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Prevalence of Obesity among Elementary Students during COVID-19 Pandemic in Yazd, Iran

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ABSTRACT

Background: Childhood obesity can affect life in three aspects, including continuing obesity after childhood, increased risk of chronic diseases, and mortality. Over the last year, students' lifestyles have changed due to the COVID-19 pandemic. In order to plan educational interventions to improve students' health, this study aimed to investigate the prevalence of obesity among elementary students during COVID-19 pandemic in Yazd, Iran. **Methods:** This cross-sectional study was conducted on 583 elementary students in 4^{th}-6^{th} grades (aged 10-12 years) in Yazd in 2021. The participants were recruited using multistage sampling (cluster, stratified, and random) method. Data collection tools included the physical activity questionnaire for older children (PAQ-C) and a validated researcher-made questionnaire in terms of fast food and carbonated sweet beverages consumption. Body mass index (BMI) was calculated using the students' height and weight information registered in student electronic registration system (SANAD). **Results:** The prevalence of overweight and obesity among primary school students was 23.9% and 14.5%, respectively. Gender ($P < 0.0001$), type of school ($P < 0.0001$), mother's education level ($P = 0.03$), amount of carbonated sweet beverages ($P < 0.0001$), and level of physical activity ($P = 0.04$) were associated with BMI status. There was no significant association between frequency of students' consumption of fast food ($P = 0.41$) or soft drinks and BMI status ($P = 0.48$). **Conclusion:** During the COVID-19 outbreak, students' weight gain has been more affected by reducing physical activity than consuming high-calorie foods. Therefore, it is required to create new infrastructure and opportunities for improving physical activity among students.

Keywords: *Students; Obesity; COVID-19; Pandemic*

Introduction

The prevalence of overweight and obesity doubled worldwide since 1980. In 2015, a total of 107.7 million children and 603.7 million adults were obese (Collaborators, 2017). Childhood obesity can affect the whole life in three aspects, including continuing obesity after childhood, increased risk of chronic diseases, and mortality (Wang *et al.*, 2018a). Obese children are

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of obesity in adulthood five times more than children with normal weight. Studies have shown that about 55% of obese children remain obese during adolescence, and about 80% of these adolescents develop obesity in adulthood (Simmonds *et al.*, 2016). The adolescent obesity is associated with morbidity and mortality of cardiovascular disease and metabolic disorders in middle ages (Berenson and group, 2012, Olds *et al.*, 2011). Additionally there is a strong association between higher body mass index (BMI) during adolescence and increased risk for several malignancies, such as leukemia, Hodgkin's disease, colorectal cancer, and breast cancer in adulthood (Weihrauch-Bluher *et al.*, 2019).

If the onset of obesity occurs around seven years old, and if this trend continues until puberty, the risk of type 2 diabetes in adulthood will significantly increase, even with normal body weight before seven. In other words, for every 2 years of obesity, the risk of type 2 diabetes increases by 14% (Mei *et al.*, 2016). According to research results, 5.1% of Iranian students are overweight and 10.8% are obese (Kelishadi *et al.*, 2017). A study in Yazd also showed that the prevalence of overweight and obesity among elementary students was 10.9% and 20.6%, respectively (Gholami *et al.*, 2019).

In fact, one of the important factors in increasing obesity in children worldwide is the change of their dietary habits. Availability and accessibility to high-calorie foods and sweet drinks, along with strategies for profitable trade, all lead to excessive energy intake at the beginning of childhood. In addition, daily physical activity has decreased dramatically over the past decades, and leisure time activities have focused on the use of new media and sedentary behaviors (Mei *et al.*, 2016, Swinburn *et al.*, 2011). According to CASPIAN study results, 11.66% of students in Yazd eat fast food daily, and only 32% of them use raw or cooked vegetables daily, and 51.25% of them have physical activity at least three days in a week for at least half an hour (Mohammad *et al.*, 2016).

During the last year, students' lifestyle changes were more noticeable due to the COVID-19 pandemic. Because of lock down, students have experienced new conditions and spent most of their time at home like summer vacation. According to several studies, students gain weight during summer vacation rather than school times (von Hippel and Workman, 2016, Wang *et al.*, 2015). Since assessing the current situation is the first step in implementing educational interventions to improve students' health, thus this study investigated the prevalence of obesity among elementary students during COVID-19 pandemic in Yazd, Iran.

Materials and Methods

Study design and participants: This cross-sectional study was conducted on 583 elementary students aged 10-12 years in Yazd in 2021. The participants were recruited using multistage sampling (cluster, stratified, and random) method. In the other words, cluster sampling was used to select educational areas in Yazd, and then the schools in each cluster (area) were stratified according to gender (girls and boys) and the type of school (state and private), and finally 12 schools were randomly selected. In each selected school, among 4^{th}-6^{th} grades, classes were randomly selected. Students whose height and weight information was not recorded in the school system were excluded from the study.

Obesity and overweight definition: According to the World Health Organization (WHO) definition, obesity and overweight was diagnosed based on weight, height, and BMI flowcharts and percentiles. BMI $\geq$ the 97^{th} percentile, between the 85^{th} - 97^{th} percentile, between the 15^{th} - 85^{th} percentile, and > the 15^{th} percentile were classified as obese, overweight, normal, and underweight, respectively (World Health Organization, 2007).

Physical activity: The tool for measuring the students' physical activity in this study included the standard children's physical activity questionnaire (PAQ-C). The validity and reliability of this questionnaire has been previously confirmed in the Iranian children (Kelishadi *et al.*, 2017). The PAQ-C is a self-administered, 7-day recall instrument. It

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consist of 9 items and each item have a value from 1 to 5 and the mean score of 9 items indicates the physical activity (Kowalski *et al.*, 2004) at low (PAQ-C score: 1–1.9) and high (PAQ-C score: 2–5) levels (Adeniyi *et al.*, 2011).

Fast food and beverages consumption: Based on the previous studies (Mohammadbeigi *et al.*, 2018, Nelson and Lytle, 2009), fast food and beverages consumption was measured by a validated researcher-made questionnaire. Outcomes in fast food questionnaire were type of fast foods and frequency of consumption. Reliability of the content was approved by an expert panel consist of 4 nutritionists and 2 health educators. To assess the reliability of the questionnaire, Cronbach's alpha coefficient was calculated and accepted by 0.74. Beverage consumption was measured by two questions, including "How often do you drink carbonated sweet beverages?" and "How much do you usually drink carbonated sweet beverages each time". Due to the lack of access to students during the pandemic, all questionnaires were designed electronically and sent to one of the parents' mobile phones. In order to increase the accuracy of the answer, parents (in most cases mothers) were asked to accompany the students in completing the questionnaire.

Ethical considerations: This research was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences with the number IR.SSU.REC.1398.240. The consent form of the study was designed at the beginning of the electronic questionnaire and the participants were directed to the question page after its approval.

Data analysis: The data were analyzed using SPSS version 22 (IBM, USA). In order to show mean demographic characteristics, standard deviations and percentages were reported. Statistically significant differences among qualitative variables were measured using Pearson Chi-square test. One-way ANOVA test was used to compare mean score of physical activity among four BMI categories. A significance level of P-value ≤ 0.05 was considered for all analyses.

Results

Demographic characteristics of the participants are presented in **Table 1**. Among 586 students participating in this study, 298 (50.9%) were girls and 288 (49.1%) were boys. The prevalence of underweight, normal weight, overweight, and obesity among the participants was 7%, 56.4%, 23.9%, and 14.5%, respectively. Totally, 63% of students were from state schools and 37% from private schools. The level of father's education in 40.8% of the samples was high school and diploma and 57% of the samples had mothers with university education. The participants' BMI status was related to the type of school, gender, and mother's education.

Fast food and sweetened beverage consumption are shown in **Table 2**. More than half of the participants (59.7%) consumed fast food less than once a month and 44.7% of them stated that never or rarely use carbonated soft drinks. Approximately half of the subjects (51.1%) consumed less or equal to half a glass of beverage per meal. There was a relationship between students' BMI status and the amount of soft drink consumed per meal.

The students' weekly physical activity is reported in **Table 3**. The mean score of physical activity among students was 2.02 (±0.62). At 95% confidence level, the mean physical activity was different in various BMI status ($P = 0.04$). Post hoc test showed that there was a significant difference between the mean physical activity in normal weight and obese students and physical activity was higher in students with normal weight than obese ($P = 0.03$).

Discussion

According to the results, the prevalence of overweight and obesity among primary school students was 23.9% and 14.5%, respectively, which was slightly higher than previous studies in Yazd (Gholami *et al.*, 2019) and Farsan (Mohammadi and Mozaffari-Khosravi, 2019).

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Table 1. Characteristics of the students aged 10-12 years based on BMI status (n=586).

Variables	Underweight N (%)	Normal weight N (%)	Overweight N (%)	Obese N (%)	Total N (%)	P-value[a]
Grade						
4th	25 (61.0)	178 (55.6)	74 (52.9)	42 (49.4)	319 (54.4)	0.05
5th	15 (36.6)	90 (28.1)	45 (32.1)	21 (24.7)	171 (29.2)	
6th	1 (2.4)	52 (16.2)	21 (15.0)	22 (25.9)	96 (16.4)	
Gender						
Female	24 (58.5)	184 (57.5)	68 (48.6)	22 (25.9)	298 (50.9)	< 0.0001
Male	17 (41.5)	136 (42.5)	72 (51.4)	63 (74.1)	288 (49.1)	
School type						
State	31 (75.6)	217 (67.8)	84 (60.0)	37 (43.5)	369 (63.0)	< 0.0001
Private	10 (24.4)	103 (32.2)	56 (40.0)	48 (56.5)	217 (37.0)	
Father education						
Elementary school	1 (2.4)	19 (5.9)	8 (5.7)	2 (2.4)	30 (5.1)	0.69
Middle or high school	18 (43.9)	135 (42.2)	54 (22.6)	32 (13.4)	239 (40.8)	
College or above	22 (53.7)	166 (51.9)	78 (55.7)	51 (60.0)	317 (54.1)	
Mother education						
Elementary school	4 (9.8)	18 (5.6)	9 (6.4)	1 (1.2)	32 (5.5)	0.03
Middle or high school	19 (46.3)	119 (37.2)	59 (42.1)	23 (27.1)	220 (37.5)	
College or above	18 (43.9)	183 (57.2)	72 (51.4)	61 (71.8)	334 (57.0)	

[a]: *Chi-squire test*

Table 2. Fast food and sweetened beverage consumption according to BMI status (n=586).

Variables	Underweight N (%)	Normal Weight N (%)	Overweight N (%)	Obese N (%)	Total	P-value *
Fast food consumption						
Never	3 (7.3)	27 (8.4)	10 (7.1)	4 (4.7)	44 (7.5)	0.41
< 1 time per month	24 (58.5)	192 (60.0)	77 (55.0)	57 (67.1)	350 (59.7)	
1-2 times per month	10 (24.4)	87 (27.2)	39 (27.9)	20 (23.5)	156 (26.6)	
1≥ time per week	4 (9.8)	14 (4.4)	14 (10.0)	4 (4.7)	36 (6.1)	
Carbonated soft drinks						
Never or rarely	22 (53.7)	150 (46.9)	56 (40.0)	34 (40.0)	262 (44.7)	0.48
1-2 times per month	9 (22.0)	99 (30.9)	43 (30.7)	29 (34.1)	180 (30.7)	
3-4 times per month	9 (22.0)	45 (14.1)	26 (18.6)	14 (16.5)	94 (16.0)	
2≥ times per week	1 (2.4)	26 (8.1)	15 (10.7)	8 (9.4)	50 (8.5)	
Amount(Every time)						
≤½ glass	16 (52.2)	169 (60.6)	59 (46.1)	23 (28.8)	267 (51.1)	< 0.0001
1 glass	12 (41.4)	90 (32.3)	56 (43.8)	47 (58.8)	205 (39.7)	
≥2 glass	1 (3.4)	20 (7.2)	13 (10.2)	10 (12.5)	44 (8.5)	

[a]: *Chi-squire test*

This increase can be attributed to the emergence of COVID-19 and quarantine days that all changed children's lifestyles and eventually led to overweight and obesity among them. It has been hypothesized that childhood obesity may increase proportionate to the number of months that schools are closed (Cuschieri and Grech, 2020) . Furthermore, several studies have suggested that shift in institutional context from schools to homes is an effective factor in increasing students' weight through reduced physical activity and increased inactive lifestyles beside social isolation (Cuschieri and Grech, 2020, Nogueira-de-Almeida *et al.*, 2020, Workman, 2020).

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Table 3. physical activity and weight status.

Weight status	Mean	SD	P-value[a]
Underweight	2.11	0.68	0.04
Normal weight	2.06	0.64	
Overweight	1.99	0.55	
Obese	1.86	0.60	

[a]: *One-way ANOVA*

The percentage of obesity and overweight among boys was significantly higher than girls. This finding was consistent with other studies in Iran and other countries showing that overweight, obesity, and abdominal obesity are more common in boys than in girls (Mohammadi and Mozaffari-Khosravi, 2019, Wang *et al.*, 2018b, Zhao *et al.*, 2017).

The type of school was another variable that affected the obesity status of students, so that obesity was higher among students in private schools than in state schools. Similarly a study in Ethiopia indicated that private school students were 2.7 times more likely to be obese than state school students (Alemu *et al.*, 2014). Results of a study in eastern Ethiopia and a systematic review in the Middle East and North Africa (MENA) showed that, private school students who belonged to families with high socioeconomic status were significantly associated with a higher risk of obesity and overweight (Desalew *et al.*, 2017, Farrag *et al.*, 2017). Given that students who attend at private schools are more likely to have better economic status than state schools, it could be concluded that better economic status is associated with more obesity among students.

It is necessary to mention that in developed countries the trend is different, and in fact having a low socio-economic status is one of the strongest risk factors for obesity. In other words, in many developed countries, child obesity has stabilized or even decreased in the higher socio-economic groups, while in the lower socioeconomic groups, there has generally been a steady increase (Gil and Takourabt, 2017, Hemmingsson, 2018). In developing countries like Iran, unlike in developed countries, people with higher economic status are still at greater risk of obesity and overweight.

In the present study, a significant relationship was revealed between mothers' education level and children' BMI. More than half of obese students' mothers had university-education. Previous studies, usually conducted in European countries, have considered mothers' education level as a protective factor against obesity (Madden, 2017, Ruiz *et al.*, 2016). In Lissner's study, the odds ratio of obesity among Swedish and Portuguese students decreased as their mothers' education increased, but the opposite was true among Bulgarian students. Parents with lower education had a lower chance of their children becoming obese (Lissner *et al.*, 2016). This might be explained by the difference in community lifestyles. Since obesity is a very complex condition, higher education is not a direct risk factor for obesity, but it is possible that mothers with higher levels of education, due to their busy schedules, follow a different lifestyle, giving their children more access to high-calorie foods and a variety of sedentary computer games which are important risk factors for childhood obesity. As a result, in a developing country like Iran, the higher level of education of mothers could be indirectly related to childhood obesity and overweight.

According to the results of this study, there was no association between fast food consumption
and student obesity. In a study carried out by Mohammadbeigi, no significant relationship was found between fast food consumption and general obesity of students based on BMI (Mohammadbeigi *et al.*, 2018). In contrast a one-year cohort study showed that the risk of weight gain increased linearly with each additional time of fast food consumption in an average week during the study (Emond *et al.*, 2020). Lack of association in the present study could be due to the low rate of fast food consumption among the participants. Overall, about half of the students reported that consumed fast food less than once a

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month, which had no effect on their BMI status.

Regarding the consumption of carbonated sweet drinks, there was a significant relationship between the consumption of these drinks with obesity and overweight among the students. Fifty-eight percent of obese students consumed at least one glass of soft drink per serving, while more than half of normal-weight students consumed less than half a glass of soft drink per serving. There is a lot of evidence that sweetened drinks have negative effects on children's health, especially in relation to obesity and overweight (Bleich and Vercammen, 2018, Yoshida and Simoes, 2018). In a study, Katzmarzyk suggested that there is a significant linear relationship between BMI and soft drink consumption in boys aged 11-9 years (Katzmarzyk *et al.*, 2016).

In Wang's study, the obesity odds ratio in students who drank equal or more than 200 mg carbonated beverage a day were 1.8 times higher than those who drank less than 200 mg a day (Wang *et al.*, 2018a). This result conveys the importance of the fact that in addition to the frequency of carbonated sweet drinks consumption, the amount consumed per meal is also a significant factor in weight gain and obesity in children.

Based on ANOVA test, there was an association between students' physical activity and their BMI status. Physical activity of normal-weight students was significantly higher than obese students. The effect of physical activity on weight control has been proven several times in previous studies. In Huang's study the risk of obesity among children who spent less than 20 minutes (OR: 0.473) or more than 20 minutes (OR: 0.505) on weekends involving moderate to vigorous physical activity was significantly less than others (Huang and Wong, 2019, Mirsolimany *et al.*, 2015). In a similar study, Mocanu found that sedentary behavior increased the risk of obesity in children more than triples (Mocanu, 2013). Since this study was carried out during the COVID-19 pandemic, when students were not at school for almost an educational year, they were deprived of some activities that they did in physical education classes or break time. In addition, parents rarely took their children to parks, and these students lost many opportunities to be physically active, which could be a reason for reducing their level of physical activity and at the same time gaining weight during the COVID-19 pandemic.

One of the strengths of the present study was the multi-stage sampling method, which made the participants a real sample of the student population in Yazd. Furthermore, completing the questionnaires online also gave participants the opportunity to answer questions at an appropriate time without time constraints, which increased the accuracy of answering. Based on the sample size, several teachers were hired to measure the students' height and weight. Although they were trained in the same way, in some cases there may be a measurement error. It is suggested that in the future, with the help of sports medicine and sports physiology experts, online trainings on improving students' physical activity in small environments such as home be designed and their effectiveness on student weight control be investigated.

Conclusion

According to the present study, it seems that during the COVID-19 outbreak students' weight gain has been more affected by reducing physical activity than consuming high-calorie foods. The food choices have under control of parents, therefore, consumption of fast food and carbonated soft drinks is not yet common among them. In addition, due to the closure of schools, gyms and recreation centers in the community during the last year, children's physical activity has become too limited, so there is a need to create new infrastructure and opportunities for improving physical activity among students.

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Authors' contributions

Mehrabbeik A, Namiranian N, Mozaffari-Khosravi H, and Aghaee SM designed the

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research; Mehrabbeik A and Namiranian N conducted the research; Askari M, and Namiranian N analyzed the data; and Mehrabbeik A wrote the paper. Namiranian N had primary responsibility for final content. All the authors read and approved the final manuscript.

Conflict of interest

The authors declare that there is no conflict of interest.

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