

# Assessment of Nutritional Status Among 12-18 Year Age Group Using Who Z-Scores in Post-Pandemic Era of Covid-19

Fakhruddin Ahmad<sup>1</sup>, Abdulrahman M Alshahrani<sup>2</sup>, Ghulam Mustafa<sup>3</sup> and Abdullah  
Mohammed Bin Hussain<sup>4</sup>

## ABSTRACT

**Objective:** To assess the proportion of overweight and obesity among adolescents living in the semi-urban areas of Shaqra and to compare it with the baseline data from 2018.

**Study Design:** A cross-sectional study

**Place and Duration of Study:** This study was conducted at the Department of Basic Medical Sciences, Colleges of Medicine, Shaqra University (SU), in Shaqra, Saudi Arabia, during September 2018 to March 2023.

**Materials and Methods:** This study was conducted among adolescents between the ages of 12 and 18 in 2023. The World Health Organization (WHO) nutritional assessment tool was used to categorize overweight and obesity based on the adolescents' Z-scores. The results were compared with the baseline data on obesity collected in 2018. The chi-square test and odds ratio with 95% CI were calculated to assess the association between age and various risk factors and obesity.  $P < 0.05$  was considered significant.

**Results:** A decrease in mean BMI score of -4.3% was observed between 2018 and 2023. The nutritional status showed a significant ( $P < 0.01$ ) improvement in all nutritional indices from 2018 to 2023. Intake of three or fewer meals per day [1.81 (1.16–2.83);  $P < 0.01$ ], healthy food intake [1.52 (1.10–2.09);  $P < 0.01$ ] showed a significant increase from 2018 to 2023. Similarly, the frequency of restaurant visits [2.0 (1.42–2.81);  $P < 0.01$ ] and time spent on outdoor activity [3.22 (2.27–4.57);  $P < 0.01$ ] showed a significant increase from 2018 to 2023.

**Conclusions:** In the post-COVID era, children became more physically active and opted for healthy eating habits, both of which improved their nutritional status.

**Key Words:** Body Mass Index; COVID; Obesity; Overweight; School; Z-score

**Citation of article:** Ahmad F, Alshahrani AM, Mustafa G, Hussain AMB. Assessment of Nutritional Status Among 12-18 Year Age Group Using Who Z-Scores in Post-Pandemic Era of Covid-19. Med Forum 2023;34(9):70-74. doi:10.60110/medforum.340916.

## INTRODUCTION

Obesity is a major health problem around the world, and it is linked to serious medical and psychosocial comorbidities, decreased health-related quality of life (HRQoL), and an increased risk of mortality.<sup>1</sup> Over the last three decades, the Kingdom of Saudi Arabia (KSA) has experienced a substantial rise in the prevalence of obesity.<sup>2</sup> Overweight or obese children frequently carry the extra weight into adolescence and adulthood, resulting in lifelong health problems.

<sup>1</sup>. Department of Basic Medical Sciences / Internal Medicine<sup>2</sup> / Pediatrics<sup>3</sup> / Medicine<sup>4</sup>, College of Medicine, Shaqra, Shaqra University, Saudi Arabia.

Correspondence: Dr. Fakhruddin Ahmad, Assistant Professor of Basic Medical Sciences, College of Medicine, Shaqra, Shaqra University, Saudi Arabia.  
Contact No: +966 569474989  
Email: dr.fakhruddin@su.edu.sa

Received: May, 2023

Accepted: June, 2023

Printed: September, 2023

Overweight and obesity are becoming more common among children and adolescents aged 10 to 19 years. Saudi Arabia's central and eastern regions have the highest reported prevalence of overweight and obesity, which has increased substantially in recent years.<sup>3</sup>

The lack of physical activity and poor dietary habits are regarded as the primary risk factors for childhood and adult obesity. Many cultural and societal conventions about diet and body image are also essential risk factors, depending on the society. Environmental and societal changes may trigger changes in nutrition and physical activity. Several restrictions were implemented during the COVID-19 pandemic to curb the spread of the virus. These restrictions resulted in significantly fewer opportunities for physical activity for people of all ages.<sup>4</sup> Several studies have documented changes in children's leisure-time physical activity during the COVID-19 epidemic.<sup>4</sup> Low levels of physical activity are closely linked to an increased risk of childhood overweight or obesity.<sup>5</sup> According to preliminary studies, leisure-time behavior and physical activity during COVID-19 restrictions differed between urban and rural locations.<sup>6-7</sup> Following the disclosure of the first case in Saudi Arabia, all schools were closed, and social activities, sports events, local travel, and

international flights were banned for almost two years.<sup>8</sup> During these two years, diminished physical activity and changes in eating habits have had a negative effect on children's health status. This study on the nutritional status of children ages 12-18 was conducted in 2023 and compared with pre-pandemic data from 2018 to note the changes in the intervening years.

## MATERIALS AND METHODS

This school-based cross-sectional study was conducted at Department of Basic Medical Sciences, Colleges of Medicine, Shaqra University (SU), in Shaqra, Saudi Arabia, during the academic year September 2018 to March 2023 and carried out in intermediate schools of Shaqra. Male children in the 12-18 year age group participated in this study. The first phase of the study was conducted before the pandemic, in September 2018, and the second phase was conducted in the same schools post pandemic, in March 2023.

Study variables were age, height, weight, physical activity, and food habits. Standard operating procedures were used to take anthropometric measurements such as weight and height. Weight was measured to the nearest 0.1 kg on a standard bathroom scale that was recalibrated periodically during data collection. Each child asked to stand on the scale wearing only light clothing, without shoes, feet apart and gazing straight ahead. Each participant's height was measured using a stadiometer (measuring rod) with an accuracy of 0.1 cm. The child's heels, buttocks, shoulders, and occiput touched the measuring rod. The top of the head, held comfortably upright, made strong contact with the horizontal headpiece. Each measurement was taken twice, and the mean of the two measurements was recorded.<sup>10</sup> Anthropometric data were recorded twice, once in 2018 and again in 2023.

To assess nutritional status, the Z-score of BMI for age was calculated using the new WHO growth reference standards for boys. Children were categorized as Normal, Overweight, Obese, Thin and Severely thin according to BMI for Z – score.

The definitions used for the study were as follows:

**Table No.1: Anthropometric measurements of study participants (n=616)**

Characteristic	Year	N	Mean	Std. Deviation	Std. Error Mean
Age (in years)	2018	265	13.992	1.1078	0.0681
	2023	355	15.783	1.7274	0.0917
Height (in cm)	All	620	163	12.4	0.499
	2018	265	154	10.9	0.671
	2023	355	169	9.24	0.491
Weight (in Kg)	All	620	60.0	19.9	0.80
	2018	265	55.3	18.6	1.15
	2023	355	63.6	20.1	1.07
BMI (Kg/m <sup>2</sup> )	All	620	22.5	6.25	0.25
	2018	265	23.0	6.54	0.40
	2023	355	22.0	6.00	0.32

- Normal: BMI for age z- score of  $< +1SD$  to  $< -2SD$
- Overweight: BMI for age z- score of  $> +1SD$
- Obese: BMI for age z- score of  $> +2SD$
- Thin: BMI for age z- score of  $< -2SD$
- Severely thin: BMI for age z- score of  $< -3SD$

The data were analysed with SPSS version 22.0 for Windows (SPSS, Inc., Chicago, IL, USA). Chi-square was used for comparison between overweight, obese and normal study participants. *P* value of less than 0.05 was accepted for statistical significance.

The study protocol was approved by the Standing Committee for Research Ethics at Shaqra University, Kingdom of Saudi Arabia (ERC\_SU\_20220124). The objective of the study was explained to parents or guardians of the children and informed consent was taken. The study followed the principles of Helsinki Declaration.

## RESULTS

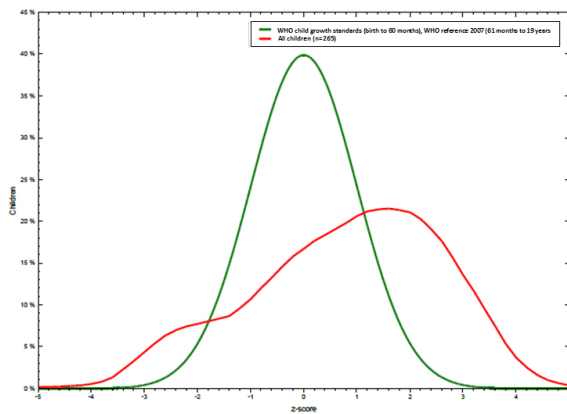
Two hundred and sixty-five (42.70%) of the 620 school-aged children surveyed were from 2018, while 355 (57.30%) were from 2023. For 2018 and 2023, the mean age was  $13.9 \pm 1.1$  and  $15.7 \pm 1.7$ , respectively. The mean height and weight were  $169 \pm 9.24$  and  $63.6 \pm 20.1$  for 2023. The percentage change in BMI was -4.5 in 2023 in comparison to 2018. (Table 1). The nutritional status of study population differed significantly ( $P < 0.05$ ) across the study years. (Table 2). Figures 1 and 2, respectively, present the distribution of nutritional status of 2018 and 2023. In 2018 the distribution was skewed to the left (more overweight and obese on right side) compared to 2023 which reflected the WHO growth standard curve. The consumption of three or fewer meals [1.81 (1.16-2.83);  $P < 0.01$ ], healthy food intake [1.52 (1.10-2.09);  $P < 0.01$ ] showed a significant increase from 2018 to 2023. Similarly, the number of restaurant visits [2.0 (1.42-2.81);  $P < 0.01$ ] and time spent on outdoor activity [3.22 (2.27-4.57);  $P < 0.01$ ] showed a significant increase from 2018 to 2023. (Table 3).

**Table No.2: Survey results of nutritional status of participants based on WHO z-scores (n=616)**

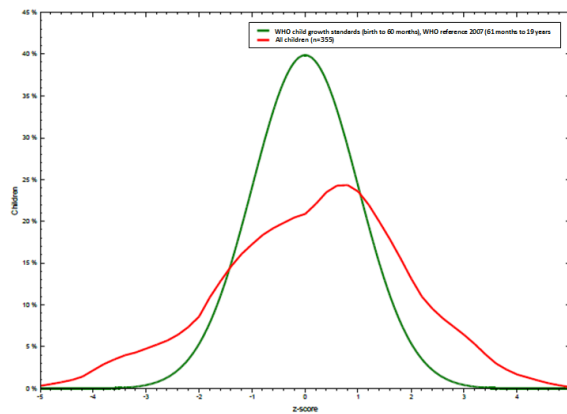
BMI category based on Z-score	Z-score	2018 n (%)	2023 n (%)	P value
Normal	< +1SD to < -2 SD	107 (40.4%)	200 (56.3%)	<0.01
Overweight	> +1SD	65 (24.5%)	69 (19.4%)	
Obese	> +2 SD	69 (26.0%)	49 (13.8%)	
Thin	<-2SD	21 (7.9%)	16 (4.5%)	
Severely Thin	<-3SD	3 (1.1%)	21 (5.9%)	

**Table No.3: Survey results of nutritional and physical activity among the study participants (n=616)**

Item	Frequency	2018	2023	Odds ratio (95% CI)	P value
No. of meals per day	3 or less	213 (80.4%)	313 (88.2%)	1.81 (1.16–2.83)	< 0.01
	More than 3	52 (19.6%)	42 (11.8%)		
No. of restaurant visit per week	2 or less	191 (72.1%)	200 (56.3%)	2.0 (1.42–2.81)	< 0.01
	More than 2	74 (27.9%)	155 (43.4%)		
Type of food	Healthy	130 (49.1%)	211 (59.4%)	1.52 (1.10–2.09)	< 0.01
	Fast food	135 (50.9%)	144 (40.6%)		
Soft drink consumption per day	One or less	123 (46.4%)	81 (39.7%)	2.93 (2.07–4.14)	< 0.01
	More than 1	142 (53.6%)	274 (77.2)		
Chips or chocolate consumption per day	One or less	87 (32.8%)	74 (20.8%)	1.86 (1.29–2.67)	< 0.01
	More than 1	178 (38.8%)	281 (79.2%)		
No of times outdoor activity per week	Daily or alternate day	161 (60.8%)	169 (47.6%)	1.70 (1.23–2.35)	< 0.01
	Weekly or rarely	104 (39.2)	186 (52.4%)		
Time spent on outdoor activity	1 hour or less	125 (47.2%)	77 (21.7%)	3.22 (2.27–4.57)	< 0.01
	More than 1 hour	140 (52.8 ( ))	278 (78.3%)		
Screen time per day	2 hours or less	101 (38.1%)	82 (23.1%)	2.05 (1.45–2.91)	< 0.01
	More than 2 hours	164 (61.9%)	273 (76.9%)		



**Figure No.1: Distribution of nutritional status of study participants of year 2018**



**Figure No.2: Distribution of nutritional status of study participants of year 2023**

## DISCUSSION

The COVID-19 pandemic forced most of the world's population to abruptly isolate at home. The pandemic's effect on people's mood, mental health, and emotional well-being also influenced their food consumption and

choices. Lack of exercise, more sedentary behavior, and the consumption of calorie-dense foods and sugary beverages all increased dramatically, leading to the rise in overweight and obesity in Saudi Arabia.<sup>10-11</sup> There are conflicting findings about the pandemic's impact on eating habits, with some studies indicating a favorable

impact while others reporting a detrimental impact or no impact at all.<sup>12</sup> School closure owing to the COVID-19 lockdowns disrupted children's daily schedule, mealtimes, and opportunities or physical activity, consequently escalating weight gain, particularly in vulnerable children with overweight and obesity.

The frequency distribution of the BMI classes for 2018 showed a left skewing with 26.0% participants classified as obese while 2023 data showed a mirroring with the standard frequency distribution of the BMI classes by WHO with only 13.8% of participants presenting in the obese category. (Figures 1 and 2) Our 2018 results are higher than those in the earlier study conducted by Al-Shammari et al.;<sup>13</sup> where only 8.7% of participants were obese. The prevalence of obesity in 2018 is lower than that found in a study by Al-Hussaini et al.;<sup>14</sup> reporting 15.7% of the participants as obese. The reason for higher prevalence of obesity in 2018 could be a result of the long interval between the studies. Our lower prevalence of obesity for 2023 could result from increased physical activity due to school closures during the pandemic. Furthermore, our study was conducted in a semiurban/ rural area. Consequently, the children in these areas were able to engage in more frequent physical activity than their counterparts in urban areas. The increased physical activity of rural children during the COVID era has already been reported.<sup>15</sup> In addition, typical houses in the study area were built around an open courtyard children had ample room to play.

Excessive consumption of energy-dense, micronutrient-poor meals; a high intake of sugary beverages; and the ubiquitous marketing of fast foods are all dietary factors that contribute to the risk of childhood obesity.<sup>16</sup> The frequency of meals decreased from 19.6% in 2018 to 11.8% in 2023. Furthermore, our findings revealed a substantial increase ( $P < 0.01$ ) in consumption of healthy food from 49.1% in 2018 to 59.5% in 2023. A study from Riyadh reported 85.6% of participants consuming home-cooked meals during COVID-19, up from 35.6% before ( $P < 0.01$ ).<sup>12</sup> Home-cooked meal interventions might have assisted households in incorporating healthful foods into their diets.<sup>13</sup> The change towards healthy dietary habits among the populations may partly explain the decrease in obesity in our study in the post-pandemic era.

We observed that the frequency of outdoor activity dropped from 60.8% in 2018 to 47.6% in 2023 ( $P < 0.01$ ). Similarly, Chambonniere et al.<sup>17</sup> showed a drop in physical activity affecting 35.2% of youth in rural areas, 46.7% in suburban areas, and 47.9% in urban areas. Conversely, the amount of time spent on each outdoor activity significantly increased from 52.8% to 76.9% in 2023 ( $P < 0.01$ ). Similar observations on the time spent in outdoor activity have previously been reported.<sup>18</sup> The increased time spent during COVID-19 in our study further supports the finding on

decreased prevalence of obesity in 2023 compared to 2018.

Mobile and gaming devices have grown in popularity since 2000. Screen exposure increases the risk of obesity in children and adolescents through prolonged exposure to food marketing, mindless eating while viewing screens, distraction from more active pastimes, reinforcement of sedentary behavior, and decreased sleep time.<sup>19</sup> Several international research studies have found that during the pandemic, there was an increase in screen time and a reduction in physical activity.<sup>4</sup> It is highly possible that once these behaviors are adopted, they are hard to abandon. These reports support our results of a significant increase in screen time of more than two hours from 61.9% in 2018 to 76.9% in 2023. According to one study, each extra hour of screen viewing by people aged 12-17 results in a 2% increase in the prevalence of obesity.<sup>20</sup> Replacing screen time and with physical activity and promoting healthy lifestyle behaviors may be an effective way to lower the risks of being overweight or obese and improve the health of children and adolescents. If that had been done, our results would have been far superior to what we have observed.

## CONCLUSION

The devastating COVID-19 altered many lives. At the same time, it paved the way for positive change. For instance, children became more physically active and adopted healthy eating habits, thereby improving their nutritional status. However, an increase in screen time was a hallmark of COVID-19. These findings have implications for how we encourage children to stay healthy. The policymakers who manage opportunities for children's health should formulate policies to incorporate healthy eating habits, more physical activity and less screen time into their routines.

**Limitations:** The important disadvantage of this study was the exclusion of female students. It should be noted, however, that in Saudi Arabia it is difficult to reach female students based on cultural norms. The absence of female students may have limited the study's generalizability. Nonetheless, this study revealed valuable information about the extent of obesity in among students in the post COVID-19 era. It also identified the modifiable risk variables that influence obesity among research participants.

**Acknowledgement:** The author extends their appreciation to the Deanship of Scientific Research (DSR) at Shaqra University for funding this research work through the project number (SU-ANN-202239). We also thank all participants, their guardians and the school staff who cooperated in the study. The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of this report.

**Author's Contribution:**

Concept & Design of Study: Fakhruddin Ahmad  
 Drafting: Abdulrahman M Alshahrani

Data Analysis: Ghulam Mustafa,  
 Abdullah Mohammed  
 Bin Hussain

Revisiting Critically: Fakhruddin Ahmad,  
 Abdulrahman M  
 Alshahrani

Final Approval of version: Fakhruddin Ahmad

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

**REFERENCES**

- Ghoch M, Fakhourly R. Challenges and new directions in obesity management: Lifestyle modification programs, pharmacotherapy, and bariatric surgery. *J Popul Ther Clin Pharmacol* 2019;26(2):e1-e4.
- Aljaadi AM, Alharbi M. Overweight and obesity among Saudi children: prevalence, lifestyle factors, and health impacts. *Handbook Healthcare Arab World* 2021;1155-79.
- Al Shehri A, Al Fattani A, Al Alwan I. Obesity among Saudi children. *Saudi J Obesity* 2013;1(1):3.
- Pietrobelli A, Pecoraro L, Ferruzzi A, Heo M, Faith M, Zoller T, et al. Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: a longitudinal study. *Obesity* 2020;28(8):1382-5.
- Margaritis I, Houdart S, El Ouadrhiri Y, Bigard X, Vuillemin A, Duché P. How to deal with COVID-19 epidemic-related lockdown physical inactivity and sedentary increase in youth? Adaptation of Anses' benchmarks. *Archives Public Health* 2020;78:1-6.
- Jarnig G, Jaunig J, Kerbl R, Strenger V, Haeusler G, van Poppel MN. Acceleration in BMI gain following COVID-19 restrictions. A longitudinal study with 7 to 10 year old primary school children. *Pediatr Obesity* 2022;17(6):e12890.
- Zagalaz-Sánchez ML, Cachón-Zagalaz J, Arufe-Giráldez V, Sanmiguel-Rodríguez A, González-Valero G. Influence of the characteristics of the house and place of residence in the daily educational activities of children during the period of COVID-19 confinement. *Heliyon* 2021; 7(3):e06392.
- Khan A, Alsofayan Y, Alahmari A, Alowais J, Algwizani A, Alserehi H, et al. COVID-19 in Saudi Arabia: the national health response. *Eastern Mediterranean Health J* 2021;27(11):1114-24.
- Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP, Kumar B. Nutritional status of school-age children-A scenario of urban slums in India. *Archives Public Health* 2012;70(1):1-8.
- Liu D, Zhao LY, Yu DM, Ju LH, Zhang J, Wang JZ, et al. Dietary patterns and association with obesity of children aged 6–17 years in medium and small cities in China: findings from the CNHS 2010–2012. *Nutr* 2018;11(1):3.
- Mahumud RA, Sahle BW, Owusu-Addo E, Chen W, Morton RL, Renzaho AM. Association of dietary intake, physical activity, and sedentary behaviours with overweight and obesity among 282,213 adolescents in 89 low and middle income to high-income countries. *Int J Obesity* 2021;45(11):2404-18.
- Alhussseini N, Alqahtani A. COVID-19 pandemic's impact on eating habits in Saudi Arabia. *J Public Health Res* 2020;9(3):1868.
- Al-Shammari S, Khoja T, Gad A. Community-based study of obesity among children and adults in Riyadh, Saudi Arabia. *Food Nutr Bulletin* 2001;22(2):178-83.
- Al-Hussaini A, Bashir MS, Khormi M, AlTuraiki M, Alkhamis W, Alrajhi M, et al. Overweight and obesity among Saudi children and adolescents: Where do we stand today? *Saudi J Gastroenterol : official J Saudi Gastroenterol Assoc* 2019;25(4):229.
- Kellstedt DK, Schenkelberg MA, Rosen MS, Von Seggern MJ, Idoate R, Welk GJ, et al. COVID-19 pandemic and changes in children's physical activity in a rural US community: a mixed methods study. *BMJ Open* 2022;12(10):e062987.
- Jebeile H, Kelly AS, O'Malley G, Baur LA. Obesity in children and adolescents: epidemiology, causes, assessment, and management. *The Lancet Diabetes Endocrinol* 2022;10:351-63.
- Chambonniere C, Lambert C, Fearnbach N, Tardieu M, Fillon A, Genin P, et al. Effect of the COVID-19 lockdown on physical activity and sedentary behaviors in French children and adolescents: New results from the ONAPS national survey. *Eur J Integrative Med* 2021;43:101308.
- Mitra R, Moore SA, Gillespie M, Faulkner G, Vanderloo LM, Chulak-Bozzer T, et al. Healthy movement behaviours in children and youth during the COVID-19 pandemic: Exploring the role of the neighbourhood environment. *Health Place* 2020;65:102418.
- Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F, Calvert SL, et al. Screen media exposure and obesity in children and adolescents. *Pediatr* 2017;140(Supplement\_2):S97-S101.
- Al Dossary S, Sarkis P, Hassan A, Ezz El Regal M, Fouda A. Obesity in Saudi children: a dangerous reality. *EMHJ-Eastern Mediterranean Health J* 2010;16 (9):1003-8.