Original Article

Burden of malnutrition among school-going children in a slum area of Kolkata: A matter of concern

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ABSTRACT

Background: Malnutrition is still a great barrier to the growth and development of children, especially in India. Children from the underprivileged sections of the society like slum children are more vulnerable to both undernutrition and overnutrition. This study aimed to estimate the magnitude of malnutrition among school-going children in a slum area of Kolkata and to elicit the association of nutritional status with parental education. **Methods:** A cross-sectional observational study was conducted from November 2017 to May 2018 among 508 school-going children of 6 years to 19 years of age in slums of Chetla, Kolkata. Out of three coeducation high schools catering to those children, two schools were randomly selected. 254 participants from each school were selected using systematic random sampling. Students, unwilling to participate and/or whose parents denied providing informed written consent were excluded. After the interview by a predesigned, pretested schedule, their anthropometric examination was conducted. **Results:** Prevalence of stunting and severe stunting was present in 9.4% and 1.2% of subjects whereas the prevalence of thinness was 23.6% among them. The prevalence of overnutrition was 11%. Boys are more stunted (OR = 2.13, *P* = 0.013) and thin (OR = 1.73, *P* = 0.011) than girls. Poor parental education was significantly associated with both undernourishment (stunting and thinness) as well as overweight and obesity. **Conclusion:** Substantial burden of double malnutrition was observed among school-going slum children. Parental education had an important role to prevent malnutrition of their children. Thus, periodic growth monitoring with the strengthening of the Mid-Day Meal program and awareness generation campaigns regarding malnutrition among parents of slum children are highly needed.

Keywords: Overweight, parental education, slum children, stunting, thinness

Introduction

More than half of the under-five children's deaths are related to undernutrition.[1] However, no such data is available for adolescents at the population level. But childhood and adolescent malnutrition (both undernutrition and overnutrition) can cause many acute and chronic comorbidities and may lead to non-communicable and metabolic diseases like Diabetes Mellitus, Hypertension, Dyslipidemia, etc., in adult life.[2-6] Thus estimation of prevalence and predictors of malnutrition among children and adolescents in a community is very essential, especially for both policymakers as well as primary health care physicians, to provide holistic care in terms of preventive promotive curative and rehabilitative measures to stop the vicious cycle of malnutrition and disease.

School children are the future citizen of a country. It is an established fact that proper nutrition can foster their appropriate growth and cognitive function in this period of life. The scenario

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of nutritional incongruity in this critical period is very common in both developing and developed countries. This "double burden of malnutrition" in terms of undernutrition as well as overnutrition in childhood and adolescence becomes one of the prevailing public health problems worldwide.[2,7,8]

Urban slum children are very much vulnerable for growth and nutritional failure to various factors like overcrowding, poor sanitation, poor drinking water supply in residential areas, etc., which are related to lower socioeconomic status.[5,6,9-11] Parental education is one of the important proxy indicators of their socioeconomic status. Lack of proper hygiene and faulty food habits are also the other reasons for nutritional failure, which are directly related to parental education.[12,13] Poor eating behavior, lack of dietary diversity, and excessive intake of energy-dense nutrient-poor junk food and sweetened beverages can lead to overnutrition in urban children. Lack of access to a playground and poor physical activity was also observed in slum children which may lead to obesity. Poor parental education can potentiate this risk. National Family Health Survey (NFHS 4 and 5) data showed the prevalence of undernutrition of under-five children in our country, but not of school-aged children.[14,15] Only a handful of studies in India reported the prevalence of the dual burden of malnutrition especially in school-age children in urban slums. In this context, the present study was conducted to find out the prevalence of malnutrition and its predictors among school-age children in a slum area of Kolkata.

Methodology

Study design

A cross-sectional observational study was conducted from November 2017 to May 2018 among the school-going children of 6 years to 19 years in the slums of Chetla. These slums were situated predominantly in Kolkata Municipal Corporation ward no. 74 and 82 over 3.9 sq. km under service area of All India Institute of Hygiene and Public Health (AIIH&PH). Out of three coeducation high schools catering to children from this area, two schools were randomly selected. All students present during the days of the survey were included. Students who were unwilling to participate or whose parents denied to provide informed written consents were excluded.

Sample size and sampling technique

In a study in 2010-11 Srivastava A *et al.* showed that the prevalence of undernutrition among school-age children of urban slums in Bareilly, Uttar Pradesh, was 53.2%.[16]

Considering the estimated prevalence = 0.532, standard normal deviate of 95% confidence interval (Z) = 1.96, 10% relative error of prevalence (L) and Design effect (D) of 1.5, minimum sample size required for this study was 507 using the following formula:

Sample size (n) = D × Z² × P × (1 − P)/L².

Number of students list was obtained from the school authorities and total 508 students were selected from those two schools (254 from each school) using systematic random sampling technique.

Data collection

After obtaining ethical clearance from Institutional Ethics Committee of AIIH&PH (Ref no: PSM/IEC/2017/31, Date: November 15, 2017) and permission from school authorities' multiple sessions were conducted during school time over a period of 2 months. Prior to the data collection, informed written consent from parents, and written assent from participants were obtained with help of authorities. Interviews of participants using a predesigned pretested questionnaire were conducted and anthropometric examinations were done as per standard operating procedures.[17]

Statistical analyses

Data were checked for consistency and completeness and analyzed using MS Excel 2013 and Statistical Package for the Social Sciences (SPSS version 16.0, USA). Gender and Age-specific Z score of Height for age (HAZ), weight for height, and BMI for Age (BMIZ) for each participant were calculated using WHO Anthro-Plus Calculator version 1.0.4.[18] Descriptive and inferential statistics including Chi-square and logistic regression were calculated. The level of significance was considered in *P* value < 0.05.

Operational definition

Stunting was defined as low HAZ. Children with z-scores < −2.00 were coined as stunted and those <−3.00 as severely stunted.[6]

Thinness was defined as low BMIZ. Children with z-scores <−2.00 were said to have thinness.[19]

Over-nutrition was defined as high BMIZ. Children with z-scores >+1.00 were termed as overweight and >+2.00 as obesity.[6,19]

Result

Background characteristics

Most of them (44.1%) belonged to 10 to 14 years of age. Almost half (49.6%) of them were female. Majority of the parents of these children received at least primary level of education (60.1% and 58.1% for mothers and fathers, respectively) [Table 1].

Stunting: Prevalence and associated factors

Stunting and severe stunting was present in 9.4% and 1.2% (total 10.6%) of subjects. Difference in prevalence of stunting and severe stunting was present in male (12.5% and 1.6%) and female students (6.8% and 0.3%) [Figure 1]. This differential pattern of prevalence of stunting (HAZ <−2 SD) between genders was statistically significant. Male had 2.13 times higher odds of stunting in comparison to female. (P = 0.013). Similarly, significant association of stunting and age was observed. Children from mothers with educational attainment below primary level had 2.93 times higher

odds of stunting than children from mothers with minimum secondary education which was statistically significant (P = 0.043). Children from mothers with minimum primary level had 1.73 times higher odds of stunting than children from mothers with secondary education. However, this finding was not statistically significant (P = 0.272). No significant association was observed between schooling of father and stunting of their children [Table 2].

Thinness and overweight: Prevalence and associated factors

Both thinness (23.6%) and overweight (11%) was present among them [Figure 2]. Differential prevalence of thinness was present in

Table 1: Distribution of Study Subjects According to Socio-demographic Attributes

Socio-demographic Attributes	Number (%)
Age in years	
6-9	170 (33.5)
10-14	228 (44.9)
15-19	110 (21.6)
Gender	
Male	256 (50.4)
Female	252 (49.6)
Mothers education	
Below Primary	113 (22.2)
Primary	307 (60.4)
Secondary and above	88 (17.4)
Fathers' education	
Below primary	93 (18.3)
Primary	295 (58.1)
Secondary and above	120 (23.6)
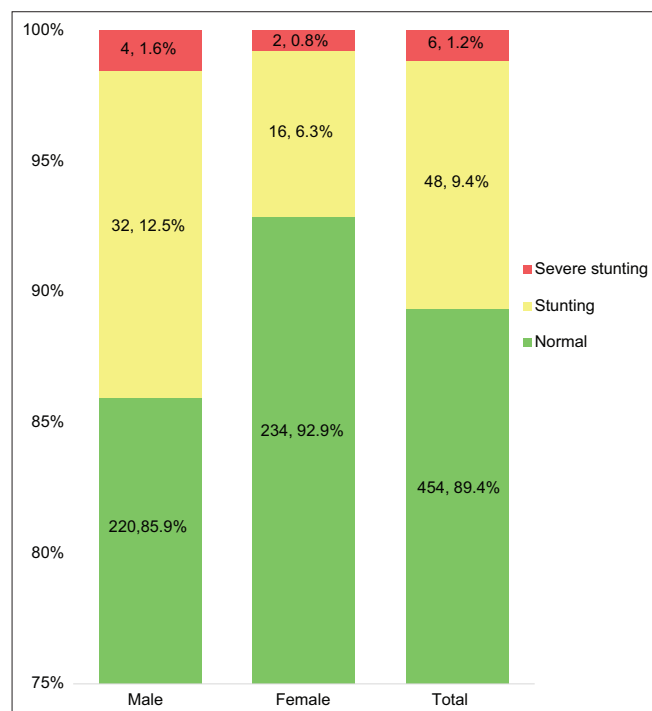
male (28.1%) and female (19%) participants, which was statistically significant (P = 0.011). However, no significant gender-wise difference in prevalence of overweight was noticed (P = 0.32) in comparison to normal BMIZ. Similarly, age was a significant predictor of thinness but it did not any significant association with overweight. Parental education has significant association with thinness. Siblings of mother who had below primary and primary level of education had 2.51- and 3.53-times higher odds of having thinness compared to mother having secondary education which is statistically significant. Similarly, significantly higher risk of thinness was noticed in children of fathers having below primary educational attainment (odds ratio = 2.63). Mother's education showed reciprocal association with odds of childhood overnutrition. A significant relationship of higher educational attainment by parents and higher risk of overweight children was observed. Mothers who had below primary education had 44% lesser chance having an overweight child. Similarly, children whose father had at least primary school certificates had 61% lesser odds of overweight [Table 3].

Discussion

A high prevalence of both ends of malnourishment was observed among school-going children in the study area. Both stunting and thinness were higher in male students. However, no significant difference in the prevalence of overweight was observed across gender. Lower educational attainment among parents was found to be significantly associated with a higher risk of malnutrition.

Undernutrition: Prevalence and associated factors

The present study observed that one-tenth (10.6%) of school children were stunted whereas thinness was present
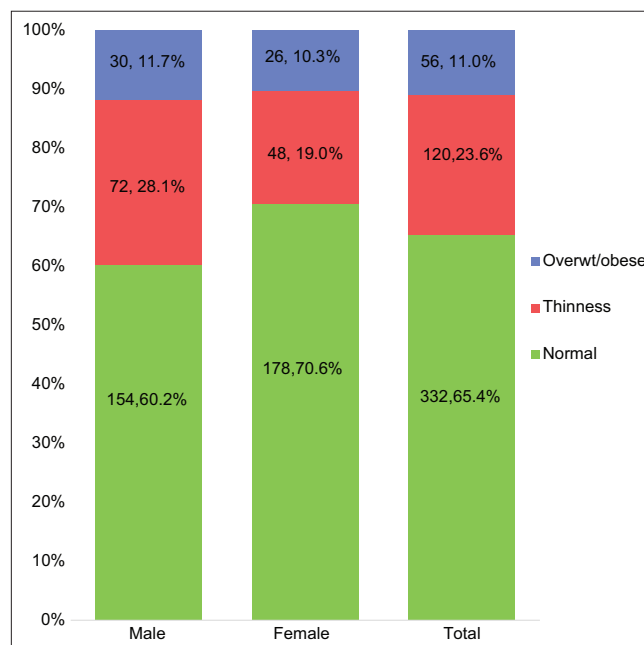

Figure 1: Distribution of Study Subjects According to Height for Age (N = 508)

Figure 2: Distribution of Study Subjects According to BMI for Age (N = 508)

in one-fourth (23.6%) of them. A slightly higher prevalence of stunting (18.5%) and thinness (33.3%) were observed by Srivastava *et al.* among school-going slum children in Bereilly in 2012.[15] Another study in Assam by Dey *et al.* showed nearly one-fourth (24.5%) of school children had stunting among which 6.5% severely stunted whereas and almost two-third (63.3%) were underweight.[20] Mondal *et al.* also found a higher prevalence of underweight (44.4%) and stunting (37.2%) among 6-16 years aged Bengali school children in Chapra block in 2012.[21] Shivaprakash *et al.* noticed prevalence of underweight and stunting were 30.3% and 27.9%, respectively, among 6-12 years aged students from a public school at Mandya district, Karnataka.[22] Verma M *et al.* conducted a study in 2018 in Punjab and found 37.5% thinness and 87.7% stunting among school-going children.[23] Present study showed a lesser prevalence of overall undernourishment compared to those studies. This is maybe due to regular school health program, home visit, and health education program in the

slums of Chetla by the urban health unit of All India Institute of Hygiene and Public Health, Kolkata. However, prevalence of undernourishment was comparable with findings of Daga S *et al.* who observed 20.2% thinness among school-going children in Pune.[24] Several other studies in low- and middle-income countries (LMIC) like Bangladesh, Ecuador, Tanzania, etc., observed a high burden of undernutrition in this age group.[25-27] Present study noticed significant association of stunting with male gender, low maternal education, and higher age. However, paternal education was not associated significantly with stunting. The probability of thinness was also higher in subjects who were of male gender, higher age, and poor parental education. Contrary to the normal belief of gender abuse and malnutrition in girls, the current study noticed slum boys were more susceptible to both chronic and acute undernutrition, which might be attributable to the higher risk of worm infestation and recurrent episodes of acute illness in slum boys, who spend a significant amount of time outdoors playing in dirty environments and may have a poor hygienic practice. Deb S *et al.* conducted a study among children of a school in the same area in 2010, and found significantly higher personal hygiene score and lower undernutrition in girls compared to boys. They also noticed comparatively higher prevalence of worm infestation in males (39.8%) than females (29.6%), however no test of significance was carried out. Findings of Deb S *et al.* supported our hypothesis behind poor nutritional outcome in male school-going children.[28] Shivprakash *et al.* also noticed higher susceptibility of both acute and chronic undernutrition in male children in Karnataka, concordant to our finding.[22] However Srivastava *et al.* found significantly higher prevalence of malnutrition in female school-going children in slums of Uttar Pradesh, contrary to our finding which can explained by possibility of gender abuse and/or higher prevalence of morbidity among female students observed by those researchers. They also showed significant relationship of parental education with malnutrition.[16] Darling *et al.* also found lesser likelihood of underweight in female children in rural part

Table 2: Predictors of Stunting (HAZ <−2SD): Binary Logistic Regression Model

	Stunting			
	Number (%)	OR	CI	*P*
Age group				
6-9 years	4 (2.4)	1	-	-
10-14 years	22 (9.6)	4.43	1.49, 13.11	0.007
15-19 years	28 (25.4)	14.17	4.81, 41.75	<0.001
Gender				
Male	36 (14.1)	2.13	1.17,3.86	0.013
Female	18 (7.1)	1	-	-
Mothers Education				
Below Primary	18 (15.9)	2.92	1.04, 8.22	0.043
Primary	31 (10.1)	1.73	0.65, 4.60	0.272
Secondary and above	5 (5.7)	1	-	-
Fathers Education				
Below Primary	15 (16.1)	1.58	0.71, 3.52	0.259
Primary	26 (8.8)	0.79	0.39, 1.61	0.523
Secondary and above	13 (10.8)	1	-	-

Table 3: Predictors of Thinness and Overweight: Multinomial Logistic Regression Model

	Thinness ¥				Overweight ¥			
	Number (%)	OR	CI	*P*	Number (%)	OR	CI	*P*
Age group								
6-9 years	28 (16.5)	1	-	-	16 (9.4)	1	-	-
10-14 years	58 (25.4)	2.32	1.29,4.15	0.005	30 (13.2)	1.19	0.51, 2.76	0.68
15-19 years	34 (30.9)	1.86	1.12,3.11	0.017	10 (9.1)	1.69	0.88, 3.24	0.12
Gender								
Male	72 (28.1)	1.73	1.13,2.65	0.011	30 (11.7)	1.33	0.76, 2.35	0.32
Female	48 (19.0)	1	-	-	26 (10.3)	1	-	-
Mothers Education								
Below Primary	27 (23.9)	2.51	1.07, 5.91	0.035	4 (3.5)	0.16	0.05, 0.48	0.001
Primary	85 (27.7)	3.43	1.57, 7.48	0.002	33 (10.7)	0.56	0.29, 1.06	0.074
Secondary and above	8 (9.1)	1	-	-	19 (21.6)	1	-	-
Fathers Education								
Below Primary	37 (39.8)	2.63	1.39, 4.98	0.003	8 (8.6)	0.54	0.23, 1.31	0.176
Primary	61 (20.7)	0.99	0.57, 1.73	0.986	25 (8.5)	0.39	0.21, 0.73	0.003
Secondary and above	22 (18.3)	1	-	-	23 (19.2)	1	-	-

¥Referent population=Normal BMI for age

of Birbhum supporting our finding.[29] Gupta *et al.* also observed significant association of underweight children with lower maternal educational attainment and poor maternal knowledge regarding childhood nutrition and diarrhea management.[12] Dey *et al.* found stunting was associated significantly with age, religion, parental education, and father occupation, which was concordant to our finding.[20]

Overnutrition: Prevalence and associated factors

Present study noticed that 11% of study participants were overweight and obese. However, no significant gender-wise variation was noticed in proportion of overweight children. A significant relationship was observed between parental higher education and overweight children. Paternal education is a surrogate marker of socioeconomic status of the family that also predict buying capacity especially in urban settings.[30] The gradual increase of literacy and buying capacities in families especially in LMICs showed a transition in food habits leading to higher proportion of energy-dense nutrient-poor foods such as fast or junk foods, sweetened drinks etc., in their diet. Moreover, poor physical activities, sedentary lifestyle, and increased screen time can potentiate the risk of being overweight among those children.[5,31] These determinants possibly interplayed in occurrence of elevated likelihood of overweight in children of higher educated parents. Bhattacharya M *et al.* conducted a study on adolescent school girls in the same area and found significantly higher proportion of sedentary lifestyle, junk food intake, and lack of physical activity in overweight/obese children compared to underweight/normal children.[32] Similar finding was obtained by Chakraborty P *et al.* They found significantly higher fast-food intake and screen time in obese children in Kolkata compared to normal peers. They also noticed that children who belonged to families of upper and upper-middle class had a significantly increased risk of overweight.[33] Findings of Bhattacharya *et al.* and Chakraborty *et al.* supported our hypothesis. Krishnan RN *et al.* studied among 5-16 years age group of semi-urban area. They found 12.8% children were overweight and 5.8% were obese. Girls were more overweight than boys.[28] Anuradha RK *et al.* noticed slightly higher prevalence of overnutrition in male (15.1%) and female (16%) school-going children in Andhra Pradesh which could be a local variation. They had also shown relationship of parental education with obesity.[34] Abdulla A showed similar prevalence (11.2%) of overnutrition in adolescents with a slightly more chance of overweight in female (12.5%) compared to male counterpart (10.0%).[7] Ahmed *et al.* observed similar burden of overweight in school-going girls in Uttar Pradesh. Risk of overweight and obesity was more in urban residence, higher parental education, upper socioeconomic class, lack of physical activity, and poor eating behavior.[35] However Darling *et al.* observed a low prevalence of overnutrition (4.6%) among adolescents in Birbhum which could be attributed to rural-urban variation.[29] Daga S *et al.* found the prevalence of overweight as 13.4% similar to findings of current study.[24]

Present study depicted the pathetic condition of malnutrition among school-going slum children in a slum of Kolkata which was unaddressed in past studies. Moreover, the current study accounted for both ends of malnutrition, which was mostly missed in earlier studies. Despite these strengths, the current study had some major drawbacks. First, micronutrient deficiencies among these children were not addressed in the present study.

Second, living conditions and population dynamics in various slums of Kolkata are not the same. Thus, it is arguable that the result of the current study might not illustrate the actual picture of malnutrition in slum children throughout Kolkata. Moreover, malnutrition among school drop-out children was not assessed by the present study. Therefore, future community-based studies are warranted with a higher sample size and representative samples of slum children from all over Kolkata.

Conclusion

Observed burden of double malnutrition among the slum school children was alarming. Parental education has a key role for prevention and management of childhood malnutrition. Thus, periodic growth monitoring using WHO BMI for age chart with the strengthening of the Mid-Day Meal program and awareness generation campaigns regarding malnutrition among parents of slum children are highly needed. Primary care physicians can provide a pivotal role in this regard by not only providing treatment and support to the malnourished children but also spread the adequate and appropriate information toward the community through their clinics for prevention of malnutrition and other diseases related to it. Moreover, further operational research is warranted to explore the effectiveness of such primary care model especially in underserved areas.

Key Points and Messages

- Huge burden of malnutrition is present among the slum school children.
- Poor parental education is an important risk factor for childhood malnutrition.
- Regular growth monitoring along with supplementary nutrition is warranted to solve the problem.
- Primary care physician as well as policymakers should work hand in hand in this regard.

Acknowledgement

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

References

1. Fact sheets-Malnutrition [Internet]. [cited 2020 May 13]. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition.

2. Wells JC, Sawaya AL, Wibaek R, Mwangome M, Poullas MS, Yajnik CS, *et al.* The double burden of malnutrition: Aetiological pathways and consequences for health. Lancet Lond Engl 2020 04;395:75-88.

3. WHO. The double burden of malnutrition: Policy brief [Internet]. 2017 [cited 2020 May 8]. Available from: https://apps.who.int/iris/bitstream/handle/10665/255413/WHO-NMH-NHD-17.3-eng.pdf?ua=1.

4. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases: 2013-2020. [Internet]. 2013 [cited 2020 May 8]. Available from: http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf.

5. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. Lancet 2020;395:65-74.

6. World Health Organization, Regional Office for South-East Asia. Adolescent nutrition: A review of the situation in selected South-East Asian Countries [Internet]. WHO Regional Office for South-East Asia: 2006 [cited 2020 May 9]. Report No.: SEA-NUT-163. Available from: https://apps.who.int/iris/handle/10665/204764.

7. Abdullah A. The double burden of undernutrition and overnutrition in developing countries: An Update. Curr Obes Rep 2015;4:337-49.

8. WHO | Double burden of malnutrition [Internet]. WHO. World Health Organization; [cited 2020 May 12]. Available from: http://www.who.int/nutrition/double-burden-malnutrition/en/.

9. Amare M, Arndt C, Abay KA, Benson T. Urbanization and child nutritional outcomes. World Bank Econ Rev 2020;34:63-74.

10. Hassan N, Ahmad K. The nutrition profile of the slum dwellers: A comparison with the rural poor. Ecol Food Nutr 1991;26:203-14.

11. Ghosh S, Shah D. Nutritional problems in urban slum children. Indian Pediatr 2004;41:682-96.

12. Gupta MC, Mehrotra M, Arora S, Saran M. Relation of childhood malnutrition to parental education and mothers' nutrition related KAP. Indian J Pediatr 1991;58:269-74.

13. Alderman H, Headey DD. How important is parental education for child nutrition? World Dev 2017;94:448-64.

14. International Institute for Population Sciences (IIPS), ICF. National Family Health Survey (NFHS-4), India, 2015-16: West Bengal [Internet]. Mumbai: IIPS; 2017 [cited 2019 Sep 10]. Available from: http://rchiips.org/nfhs/NFHS-4Reports/WestBengal.pdf.

15. International Institute for Population Sciences, Ministry of Health and Family Welfare, Government of India. NFHS-5 (2019-20) State Factsheet Compendium: Key Indiactors of 22 States/UTs from Phase I [Internet]. International Institute for Population Sciences; 2019 [cited 2021 Feb 20]. Available from: http://rchiips.org/NFHS/NFHS-5_FCTS/NFHS-5%20State%20Factsheet%20Compendium_Phase-I.pdf.

16. Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP, Kumar B. Nutritional status of school-age children-A scenario of urban slums in India. Arch Public Health 2012;70:8.

17. CDC. National Health and Nutrition Examination Survey (NHANES): Anthropometry measurement manual [Internet]. 2007 [cited 2019 Sep 13]. Available from: https://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf.

18. WHO. AnthroPlus for personal computers Manual: Software for assessing growth of the world's children and adolescents [Internet]. Geneva; 2009. Available from: https://www.who.int/growthref/tools/en/.

19. WHO | BMI-for-age (5-19 years) [Internet]. WHO. World Health Organization; [cited 2020 May 8]. Available from: http://www.who.int/growthref/who2007_bmi_for_age/en/.

20. Dey AK, Nath AB. Nutritional Status of School Going Children (6-15 Years) in a Semi-Urban Area of Cachar District, Assam. 2017 Jun 7 [cited 2020 Sep 24]. Available from: https://jemds.com/latest-articles.php?at_id=13764.

21. Mondal PR, Biswas S, Bose K. Gender discrimination in undernutrition with mediating factors among Bengalee school children from Eastern India. Homo 2012;63:126:35. doi: 10.1016/j.jchb.2012.01.001. Epub 2012 Mar 5. PMID: 22398147.

22. Shivaprakash NC, Joseph RB. Nutritional status of rural school-going children (6-12 years) of Mandya District, Karnataka. Int J Sci Stud 2014;2:39-43.

23. Verma M, Sharma P, Khanna P, Srivastava R, Sahoo SS. Nutrition status of school children in Punjab, India: Findings from school health surveys. J Trop Pediatr 2020;67:fmaa068.

24. Daga S, Mhatre S, Kasbe A, Dsouza E. Double burden of malnutrition among Indian schoolchildren and its measurement: A cross-sectional study in a single school. BMJ Paediatr Open 2020;4:e000505.

25. Shahabuddin AK, Talukder K, Talukder M-K, Hassan M, Seal A, Rahman Q, *et al.* Adolescent nutrition in a rural community in Bangladesh. Indian J Pediatr 2000;67:93-8.

26. San Sebastián M, Santi S. The health status of rural school children in the Amazon basin of Ecuador. J Trop Pediatr 1999;45:379-82.

27. Lwambo NJ, Brooker S, Siza JE, Bundy DA, Guyatt H. Age patterns in stunting and anaemia in African schoolchildren: A cross-sectional study in Tanzania. Eur J Clin Nutr 2000;54:36-40.

28. Deb S, Dutta S, Dasgupta A, Misra R. Relationship of personal hygiene with nutrition and morbidity profile: A study among primary school children in South Kolkata. Indian J Community Med 2010;35:280-4.

29. Darling AM, Fawzi WW, Barik A, Chowdhury A, Rai RK. Double burden of malnutrition among adolescents in rural West Bengal, India. Nutrition 2020;79-80:110809.

30. Conger RD, Conger KJ, Martin MJ. Socioeconomic status, family processes, and individual development. J Marriage Fam 2010;72:685-704.

31. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutr Rev 2012;70:3-21.

32. Bhattacharyya M, Sen P, Hazra S, Sinha RN, Sahoo SK, Panda AK. Prevalence of overweight and obesity among adolescent school girls in urban slum of Kolkata. Int J Health Sci Res 2015;5:59-65.

33. Chakraborty P, Dey S, Pal R, Kar S, Zaman FA, Pal S. Obesity in Kolkata children: Magnitude in relationship to hypertension. J Nat Sci Biol Med 2011;2:101-6.

34. Anuradha RK, Sathyavathi RB, Reddy TM, Hemalatha R, Sudhakar G, Geetha P, *et al.* Effect of social and environmental determinants on overweight and obesity prevalence among adolescent school children. Indian J Endocrinol Metab 2015;19:283-7.

35. Ahmad S, Shukla NK, Singh JV, Shukla R, Shukla M. Double burden of malnutrition among school-going adolescent girls in North India: A cross-sectional study. J Fam Med Prim Care 2018;7:1417-24.