integrity Research Journals

Research Journal of Food Science and Nutrition
Volume 4(5), pages 90-96, October 2019
Article Number: 33DD3BBF1
ISSN: 2536-7080
https://doi.org/10.31248/RJFSN2019.081
https://integrityresjournals.org/journal/RJFSN

Full Length Research

Reference percentile for height, weight and BMI among children/adolescents of Karachi Pakistan

Sara Sadiq[1*], Muhammad Fazal Hussain Qureshi[2], Lubna Farooq[3], Danish Mohammad[2], Mahira Lakhani[2] and Muneeza Lodhi[4]

[1]Department of Physiology, CMH Institute of Medical Sciences, Bahawalpur, Pakistan.
[2]Undergraduate Students, Ziauddin University, Karachi, Pakistan.
[3]Department of Pharmacology, Baqai Medical University, Karachi, Pakistan.
[4]Department of Pharmacology, Ziauddin University, Karachi, Pakistan.

*Corresponding author. Email: dr.sarabhatti@gmail.com; Tel: +923352127642.

Received 22nd September, 2019; Accepted 15th October, 2019

ABSTRACT: Pakistani children of school going age significantly differed from WHO references in which overweight and obesity were significantly higher and underweight was lower than normal when compare to WHO references. Due to this huge discrepancy and lack of data, there was a dire need to establish age appropriate BMI ranges for Pakistani population. The basic aim of the study is to find out the BMI ranges among the school going children/adolescents of Karachi Pakistan. A cross sectional study was conducted among children belonging to different ethnic groups in primary, middle, secondary schools and Maddarsa (religious educational institutes) of Karachi. Height in centimeters (cm) and weight in kilogram (kg) were measured. BMI was calculated using height and weight. WHO's BMI graph was used to find out the percentile for labelling underweight, normal healthy individual, overweight and obese. A total of about 1244 samples of children and adolescents aged seven to eighteen years were included. The mean age of the study participants was 12.96±2.8 years, in which boys having mean age of 13.1±2.7 years while for girls mean age was 12.66±2.8 years. The mean height (cm) and weight (kg) among the study participants were 146.92±15.84 and 41.20±15.69 respectively. Among younger age group, the girls were taller than the boys but after reaching the age of 15 the girls having approximately the same height up to the age of 18th and as for boys, the findings were vice versa. Majority of the participants reported normal BMI while for over abnormality, the higher prevalence of participants being overweight rather than underweight when comparing with the WHO references. Measures must be taken to assess what current set up is doing right, and then it must be implemented at a larger scale.

Keywords: BMI cut-off values, height percentile, weight percentile.

INTRODUCTION

The most important indicator for recognizing the nutritional or health status of a child is his/her growth rate and a change in body mass index. Body Mass Index (BMI) is statistical guide using weight and height of a person in order to determine approximate body fat in males and females of any age. Formula used for calculation of BMI is weight (kg)/Height^2 (m^2). BMI is classified as underweight, normal, overweight and obese (WHO Expert Consultation, 2004; WHO Expert Consultation, 2000; Weir and Jan, 2019). To assess the difference in weight and height of children in same age group BMI is used (Hales et al., 2018). Body Mass Index (BMI) cut-off of 30 kg/m^2 for obesity is used internationally.

In order to take the proper preventive measures, important task is to identify high risk population which is done using BMI (World Health Organization, 1995; Vazquez et al., 2007). It has been shown that the WHO percentile references to estimate the level of obesity, normal or underweight among South Asian children is not suitable because of high metabolism rates as compared to

children of rest of the world (de Wilde et al., 2018). Pakistani children of school going age significantly differed from WHO references in which overweight and obesity were significantly higher and underweight was lower as compare to WHO reference (Mushtaq et al., 2012). Due to this huge discrepancy and lack of data, there was a dire need to establish age appropriate BMI ranges for Pakistani population. The basic aim of the study is to find out the BMI ranges among the school going children/adolescents of Karachi Pakistan.

METHODOLOGY

Design, setting and sample

A cross sectional study was conducted among children belonging to different ethnicities in primary, middle, secondary schools and Maddarsa (religious educational institutes) of Karachi from May to July 2019. Children and adolescents aged between seven to eighteen years were enrolled in the study with consent from their parents/guardians. The list of educational institution from all three socioeconomic strata of all districts of Karachi was obtained by the Department of Education Karachi. Multistage sampling technique was used in order to avoid bias. In the first stage eight private and public schools and a maddarsa was selected randomly. Permission was obtained from school management before sampling. Children suffering with any known metabolic syndrome (e.g. Prader- Willi syndrome) and children not willing to participate in the study were excluded. Sample size was calculated using OpenEpi calculator with 95% confidence interval. The study was approved by the Ethical Review Board of Zaiuddin University Karachi.

Data collection

The selected schools were visited on pre-arranged dates. Ten trained senior medical students including 5 males and 5 females, led by the Principal Investigator, collected the data. Informed consent was obtained from school authorities and parents/guardians of children and adolescents. Demographic information including age, gender and date of birth was noted from each of the enrolled participant for the study. Analogue physician health scale, standardized before the examination, were used. Height was measure in centimeters (cm) and weight was measured in kilogram (kg). The child was asked to stand relax, feet were placed together with heels, buttocks and shoulder blades against the stick and head was positioned in the Frankfurt horizontal plane. Quality control measures and good practices including training, pre-testing the processes and materials, field monitoring of data collection, logistics management and daily meetings of the study teams were ensured.

Statistical analysis

Statistical Program of Social Science (SPSS)-version 20 was used for data analysis. Frequency and percentages were calculated for qualitative variables while mean with standard deviation for quantitative variables. BMI was calculated using height and weight. WHO's BMI graph was used to find out the percentile for labelling underweight, normal healthy individual, overweight and obese.

RESULT

A total of about 1244 samples of children and adolescents aged seven to eighteen years were included in the study as shown in Figure 1. The majority of participants were boys consisting of 63.5% while 36.5% were girls. The mean age of the study participants was 12.96±2.8 years, in which boys having mean age of 13.1±2.7 years and 12.66±2.8 years for girls. The mean height (cm), weight (kg), waist (cm), hip (cm) and waist/hip ratio among the study participants were 146.92±15.84, 41.20±15.69, 70±11.61, 81.91±12.17 and 0.85±0.062 respectively.

The mean BMI was 18.47 (kg/m^2) with standard deviation of 4.145 among 1244 study participants (Figure 2). The majority of participants (about 79.2%) were healthy as having their BMI values within normal range followed by overweight (9.20%) and obese (6.40%) while very few were underweight (5.20%) as shown in Figure 3. The cut-off value for labelling underweight, normal, overweight and obese were taken by following the children BMI graph according to which less than 5th percentile is underweight, 5th -85th percentile is normal healthy individual, 85th to 94th percentile is considered as overweight and above 95th percentile is obese (Onis et al., 2007). In the current study, the BMI values at 5th, 85th and 95th percentiles are 13.7, 22.1 and 26 respectively. Age-gender specific height percentiles and age-gender specific weight percentiles are reported in Table 1 and Table 2 respectively.

The gender and age specific mean with standard deviation for all the anthropometric variables including height, weight, BMI, waist, hip and waist/hip ratios are shown in Table 3. Among both boys and girls, height, weight and BMI were significantly associated with increasing age. At the younger age group, the girls were taller than the boys but after reaching the age of 15 the girls having approximately the same height up to the age of 18th but conversely boy's height increase rapidly after 15 years of age and became taller than the girls.

DISCUSSION

Majority of the BMI values seem to be normal in current study. The results show that 79.20% of sample lie in the normal range of BMI, 9.20% lie in the overweight range, and 6.40% lie in the obese range. On the other hand,

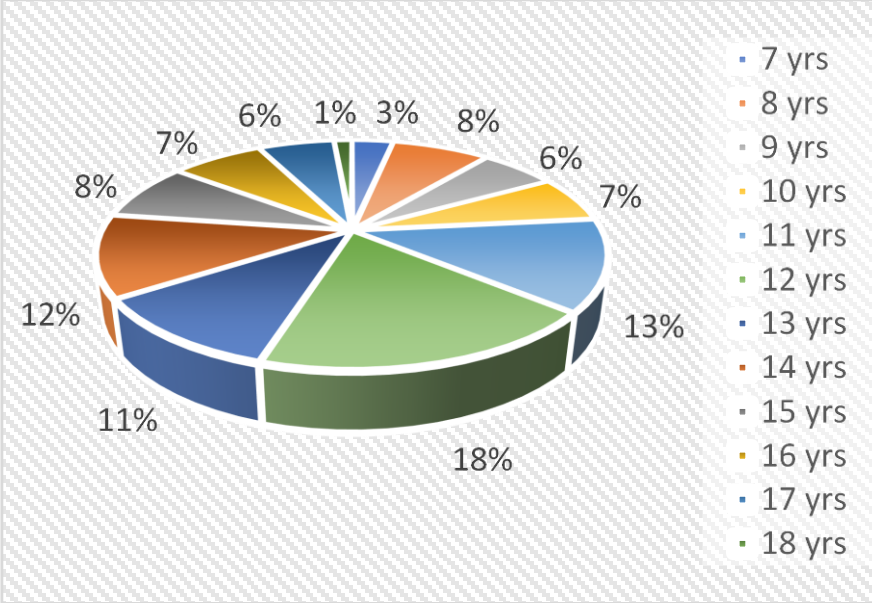

Figure 1. Different age groups included in the study.

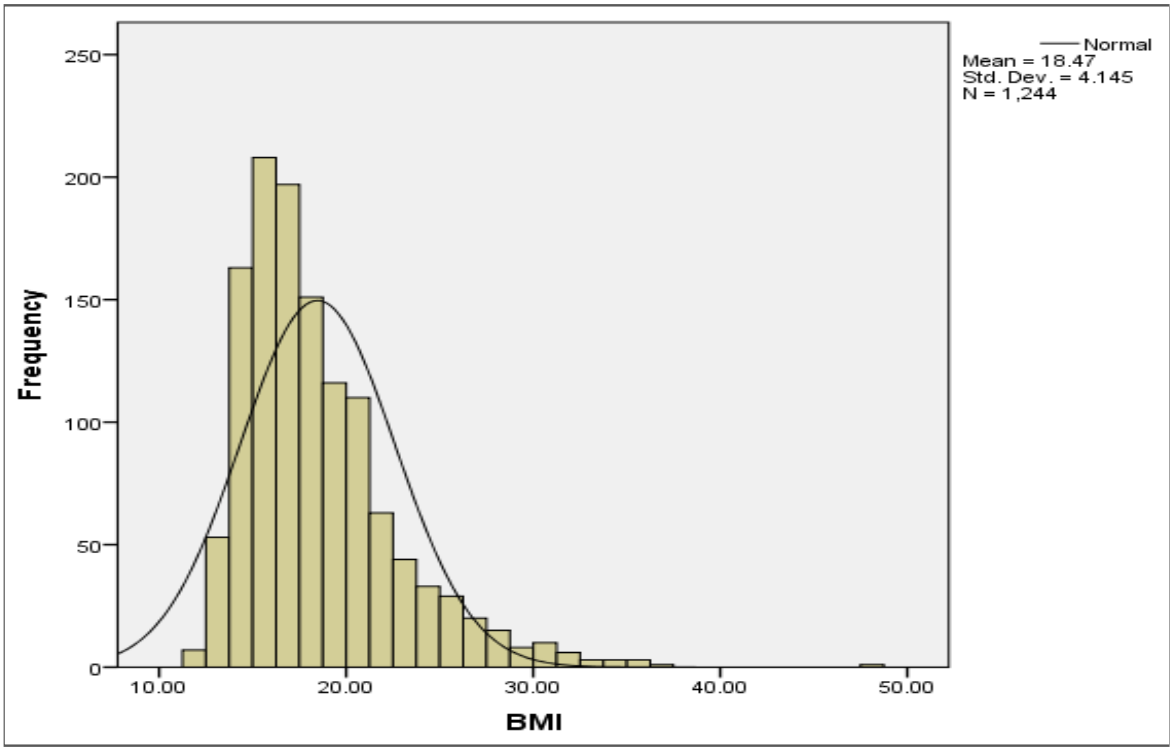

Figure 2. BMI (kg/m^2) histogram.

5.20% lie in the underweight range. Further analysis revealed that girls tend to grow in height faster than boys initially until puberty, however, boys tend to grow taller after puberty.

Analyses of the data shows that on average, BMI has improved. BMI was expected to be lower because Pakistan seems to be a country with high rates of malnutrition. Current study suggests that the prevalence of malnutrition in Pakistan is on the higher side ranging from 10 to 15% (Bhutta et al., 2017). Specifically, in children,

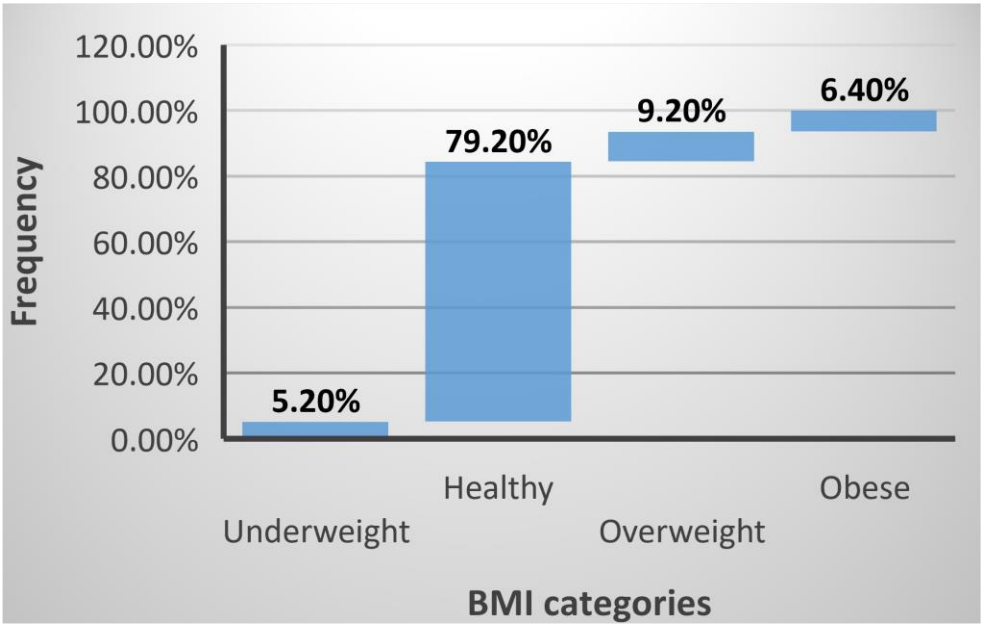

Figure 3. Segregation of BMI categories.

Table 1. Age and gender specific height percentiles for children and adolescents

Age (years)	Percentiles								
	3rd	5th	10th	25th	50th	75th	90th	95th	97th
Boys									
7	112	113	114	116	117	121	137	137	141
8	113	113	120	121	129	132	133	146	152
9	120	120	121	126	130	133	135	147	155
10	115	115	117	130	139	141	143	145	149
11	119	119	129	135	142	149	153	157	161
12	125	125	128	139	143	151	160	162	168
13	133	136	136	141	148	157	164	168	173
14	130	132	139	148	155	168	173	175	180
15	142	146	149	155	163	170	173	175	179
16	134	136	147	159	169	173	179	183	185
17	131	133	146	160	167	173	179	184	185
18	158	158	159	169	172	175	178	186	187
Girls									
7	109	111	113	117	120	125	138	138	139
8	110	113	115	123	125	134	138	144	145
9	120	121	122	128	138	142	144	146	149
10	114	114	124	127	134	143	150	157	167
11	118	118	118	132	138	145	149	155	161
12	130	130	132	137	143	151	158	160	162
13	136	137	138	145	153	155	158	158	163
14	137	137	139	151	158	167	174	178	179
15	135	135	141	150	154	163	168	175	177
16	142	142	147	151	161	166	173	174	175
17	145	145	149	153	159	166	185	187	188
18	151	151	151	151	167	168	186	188	189

Table 2. Age and gender specific weight percentiles for children and adolescents.

Age (years)	Percentiles								
	3rd	5th	10th	25th	50th	75th	90th	95th	97th
Boys									
7	15	16	20	20	20	21	29	30	32
8	20	20	21	23	24	26	30	42	43
9	19	20	21	23	25	29	31	42	44
10	23	23	24	25	30	34	43	47	49
11	22	22	26	28	32	37	51	55	57
12	21	25	26	30	36	45	56	61	62
13	27	29	30	35	41	50	66	77	81
14	23	25	31	36	47	54	60	66	77
15	30	32	36	41	53	60	74	79	80
16	29	33	35	45	55	63	66	78	100
17	25	29	40	46	56	67	90	93	104
18	27	31	42	47	58	71	94	97	109
Girls									
7	18	19	20	22	22	25	27	35	39
8	20	20	21	23	24	26	30	42	43
9	18	19	20	25	26	30	33	43	54
10	19	20	22	26	32	35	55	68	69
11	22	23	25	27	30	38	40	52	54
12	22	25	26	29	35	42	54	60	72
13	26	27	29	30	45	50	53	59	63
14	30	31	33	40	49	62	67	75	81
15	36	37	38	40	49	57	75	80	92
16	34	37	41	45	55	66	76	77	83
17	38	39	40	42	50	64	75	96	98
18	50	51	52	55	58	67	81	97	103

one national survey claims that 31.5% of children are stunned, 45% are underweight, and 10.5% are wasted (Hamad et al., 2016). To be more precise with BMI, a study in Lasbela, Balochistan showed that 45% of children had normal BMI, whereas the remainder of children were classified into malnourished (Mustufa et al., 2017). In contrast, current study suggests an improvement in BMI with 79.2% of children are within the normal BMI. According to Asim and Nawaz (2018), in the province of Sindh, 61% of children were stunned, 54% were underweight, and 47% were wasted. However, in current study, samples were taken from Karachi, Sindh and the underweight range for BMI was only 5.2%.

The results cannot predict why there is an improvement in BMI statistics, but there could be multiple reasons. A South Asia study stated that there are 13 correlates which impact growth in childhood (Kim et al., 2017). These correlates include the following: complementary feeding, breastfeeding, feeding frequency, dietary diversity, maternal height, body mass index (BMI), education, age at marriage, child vaccination, access to improved drinking source and sanitation facilities, household indoor air quality, and household wealth. It could be that the sample studied are excelling in multiple correlates presented. Furthermore, a study by Hassan et al. (2017) in Lahore, Pakistan used BMI to analyse poor nutritional status in low income household adolescent girls. The results showed that factors such as renting houses, recurrent illness, and illiterate fathers were major factors in poor nutrition. It is possible that in Karachi, these factors are controlled, which leads to better results. Another study hints that the area you are exposed to, urban or rural, can predict the chances of being overweight or underweight. In Pakistan, women situated in urban areas had higher chances of being overweight, and women situated in rural areas had higher chances of being underweight (Janjua et al., 2015). This study was majorly done for women aged 15 to 49, so one may argue that this study does not correlate with the research presented. Therefore, the environment could be a possible factor that affected current study since Karachi is predominantly urban.

Another finding that cannot be ignored is that the BMI for samples in the overweight and obese were more than samples in the underweight scale. 9.20% of the sample

Table 3. Mean and standard deviation of height, weight, BMI, waist, hip and waist/hip ratio for children and adolescents.

Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)	Waist (cm)	Hip (cm)	Waist/Hip
Boys (n = 790)						
7	119.97 ± 7.21	21.17 ± 3.37	14.64 ± 0.89	57.77 ± 3.12	65.97 ± 3.59	0.88
8	127.63 ± 7.88	25.56 ± 5.21	15.62 ± 2.07	60.12 ± 6.15	69.58 ± 5.51	0.86
9	129.82 ± 6.95	26.26 ± 5.34	15.76 ± 1.79	60.37 ± 5.31	71.05 ± 6.47	0.85
10	135.53 ± 8.48	31.56 ± 7.11	17.03 ± 2.91	64.88 ± 8.47	74.47 ± 6.92	0.87
11	141.23 ± 10.28	34.23 ± 9.21	16.93 ± 2.81	66.38 ± 10.26	78.27 ± 10.61	0.84
12	144.54 ± 10.56	38.11 ± 11.15	17.97 ± 3.54	68.37 ± 11.29	79.86 ± 10.99	0.85
13	149.75 ± 11.18	44.73 ± 15.64	19.59 ± 4.80	71.62 ± 11.07	83.39 ± 11.79	0.86
14	156.34 ± 12.74	46.22 ± 12.21	18.65 ± 3.31	69.50 ± 8.71	82.78 ± 9.12	0.83
15	162.33 ± 9.68	52.23 ± 13.19	20.06 ± 4.24	75.17 ± 10.21	88.73 ± 10.36	0.85
16	165.39 ± 12.36	55.44 ± 14.19	20.02 ± 3.49	76.09 ± 11.43	89.72 ± 9.04	0.84
17	165.47 ± 12.25	59.98 ± 18.53	21.69 ± 5.77	77.79 ± 13.43	92.53 ± 11.98	0.84
18	171.64 ± 7.29	66.36 ± 11.92	22.65 ± 4.29	78.73 ± 9.35	96.45 ± 8.61	0.82
Girls (n = 454)						
7	145.90 ± 10.96	23.50 ± 4.04	15.48 ± 4.07	61.0 ± 12.96	72.80 ± 9.29	0.84
8	127.75 ± 8.48	27.23 ± 4.41	16.63 ± 1.72	63.87 ± 7.09	74.65 ± 9.39	0.86
9	136.08 ± 8.02	33.36 ± 12.09	17.78 ± 5.12	68.28 ± 11.89	78.78 ± 13.10	0.87
10	135.68 ± 12.40	31.44 ± 10.96	16.74 ± 3.37	66.20 ± 10.51	75.68 ± 10.76	0.86
11	137.69 ± 10.58	32.49 ± 7.81	17.00 ± 2.76	68.45 ± 11.12	79.29 ± 11.21	0.86
12	144.61 ± 9.21	37.84 ± 11.71	17.74 ± 3.52	71.39 ± 11.69	81.85 ± 11.10	0.87
13	150.21 ± 6.65	42.32 ± 10.18	18.56 ± 3.51	70.87 ± 10.73	83.26 ± 10.49	0.85
14	157.51 ± 11.27	49.74 ± 12.98	19.94 ± 4.34	76.94 ± 10.21	91.00 ± 10.86	0.84
15	158.34 ± 10.75	51.92 ± 13.32	21.44 ± 4.86	77.87 ± 11.59	90.61 ± 9.78	0.86
16	159.61 ± 9.51	56.08 ± 12.35	21.96 ± 4.08	78.44 ± 10.97	93.21 ± 8.98	0.84
17	161.88 ± 11.45	57.38 ± 20.23	21.44 ± 5.15	76.19 ± 13.17	92.13 ± 12.32	0.82
18	161.89 ± 9.10	58.43 ± 5.71	22.39 ± 2.33	76.14 ± 5.69	93.00 ± 5.23	0.82

was considered overweight and 6.40% of the sample was considered obese. In Pakistan, girls of all age groups are considered predominantly obese (Tanzil and Jamali, 2016). Specifically, amongst children and adolescents, there seems to be varying prevalence of obesity. This tells us why there is a slight leaning in current data towards overweight BMI since Pakistan has an emerging count of obesity. In Karachi, factors pointed out to increase the prevalence of obesity are socioeconomic status, lack of physical activity and intake of meat (Warraich et al., 2009). The study presented did not analyse specific factors, but these are factors that can further be studied to assess this slight prevalence of obesity.

BMI is simply a finding that needs further assessment. If the BMI in current setup is considered normal, then one must understand why it is normal. Current study did not assess the lifestyle habits for each participant. It is important to assess both healthy and unhealthy lifestyle habits. The healthy lifestyle habits must be emphasised and further implemented throughout various areas so that the population is at less risk for malnutrition or obesity. The risk factors must be pointed out so that different health programs can target the specific issues at hand to promote a healthier society.

Conclusion

In conclusion, majority of the participants reported normal BMI. For over abnormality, the higher prevalence of participants being overweight rather than underweight when comparing with the WHO references. BMI is an important variable that can be used for classification, and current study shows that the specific set up has a healthy standard of BMI. The future recommendation is for the study to be repeated systematically in a larger scale and in other areas of Pakistan to come out with a reference height, weight and BMI for Pakistani children. Measures must be taken to assess what current set up is doing right, and then it must be implemented at a larger scale. In the end, these results are a good indicator that the environment is proceeding to the right direction, but the circumstances can always be better.

Limitations

The main limitation of the study was the lack of financial support. Therefore, the study could not be conducted at a larger scale. In addition, the study was confined to children

and adolescents due to easy consent. Lack of resources did not allow us to conduct this study on young adults, middle aged or elderly.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCE

Asim, M., & Nawaz, Y. (2018). Child malnutrition in Pakistan: evidence from literature. *Children*, 5(5), 60.

Bhutta, Z. A., Berkley, J. A., Bandsma, R. H., Kerac, M., Trehan, I., & Briend, A. (2017). Severe childhood malnutrition. *Nature Reviews Disease Primers*, *3*, 17067.

de Wilde, J. A., Dekker, M., & Middelkoop, B. J. C. (2018). BMI-for-age in South Asian children of 0–20 years in the Netherlands: secular changes and misclassification by WHO growth references. *Annals of Human Biology*, 45(2), 116-122.

Hales, C. M., Fryar, C. D., Carroll, M. D., Freedman, D. S., & Ogden, C. L. (2018). Trends in obesity and severe obesity prevalence in US youth and adults by sex and age, 2007-2008 to 2015-2016. *Jama*, 319(16), 1723-1725.

Hamad, N., Sarwar, Z., Ranjha, M. K., & Ahmad, I. (2016). Food utilization as anti-stunting intervention in Pakistan. *Medical Channel*, 22(3), 80-87.

Hassan, F., Asim, M., Salim, S., & Humayun, A. (2017). House ownership, frequency of illness, fathers' education: the most significant socio-demographic determinants of poor nutritional status in adolescent girls from low income households of Lahore, Pakistan. *International Journal for Equity in Health*, 16(1), 122.

Janjua, N. Z., Mahmood, B., Bhatti, J. A., & Khan, M. I. (2015). Association of household and community socioeconomic position and urbanicity with underweight and overweight among women in Pakistan. *PLoS One,* 10(4), e0122314.

Kim, R., Mejía-Guevara, I., Corsi, D. J., Aguayo, V. M., & Subramanian, S. V. (2017). Relative importance of 13 correlates of child stunting in South Asia: insights from nationally representative data from Afghanistan, Bangladesh, India, Nepal, and Pakistan. *Social Science & Medicine*, 187, 144-154.

Mushtaq, M. U., Gull, S., Mushtaq, K., Abdullah, H. M., Khurshid, U., Shahid, U., Shad, M.A., & Akram, J. (2012). Height, weight and BMI percentiles and nutritional status relative to the international growth references among Pakistani school-aged children. *BMC Pediatrics*, 12(1), 31.

Mustufa, M. A., Jamali, A. K., Sameen, I., Burfat, F. M., Baloch, M. Y., Baloch, A. H., Lashari, S.K., Ayaz, S. M., & Baloch, M. Y. (2017). Malnutrition and poor oral health status are major risks among primary school children at Lasbela, Balochistan, Pakistan. *Journal of Health, Population and Nutrition*, 36(1), 17.

Onis, M. D., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World health Organization,* 85, 660-667.

Tanzil, S., & Jamali, T. (2016). Obesity: An emerging epidemic in Pakistan- A review of evidence. *J Ayub Med Coll Abbottabad*, 28(3), 597-600.

Vazquez, G., Duval, S., Jacobs Jr, D. R., & Silventoinen, K. (2007). Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis. *Epidemiologic Reviews*, 29(1), 115-128.

Warraich, H. J., Javed, F., Faraz-Ul-Haq, M., Khawaja, F. B., & Saleem, S. (2009). Prevalence of obesity in school-going children of Karachi. *PLoS One,* 4(3), e4816.

Weir, C. B., & Jan, A. (2019). BMI classification percentile and cut off points. In *StatPearls [Internet]*. StatPearls Publishing.

WHO Expert Consultation (2000). Obesity: Preventing and managing the global epidemic. Report of a *World Health Organ Tech Rep Ser,* 894, i-xii, 1-253.

WHO Expert Consultation (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet (London, England)*, 363(9403), 157-163.

World Health Organization (1995). Physical status: The use of and interpretation of anthropometry, Report of a WHO Expert Committee.