S1: The percentage distribution of the meal intake of the students during the COVID-19 pandemic, based on certain background characteristics; statistically significant differences were determined by performing Chi-square tests.
2. Table S2: The percentage distribution of the physical activity of the students during the COVID-19 pandemic, based on certain background characteristics; statistically significant differences were determined by performing Chi-square tests.

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