**“Assessment of Nutritional Status of Rural Children (0-18 years) in Central India Using World Health Organization (WHO) Child Growth Standards 2007”**

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**Abstract**

**Background:** The World Health Organization (WHO) Child Growth Standards (“WHO Standards”) 2007 are the most recent and updated indicators which provide a single international standard that represents the best description of physiological growth for all children. **Objectives:** The objective of the study was to estimate the prevalence of malnutrition as per anthropometric indicators, namely underweight, stunting, and wasting among rural children in Raipur district, Chhattisgarh, using the WHO Child Growth Standards. **Materials and Methods:** Nutritional assessment of children was conducted in rural areas using standard anthropometric measurements of height and weight. Totally 10,730 children were screened in 61 schools and 30 Anganwadis belonging to 26 villages across 3 major blocks in Raipur district, Chhattisgarh, during June 2013 to February 2018. Weight-for-age, height-for-age, and body mass index-for-age z-scores were calculated using WHO AnthroPlus software. **Results:** The prevalence of underweight (≤2 standard deviation) was 45.7% in the children examined. The prevalence of stunting and wasting was 40.4% and 22.0%, respectively. Twenty-two of the 26 villages screened reported malnutrition in more than 30.0% of children, namely every third child lags behind in his or her growth curve despite the Mid-Day Meal Program implemented across the nation including this region since several decades. **Conclusion:** Malnutrition remains an ongoing health problem in school-going children. WHO AnthroPlus software can be very useful for analysis of state- and national-level data of nutritional status of children and could be used to shape health policies for this age group accordingly.

**Keywords:** AnthroPlus software, anthropometry, malnutrition, stunting, wasting

**INTRODUCTION**

The health of a child is the true wealth of the nation. The Government of India has initiated several large-scale supplementary feeding programs in the last 71 years; still, one in three of the world’s malnourished children lives in India, which speaks volumes of the sorry state of the nutritional status of the supposed future of the nation.[1]

As per the National Family Health Survey-4 (NFHS-4) and NITI Aayog data,[2] nearly 47.0% of children in our country are malnourished, 43.0% are underweight, and 20.0% are wasted which in numbers amount to eight million severely acute malnourished children. Two important findings highlighted in the 2016 Global Burden of Disease report[3] stated that (1) 10.56% of the total years lived with disability were due to anemia and (2) nutritional diseases and malnutrition are among the topmost causes for most death and disability combined.

Anemia and malnutrition impacts the immune system and increases the chances of infections and inflammatory disease, further affecting individual physical and mental growth and development.[4]

Certain states in India have poor health indicators compared to the national average. One of them is Chhattisgarh, which, although is a fast-emerging state formed after separation from Madhya Pradesh in 2001, still lags behind in key maternal and child health indicators. As per NFHS-4 data

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of rural Chhattisgarh. 39.6% of children under 5 years are underweight (weight-for-age), 39.2% of children under 5 years are stunted (height-for-age), 23.7% of these are wasted, 8.5% are severely wasted, and 41.2% of children in the age group of 6–59 months are anemic (<11.0 g/dl).

The World Health Organization (WHO) Child Growth Standards (“WHO Standards”) 2007 are the most recent and updated indicators which provide a single international standard that represents the best description of physiological growth for all children from birth to 5 years of age and establishes the breastfed infant as the normative model for growth and development. According to the WHO, nutritional status can be assessed through nutritional indicators based on the anthropometric measurements: age, weight, and height due to its sensitivity to the full spectrum of malnutrition. These indicators are as follows: height-for-age z-score (HAZ) (age range: 5–19 years) to measure stunting. Stunting is defined as HAZ < −2 standard deviation (SD). Weight-for-age z-score (WAZ) indicator is used to assess if a child is underweight in children up to 10 years old. After 10 years of age, weight-for-age is not a good indicator where the children grow faster during the period of puberty and can be falsely categorized as excess weight. Underweight is defined as WAZ < −2 SD body mass index (BMI)-for-age z-score (BAZ) (age range: 5–19 years): BMI measures weight in kilogram divided by height in meter square. It is a preferred indicator for assessing thinness, overweight, and obesity in children 10–19 years.

Wasting is defined as BAZ < −2 SD.

The aim of this study was to assess the nutritional status of children attending government schools and Anganwadis (preschool centers) in rural areas of Raipur district, Chhattisgarh, using the WHO Child Growth Standards (“WHO Standards”) and to assess common morbidities in the same.

**Materials and Methods**

**Study area**

This study presents a retrospective data analysis of the School Health Screening Program conducted by Department of Public Health, Sri Sathya Sai Sanjeevani Hospital, Naya Raipur, Chhattisgarh, over 5 years (2013 to 2018). Ethical approval was received from the Institutional Ethics Committee for using this data set for retrospective data analysis and eventual publication of report findings.

The School Health Screening Program initiated in 2013 with the objective of early intervention for child health through screening, referral, and treatment services is based on the Government of India’s Rashtriya Bal Swasthya Karyakram (RBSK) which aims at early detection of 4Ds – birth defects, diseases, deficiencies, and development delays and disability, thus covering around 30 childhood ailments.

This study was conducted in rural areas of 3 blocks of Raipur district in Chhattisgarh. The major focus was on assessment of nutritional status of children through anthropometric indicators such as stunting, wasting, and underweight and common morbidities in the same.

**Study population**

Before the start of the school screening program, in-depth review and benchmarking of similar programs and protocols was performed to design the final assessment tool (questionnaire). Necessary permissions and approvals with key stakeholders, i.e., District Health and Education Departments, Government of Chhattisgarh, school principals, and block development officers (for Anganwadi centers [AWCs]), were received before the start of each academic year’s school screening program.

The list of schools to be screened was provided by District Education Office. Universal sampling was used for this noninterventional, observational study design to include all students screened in these schools since September 2013 to April 2018 in rural government schools and Anganwadis of Raipur district, Chhattisgarh, India. Regular screening sessions were conducted in schools and Anganwadis by the team comprising medical and paramedical personnel trained in RBSK guidelines.

A comprehensive questionnaire (Annexure 1) was filled for each child screened through this program. It includes basic information of the child, anthropometric details such as weight, height, and mid-upper arm circumference, basic history, and details of about 30 childhood ailments covering 4Ds, i.e., diseases, congenital defects, nutritional deficiencies, and developmental delays/disability. Data on nutritional status of the children were assessed using anthropometric measurements.

Weight and height were taken for each student who completed the questionnaire. Weight was measured to the nearest 0.1 kg with an electronic scale, and the children were wearing light clothing and without shoes. A child’s height was measured to the nearest 0.1 cm using a wooden stadiometer placed on a flat surface. The child was made to stand without shoes on a flat surface with the back of the head, shoulder blades, buttocks, and heels touching the wall and head in Frankfurt plane. Age of the child was taken from a school register.

The cutoffs for classification of nutritional status are as follows:
- **WAZ**: <-3 SD (severely underweight) and −2 SD to −3 SD (underweight)
- **Length/HAZ**: <-3 SD (severely stunted) and −2 SD to −3 SD (stunted)
- **BMI-for-age**: <-3 SD (very thin), −3 SD to −2 SD (thin), −2 SD to 2 SD (normal), >+2 SD (overweight), and >+3 SD (obese).

**Assessment plan**

EpiData 6.0 software was used for data entry, WHO AnthroPlus software was used for assessing nutritional status – indicators such as undernutrition, stunting, and wasting, and Statistical Package for Social Sciences (SPSS) version 21.0 was used for data analysis. WHO AnthroPlus is a software for the
global application of the WHO Reference Standards 2007 for 0–19 years to monitor the growth of school-age children and adolescents. It consists of the following modules: anthropometric calculator, individual assessment, and nutritional survey. This software analyses anthropometric indicators based on the WHO Child Growth Standards 2007.

**Results**

Totally, 10,730 children were screened across 61 schools and 30 Anganwadis belonging to 26 villages in 3 major blocks in Raipur district, Chhattisgarh, during June 2013 to February 2018 [Figure 1]. Nine thousand seven hundred and sixty-four children were screened across 61 schools – 32 primary, 18 middle, and 11 higher secondary schools in Raipur district. Nine hundred and sixty-six children were screened across 30 Anganwadis.

55.5% of the children screened were girls and 45.5% were boys. Of the 31 villages, majority of villages had more girls attending schools compared to boys. This difference was more pronounced in government middle schools where the data highlight an important observation that ~60.2% of attendees were girls and ~39.8% were boys. There are few private schools in the area and few government-aided schools. There may be a possibility that boys are admitted in private schools since they are more expensive and girls continue their studies in government schools. However, this cause alone is insufficient to explain the difference noted here. This observation needs an in-depth study to assess reasons for school dropout among students of government middle schools in this region and to ascertain if it is more in boys compared to girls. Considering the demographic profile of the parents, over one-sixth of the fathers and one-third of the mothers of the children screened were illiterate.

Malnutrition was assessed against three indicators, namely underweight, stunting, and wasting, and it was found that a significant proportion of children had malnutrition. Out of the 10,730 children screened over the last 5 years in government schools and Anganwadis, 45.7% of children (4904 of 10,730) were found to be underweight [Figure 2]. Of these, 18.3% of children were severely underweight and 27.4% were moderately underweight. Only 1.5% of children were overweight.

Out of the 10,730 children screened over the last 5 years in government schools and Anganwadis, data for height was available for 10,470 children, of which 40.4% of children (4232 of 10,470) were found to be stunted. Of these, 17.2% of children had severe stunting and 23.2% were moderately stunted. The problem of stunting is shown in height-for-age distribution in Figure 3 where the curve is skewed to the left to the WHO world standard normal distribution curve.

Out of the 10,470 children for whom data for weight and height both were available, 22.0% of children (2303 of 10,470) were found to be wasted. Of these, 8.3% of children had severe wasting and 13.7% had moderate wasting [Table 1].

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economic factors during the study period, it is less likely for the prevalence to be influenced significantly.

The following bubble chart [Figure 4] depicts the distribution of malnutrition across the villages covered in the last 5 years in this region. Size of the bubble denotes the magnitude of malnutrition. The highest percentage of malnutrition was observed in Kotni, with 56.1% of the children having weight or height below 2 SD, followed by Dharampura (55.8%), Mandir Hasaud (54.3%), and Khuteri (52.0%). It is disheartening to note that 22 of the 26 villages screened reported malnutrition in more than 30.0% of children, namely every third child lags behind in his or her growth curve despite the Integrated Child Development Services (ICDS) and Mid-Day Meal Program implemented across the nation including this region since several decades.

Common morbidities identified in this group were anemia in 24.9%, Vitamin A deficiency (VAD) in 5.0%, skin diseases in 10.0%, eye ailments in 7.0%, and substance abuse in 3.0% of children. Eleven school-going children show symptoms associated with Vitamin D deficiency (rickets). The survey identified 17 school-going children with enlarged thyroid glands, which on examination were found to be asymptomatic. Hence, these were considered to be “physiological goiter.” Eleven of the 17 children were girls with physiological goiter within the age group 14–18 years, thus reflecting global trends which indicate the increased prevalence of goiter among girls during puberty.

**DISCUSSION**

Undernutrition is identified as both a health outcome and a risk-factor. It initiates a vicious cycle wherein it causes several other infectious diseases (including respiratory diseases) and further deteriorates nutritional health and is identified as a major cause of child mortality.

Undernutrition persists as a major public health challenge for the country. The CAB 2014 survey finds that among the annual health survey states, stunting prevalence among children is highest in Uttar Pradesh (62.0%), while the highest prevalence of underweight and wasting is in Jharkhand (45.7%) and Chhattisgarh (32.4%), respectively. The findings in this study corroborate with NFHS-4 data for rural India,[2,5] wherein India’s national average for stunting is reported as 41.2%, wasting 21.5%, severe wasting 7.4%, and underweight children as 38.3%. The state of Chhattisgarh reports stunting as much as 39.2%, wasting 23.7%, severe wasting 8.5%, and underweight 39.6%. Findings in this report correlate with the available national and state statistics except the percentage of wasting and stunting in this report which was comparatively higher with stunting 40.4%, wasting 22.0%, severe wasting 8.3%, and degree of underweight to the tune of 45.7%.

The prevalence of stunting similar to the present study was noted by Ahmad *et al.* in Aligarh[10] and in the Rapid Survey of Children in under-fives in Uttar Pradesh in 2014.[11] A higher

| Table 1: Distribution of study children as per wasting (body mass index-for-age) indicator |
|-----------------------------------------------|-----|
| Wasting (BMI for age)                         |
| Grade                                        | n (|) |
| Severe wasting                               | 869 (8.5) |
| Moderate wasting                             | 1434 (13.7) |
| Normal                                       | 7370 (70.4) |
| W/H between 2.0 and 3.0 SD                   | 99 (0.9) |
| W/H >3.0 SD                                  | 697 (6.7) |
| Total                                        | 10470 (100) |

BMI: Body mass index, SD: Standard deviation, W/H: Weight-for-height z-score

| Table 2: Year-wise distribution of malnutrition indices - underweight, stunting, and wasting in children screened |
|---------------------------------------------------------------|-----|
| Years | Underweight (%) | Stunting (%) | Wasting (%) |
|-------|----------------|-------------|-------------|
| 2013-2014 | 45.0 | 37.3 | 26.4 |
| 2014-2015 | 40.0 | 40.2 | 18.0 |
| 2015-2016 | 48.5 | 41.9 | 19.8 |
| 2016-2017 | 46.8 | 39.5 | 19.3 |
| 2017-2018 | 42.8 | 42.0 | 21.5 |
| Overall 2013-2018 | 45.7 | 40.4 | 22.0 |

Figure 4: Bubble graph to denote the distribution of malnutrition across villages screened over 5 years, note size of bubble denotes the severity of malnutrition. The legend on bubble depicts the name of village and percentage of malnutrition in children.
prevalence of wasting was noted in other developing countries such as Sri Lanka and Pakistan. Galgamuwa et al. reported wasting more than 32.0% in Sri Lanka.\textsuperscript{[12]}

Malnutrition was found to be slightly more in girls compared to boys. Bhargava et al. reported that females were more stunted, underweight, and wasted than males, especially in rural schools in India.\textsuperscript{[13]} In Beni-Suef survey in Egypt,\textsuperscript{[14]} it was concluded that females were more stunted than males (65.3% versus 59.9%) in the 10–14-year age group. This could be due to the cultural preference of boys over girls in rural areas, which influences access to adequate food.

Regarding different morbidities in children, Abu Bashar et al.\textsuperscript{[15]} observed that anemia is the most commonly seen morbidity among children, wherein anemia was noted in 65.8% of children, and 6.0% of children were found to have signs of VAD in form conjunctival xerosis (3.6%) and Bitot’s spots (2.4%). The prevalence of skin diseases (scabies and dermatitis combined) was 11.1%. Despite the weekly Iron and Folic acid Supplementation program being there for a while in all the states of India, such a high prevalence of anemia is a cause of concern.

**Limitations**

Due to limited resources of this study, only rural areas of Raipur district, Chhattisgarh state, were covered. Different results might be obtained in urban areas. The study includes assessment of school and AWC attendees, and it does not include out-of-school children and those who are not coming to school due to serious health issues (severely undernourished). Although the study period is 2013–2018, there is a possibility that prevalence itself may change during this period because of changes in external factors. However, since this area has not experienced a significant change in socio-cultural-economic factors, it is less likely for the prevalence to be influenced significantly.

**Conclusion**

Malnutrition is highly prevalent in rural schoolchildren in line with the national prevalence. WHO AnthroPlus software is a very useful inexpensive tool for standardized anthropometric assessment of children of all age groups. Twenty-two of the 26 villages screened reported malnutrition in more than 30.0% of children, namely every third child lags behind in his or her growth curve despite the ICDS and Mid-Day Meal Program implemented across the nation including this region since several decades.

**Recommendations**

The state of Chhattisgarh is implementing the RBSK program since 2014. At present, the mobile health teams under RBSK are examining children in government schools and Anganwadis, with regular anthropometry being done and health cards being issued, although many shortcomings have been reported. This will be a great opportunity to collect anthropometric information at state level and identify vulnerable districts. WHO AnthroPlus software is a very useful inexpensive tool for standardized anthropometric assessment of children of all age groups. The authors recommend that it can be used not only for individual child assessment but also for performance of districts and state.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Kishore. J. National Health Programs of India. 13th ed. India: Century Publications; 2019. p. 461.
2. Available from: http://rchiips.org/NFHS/pdf/NFHS4/India.pdf. [Last accessed on 2019 Jun 20].
3. GBD Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1211-59.
4. Available rom: http://www.indiaspend.com/cover-story/anemia-is-the-biggest-cause-of-disability-in-india-worst-in-brics-43371. [Last accessed on 2019 May 28].
5. Available from: http://rchiips.org/NFHS/pdf/NFHS4/CT_FactSheet.pdf. [ Last accessed on 2019 Jun 20].
6. Van den Broek J, Willie D, Younger N. The World Health Organization child growth standards: Expected implications for clinical and epidemiological research. Eur J Pediatr 2009;168:247-51.
7. World Health Organization. Growth Reference 5-19 years-Application tools: Anthroplus Software. World Health Organization; 2016.
8. Available from: http://www.who.int/growthref/tools/en/. [Last accessed on 2019 May 28].
9. Annual Health Survey Report: A Report on Clinical, Anthropometric and Bio-Chemical Survey Part-II; 2014.
10. Ahmad I, Khalique N, Khalil S, Urfi, Maroof M. Dietary diversity and stunting among infants and young children: A cross-sectional study in Aligarh. Indian J Community Med 2018;43:34-6.
11. Raykar N, Majumder M, Laxminarayan R, Menon P. India Health Report: Nutrition 2015. New Delhi, India: Public Health Foundation of India and International Food Policy Research Institute (IFPRI); 2015. Available from: http://www.ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130085. [Last accessed on 2019 Jun 20].
12. Galgamuwa LS, Iddawela D, Dharmaratne SD, Galgamuwa GL. Nutritional status and correlated socio-economic factors among preschool and school children in plantation communities, Sri Lanka. BMC Public Health 2017;17:377.
13. Bhargava M, Aggarwal P, Kandpal SD, Senwal J. Magnitude of undernutrition in urban and rural school-going children of district Dehradun using WHO reference standards. Ntl J Community Med 2015;6:452-7.
14. Abdelaziz SB, Youssef MR, Sedrak AS, Labib JR. Nutritional status and dietary habits of school children in beni-suef governorate, Egypt. Food NutSci 2015;06:54-63.
15. Abu Bashar MD, Aggarwal AK, Pilania M. A study to assess pattern of morbidities among adolescents under school health program from a rural block of North India. Natl J Community Med 2017;8:721-5.

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