ORIGINAL ARTICLE

Stunting and BMI in Rural Adolescents from Three Day-Schools in Nashik District of Maharashtra (India): A Descriptive Cross-Sectional study

Shyam V Ashtekar*, Shekhar B. Padhyegurjar, Jagdish D Powar, Siddiqui Aqsa

Abstract

Background: India has high stunting levels in 0-5 age group and the loss can't be compensated in the adolescent period also. WHO and IAP parameters differ somewhat in defining childhood stunting.

Objectives: This study aims to estimate stunting levels in rural school-going adolescents. The descriptive cross-sectional study in 2016 involved 261 students from 8th and 9th class with age of 13 to 14 completed years from three rural schools in Nashik district (m 128, f 133). The heights and weights were taken using standard procedures with a stadiometer and a bathroom digital scale. WHO and IAP growth charts were used to estimate and compare stunting and BMI values of the study population.

Results: 31.51% adolescents were stunted by WHO standards (<-2SD), while 15.71% adolescents were found below 3rd percentile of IAP charts. The mean heights and sd in cms of students were as follows: 8th Class Girls, 146.05 (5.99), Boys 148.15 (7.81) and 9th class, Girls 150.15 (5.48) Boys 153.73 (8.83). mean BMI values were also below 25th percentile of IAP charts and around 15th percentile of WHO height charts.

Conclusions: The study population showed a high level of stunting at 31% and 15% by WHO and IAP standards and concurred with similar studies from the state. Multi-pronged actions are required to mitigate rural adolescent undernutrition in the form of stunting and low BMI.

Keywords: Adolescents, BMI, Stunting,

Journal of Research in Medical and Interpathy Sciences, (2023)

Introduction

India has a high rate of childhood stunting. The National Family Health Survey (NFHS4 2015-16) estimated combined rural and urban U5 stunting at 38.4%, and 41.2% for rural.[1] The National Nutrition Mission (NNM) 2017 aimed to achieve a reduction in stunting from 38.4% as per the NFHS4 to 25% by 2022.[2] The NNM rightly argued for a life-cycle approach since height gain is affected by factors related to the antenatal period to adolescence, not to mention parental heights. Prevention of stunting is very important to the overall growth and development of individuals and society. Height is also a robust indicator of long-term growth and India is rightly focusing on U2 height gain through Angnawadis, and better nutrition of U2 population by targeted schemes.[3] The RTE (Right to Education) has ensured mid-day meals across states, with 450 calories and 12 gm protein for 1st to 5th class and 600 calories and 20 gm protein for 6th & 7th class; mainly through rice and dal.[4] Adolescent heights are a good indicator of achievement of growth and nutrition potentials and socio-economic development.[5,6] This suggests that adolescent stunting will be a problem to continue for some years.

After the publication of WHO 2007 growth standards, the Indian Academy of Pediatricians (IAP) has also published its Indianized growth standards for children above 5 years, allowing for somewhat lower attainment.[7,8] The NFHS statistics do not offer adolescent growth data but ICMR has published growth standards for 3-18years children.[9] Although abundant data on heights and weights from schools are collected through Rashtriya Bal Swasthya Karyakram (RBSK), there is no reporting of comparative statistics to facilitate more targeted action at the individual or community level.

Some reports regarding stunting in adolescents are available. A recent Bengal rural study reported 56% stunting among of adolescents.[10] A Wardha district study indicated that 34.5% were stunted in age group 11-19.[11] MDM has been established for all primary schools in Maharashtra along with India and these children have been consuming MDM from their enrolment in schools.

The research queswtion for the study was: what are the stunting and BMI levels of adolescent schoolchildren in the three schools? This study aims to estimate height and BMI attainments in rural adolescents from Nashik district from 8th and 9th class in reference to IAP and WHO standards.

Methods

This descriptive cross-sectional study was conducted in parts of Nashik district having both tribal and non-tribal

[1-3]Dept of Community Medicine, SMBT Institute of Medical Sciences and Research Centre, Dhamangaon, Nashik, Maharashtra, India

[4]SMBT Institute of Medical Sciences and Research Centre, Dhamangaon, Nashik, Maharashtra, India

Corresponding Author: Dr. Shyam Ashtekar, Dept of Community Medicine, SMBT IMS&RC Medical College, Dhamangaon, Nashik, MS, India. Email: ashtekar.shyam@gmail.com

Source of support: Nil

Conflict of interest: No conflicting interest

population. The Igatpuri block is mainly a tribal rural hilly block with rice farming as main occupation for 80% of people. The selected schools were from three villages in the field practice area of a rural Medical College. No urban high school or convent schools existed within 30 km perimeter of this institute in 2016-17 and hence most students attended local schools run by Zilla parishad or grant-in-aid schools run by charitable trusts. All three schools were under the Maharashtra State board of Secondary Education. The students were a mix of tribal, non-tribal rural families from surrounding villages.

Prior approval from Institutional Ethics Committee was obtained for the study. The consent of school authorities was taken for the study. Oral assent of the students was obtained after explaining the procedure. Convenience sampling was used to select schools in the vicinity of the institute.

Sample Size Calculation

The desired sample size was estimated using Formula $n = \frac{4 * p * q}{L^2}$ using proportion of stunting among rural adolescent students to be (p): 54%+/-10%, based on Open-Epi estimation.[12] The sample size was 96, taken separately for boys and girls, rounded to 100 hence 200.

Inclusion Criteria

The study included 8th and 9th class, and the median age is assumed to be about 13Y-6m and 14Y-6m, respectively. This age is commensurate with a pubertal growth spurt. All students attending on the research team's visit day in the selected classroom division were included. Out of 305 students, 236 participated in the study on first visits and 25 absent students were included subsequently. Some student absentees were reported to be habitual either because of long walking distances or unsupporting families. The visits were conducted in mid-week to ensure maximum attendance. In one school, absentees in 9thclass were remarkable (31 absentees out of 109); hence the school was revisited to cover missing students. In other schools and divisions, the absentee was less than 10%, so no repeat visit was done. Together the study included 128 students from 8th and 135 from class 9th.

Time frame: This study was undertaken in August and September 2016, nearly two months after schools opened in the second fortnight of June 2016, and data analysis done in 2017.

Anthropometry: Body weight was recorded on a digital bathroom weighing scale, with usual school clothes and without footwear and belt. The digital weighing machine (OmronHN-283 serial number 201109-02704F) did not show variation once adjusted for plane with spirit level. The adult weighing machine was tested each day against a pre-measured weight of sandbag wrapped in plastic to retain moisture if any for weight accuracy. The weighing scale did not show error of >0.1 kg. The weighing was done by a trained single observer throughout study to prevent inter-observer error. The scale on floor was adjusted with a spirit level and allow the reading to settle. Only one reading was taken as it was found that repeated readings with these procedures were nearly always consistent. The height was taken by a separate observer with a stadiometer fixed on wall, with head, toes, buttocks and shoulders touching the wall. Age was taken as 13Y 6 months and 14 Y 6 months for 8th and 9th class, respectively.

Statistical analysis was done with Excel and Epi-Info7.2 software. ANOVA was used to test differences in height and BMI in three schools

Results

The students (n=261) from the three schools were 91, 134 and 36. Students (Class 8th: girls 62, boys 64 and Class 9th: girls 71, boys 64). Table 1 depicts the heights of adolescents in 8th and 9th class, with commensurate height percentiles and stunting by WHO and IAP growth curves. Observed stunting among all students was 31.51% and 15.71% with WHO and IAP standards respectively. Table 2 depicts BMI values of girls and boys in 8th and 9th class, with commensurate BMI percentiles from WHO and IAP growth curves.

The heights and BMI estimates of boys and girls in the three schools were studied for differences by using ANOVA. For the heights of girls (F statistic 0.3291, p=0.7202) and boys (F: 1.5102, p=0.2186) the ANOVA showed no significant differences. For body weight also girls (F statistic 0.8064, p=0.4487) and boys (F: 1.8614, p=0.1597) the ANOVA showed no significant differences.

Table 1: Height and stunting of rural adolescents

Class, and (age)	Gender	Observed Height cm mean (SD) cms	IAP values for 3rd percentile (SD) cms	Students below -3rd percentile of IAP standards (%)	-2SD value in WHO Growth charts (SD) cms	Students below -2SD of WHO standards (%)
8th (13Y6M)	Girls (62)	146.05 (5.99)	139.9 (6.0)	10 (16.12)	144.4 (6.95)	23 (37.1)
	Boys (64)	148.15 (7.81)	140.9 (8.4)	11(17.18)	144.5 (7.57)	21 (32.8)
9th (14Y6M)	Girls (71)	150.15 (5.48)	142.4 (5.9)	13 (20.63)	147.1 (6.92)	17 (23.9)
	Boys (64)	153.73 (8.83)	145.8 (7.8)	7 (9.86)	150.3 (7.76)	20 (31.3)
	Total			41(15.71)		83 (31.51)

Table 2: BMI of Rural Adolescents

Class, and (age)	Gender	BMI Mean (SD)	Observed BMI in ref to IAP ref charts	Observed BMI in ref to WHO ref charts
8th (13Y6M)	Girls (62)	16.85 (2.99)	Below 25th percentile	>15th percentile
	Boys (64)	15.93 (1.93)	Below 25th percentile	<15th percentile
9th (14Y6M)	Girls (71)	17.91 (2.47)	Below 25th percentile	>15th percentile
	Boys (64)	16.31(2.20)	Below 25th percentile	>5thpercentile

Discussion

The heights and weights of girls and boys in the three schools analyzed with one way ANOVA had no significant differences, hence the data of three schools was homogenous could be pooled and treated together.

Stunting as an important measure of human development

Malnutrition is a major problem among children, but adolescent malnutrition is often overlooked because of the current emphasis to U5 malnutrition. Height is a robust indicator of long-term growth of children and adolescents up to 18 years and shows the overall impact of several factors like nutrition, health care, sanitation and parental heights. Height gains, therefore, are important to both human development and socio-economic development and there is also a bidirectional cause-and-effect relationship between heights and socio-economic development.

The Problem of High Stunting and Programmatic Interventions

The NFHS5 (in 2019-20) estimates of U5stunting at 36.1% in Maharashtra have remained the same as in NFHS4 done in 2014-15.[5,6] National and State level factsheets of the Rapid Survey on Children (RSoC) that was conducted in 2013-14 jointly by the Ministry of Women and UNICEF estimated that U5 stunting by WHO set levels have reduced but still about 31% at the national level.[13] Stunting in U5 children decreased to 38.7%. The NFHS4 in 2015-16 confirmed these improving trends over NFHS3.[5] Even then these stunting levels continue to be high.

The study population had a high degree of stunting at 31.51% by WHO -2SD level and 15.71% by IAP standards.[7,8] Even by the less demanding IAP standards the heights of adolescent girls and boys are closer to 10th-20th percentiles suggesting chronic under-nutrition of the study population and may have been influenced by several factors including health care, sanitation, and protein-energy intakes; in short, the multi-dimensional poverty.

There exists a considerable debate about adopting for India the ideal heights prescribed by WHO standards. While WHO charts are used universally for U2 children, IAP and ICMR have published their own tables and curves for 2-18 years.[7,8] The IAP and ICMR standards are pegged somewhat lower than the WHO and hence there is an observed difference between stunting percentages between WHO (31.51%) and IAP (15.71%). That parental height is also an influential factor for offspring height has been reported in a study based on WHO multicentric study for child growth.[14]

The stunting levels in Maharashtra have been reported by various studies. A Wardha district study indicates that 34.5% were stunted in age group 11-19.[9] Another study from the sugar belt block of Maharashtra reported the prevalence of stunting in 10 to 15 years age group at 16.9% among boys and 6.3% in girls and an overall prevalence of 11.6% by WHO standards and using a cut-off level of <3 percentile.[13] The socio-economic status of this block in south Maharashtra is known to be better than the study population from Nasik district and particularly Igatpuri block. A 2016 Bengal rural study reported a high rate of stunting at 56% in adolescents.[10] Except parental height, most of the height-influencing factors are amenable to the life cycle approach which includes the 1000 days' window, IYCF, complementary feeding from 6m-2y, preschool nutrition programs esp Anganwadi, MDMS, Kishori Shakti Yojna. Also, there is the RBSK program since 2011-11 dealing with health and anthropometric checkup of schoolchildren.[15] Weight and hence BMI is subject to both short-term and long influences and both these parameters also are linked to height. It is necessary to note that stunting 'paradoxically' reduces wasting and improves BMI as the height is the denominator in BMI calculation. Hence, stunting perniciously hides other undernutrition parameters. There are also the other larger programs of water safety, sanitation (Swatch Bharat), annual national deworming day (NDD) etc. However, the NFHS5 findings underline the need for better efforts on the nutrition of adolescents both through family and school resources.

Low BMI of Study Population

Our BMI findings are also suggestive of chronic malnutrition as BMI values for the study population are below 25th percentile by IAP standards and just above 10th percentile by WHO standards. RSOC report estimated that 54% of adolescent girls in Maharashtra were in the low BMI category in 2013-14.[13]

Have ICDS, MDM been Effective?

The Integrated Child Development Scheme (ICDS) was launched in 1978 in most of Maharashtra state and the coverage of the Angwnawdis was extended to villages and padas in a few years. That makes four decades of ICDS services. The MDMS was improved so that all children in every Government and Government aided primary school

get a prepared cooked meal with a minimum content of 300 calories of energy and 8–12-gram protein per day for a minimum of 200 days. The scheme was extended to 7th and 8th classes with 450 calories and 20-gram protein.[4] The study population has been a beneficiary of MDMS right from school enrolment till 8th standard since the revised MDMS is operating since 2007. RBSK is operative since 2010 and has involved health and anthropometry checkups of all schoolchildren. Thus, there are major schemes for children and adolescents and the study population has had all these services. Also, adolescent girls have had IFA supplementation through ICDS.

MDMS is a supplementary meal providing nearly a third part of energy and protein requirements and schoolchildren eat bellyful of the same for minimum 200 days in each year.[4] Thus, the students in this study population have benefited from both the targeted schemes of ICDS and MDMS. Despite these two targeted services, the stunting levels continue to remain high both by global and Indian standards. The food served in MDM is mainly carbohydrates (rice with little of moong dal as khichdi) and occasional vegetables. In childhood and adolescence, the protein requirement in vegetarian diets is about 1.6 gms-1.2 per kg bodyweight to ensure growth in height and adequate muscle mass.[17] The prevalent operation of MDMS is unlikely to give the desired protein content of 20gm unless the pulses/legumes portion reaches about 60-70 gms/ student in the 7th and 8th classes. A recent cross-sectional study by the authors in Ashram schools in the same district reported halving of stunting levels among tribal students in 9th standard (15 years of age) as compared to school entry at 6-7 years of age.[18] This study reported adequate protein-calories intakes in the Ashramschools, using the food inventory method. This supports a suggestion that better nutrition even of the Ashramschool level can mitigate stunting levels by some catch-up effect in adolescence. Hence India needs to improve its protein-energy content in MDMS and family food source significantly. Milk supplements and eggs have been added recently in Ashramschools to improve good quality proteins.

Finally, the causes of chronic malnutrition among the study population could include childhood malnutrition continuum, inadequate food intake, poor sanitation and hard physical work at homes and farms. These are socio-economic causes and need larger action from society and Governments.

Conclusions

The rural adolescent population in this study group shows chronic malnutrition- with 15% stunted as per IAP curves and 31% stunting by WHO MAM cut-off points of <-2SD. The study population had low BMI. It seems years of several targeted schemes have barely helped to lessen or prevent high stunting levels in these rural children and there could be other factors contributing to this undernutrition including overwork, lack of sanitation and timely health care.

Limitations

Convenience sampling is a limitation in this study for external validity.

Acknowledgments

The authors are grateful for support from the Institute. We thank the students, teachers of the school for their participation.

Declarations

The authors have no conflict of interest with this research or its findings. This study has received no funding. The data was collected along with an STS ICMR project in 2015-16.

References

1. NFHS4 http://rchiips.org/NFHS/pdf/NFHS4/MH_FactSheet.pdf, Accessed on 12/1/ 2018
2. NITI Ayog, Government of India, Nourishing India, National Nutrition Strategy http://niti.gov.in/writereaddata/files/document_publication/Nutrition_Strategy_Booklet.pdf, accessed on July 2018
3. Tiwari S, Bharadva K, Yadav B, Malik S, Gangal P, Banapurmath CR et al, For The IYCF Chapter Of IAP, Infant and Young Child Feeding Guidelines, 2016, pp703-713 https://www.indianpediatrics.net/aug2016/703.pdf accessed on 20 Feb 2021
4. Govt of Maharashtra, MID Day Meal, Guidelines, https://education.maharashtra.gov.in/mdm/files/Introduction%20Marathi.pdf, accessed on 20/1/2018
5. NFHS5, http://rchiips.org/nfhs/NFHS-5_FCTS/FactSheet_MH.pdf, p7-10, 2020 accessed on 20/1/2021
6. NFHS5, http://rchiips.org/nfhs/NFHS-5_FCTS/FactSheet_MH.pdf
7. WHO, Growth reference 5-19 years, http://www.who.int/growthref/who2007_bmi_for_age/en/ accessed on 12 December 2017
8. Khadilkar V, Yadav S, Agrawal SK, Tamboli S, Banerjee B, Cherian A, et al. Revised IAP Growth Charts for Height, Weight and Body Mass Index for 5- to 18-year-old Indian Children. Indian pediatrics http://www.indianpediatrics.net/jan2015/jan-47-55.htm. Accessed on 12 January 2018
9. Marwaha RK, Tandon N, Ganie MA, Kanwar R, Shivaprasad C, Sabharwal A, et al, Nationwide reference data for height, weight and body mass index of Indian The National Medical Journal Of India Vol. 24, NO. 5, 2011 pp269-278 schoolchildren http://archive.nmji.in/archives/Volume-24/Issue-5/Original-Articles-II.pdf, accessed on 9/7/ 2018
10. Amitava Pal A, Pari AK, Sinha A, Dhara PC, Prevalence of undernutrition and associated factors: A cross-sectional study among rural adolescents in West Bengal, India Bengal study, Int J Pediatr Adolesc Med, 2017 Mar;4(1):9-18. doi: 10.1016/j.ijpam.2016.08.009. Epub 2016 Sep 13.

11. Dambhare, DG, Bharambe MS, Mehendale AM and Garg BS (2010) Nutritional Status and Morbidity among School going Adolescents in Wardha, a Peri-Urban area, Online Journal of Health and Allied Sciences, https://www.researchgate.net/publication/46216409_Nutritional_Status_and_Morbidity_among_School_going_Adolescents_in_Wardha_a_Peri-Urban_area/citation/download, accessed on 24/2/2021
12. Sample Size for Frequency in a Population, https://www.openepi.com/SampleSize/SSPropor.htm
13. Rapid Survey on Children (RSOC) 2013-14, https://wcd.nic.in/acts/rapid-survey-children-rsoc-2013-14, accessed on 18/2/2021
14. Garza C, Borghi E, Onyango AW, Onis M De, Growth WHOM. Parental height and child growth from birth to 2 years in the WHO Multicentre Growth Reference Study. 2021;9(Suppl 2):58–68.
15. Rashtriya bal Swasthya Karyakram, Patil SS, Patil SR, Naik SS, Durgawale PM, Devkar VV. An Assessment of Nutritional Status, among School Going Adolescents (10-15 Years-A Study from Rural Maharashtra. Online J Health Allied Scs. 2015;14 (2):1. Available at URL: http://www.ojhas.org/issue54/2015-2-1.html, accessed on 25/2/2021
16. http://www.mdm.nic.in/Files/School%20Health%20Programme/Nutrition_Support/Rastriya_Bal_Swaasthya_Karyakram.pdf accessed on 18 January 2018
17. Manual A. Dietary Guidelines for Indians - A Manual. Natl Inst Nutr Hyderabad. 1998;500(7). Last accessed on 12 January 2018
18. Ashtekar SV, Padhyegurjar MS, Powar J. Protein calorie intakes and growth profiles in ashram school students in Nashik district in Maharashtra. Indian J Public Health 2019;63:341-7. Last accessed on: 12 Jan 2018

Contributor Details

Stunting and BMI in Rural Adolescents in three Day-Schools Nashik District

	Contributor 1	*Contributor 2*	*Contributor 3*	*Contributor 4*
Concepts	✓			✓
Design	✓			
Definition of intellectual content	✓			
Literature search	✓			
Clinical studies	NA			
Experimental studies				
Data acquisition	✓		✓	✓
Data analysis		✓	✓	
Statistical analysis	✓	✓	✓	
Manuscript preparation	✓			
Manuscript editing	✓	✓		
Manuscript review		✓		
Guarantor	✓			