

# Nutrition and health status of school children in urban area of Ahmedabad, India: Comparison with Indian Council of Medical Research and body mass index standards

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## Abstract

**Background:** Identifying the commonly prevailing health and nutritional disorders in school going children is essential to initiate appropriate public health measures. **Materials and Methods:** A cross-sectional prospective study was designed to conduct a detail physical health assessment of children studying in class 1-8 (age- 5-13 years) of 31 schools of Ahmedabad city, India between December 2011 and February 2012. Under the school health program of state government, medical history, height, weight and general physical examination findings, including dental and ophthalmic examination were recorded by qualified medical practitioners. Children with abnormal results were further investigated and treated by the subject experts. **Result:** Total 28,256 children were screened (boys-15,087 and girls-13,169). Mean weight and height of the children were 27.04 kg and 128.81 cm, respectively. Analysis of nutritional status of the cohort population as compared to body mass index standards revealed that 8319 (29.44%) children were underweight while only 221 (0.78%) children were either overweight or obese. The subgroup analysis of basic nutrition indices in children revealed prevalence of significant malnutrition (based on Indian Council of Medical Research standards) in children below 10 years of age. Commonly prevailing health disorders included worm infestation (42%), upper respiratory tract infection (36.39%), anemia (30.99%) dental caries (25.19%) and refractory errors (10.2%). **Conclusions:** Malnutrition and related health disorders are commonly prevailing childhood diseases in the urban community and can effectively be addressed by appropriate public health program.

**Key words:** Health status, Indian children, nutritional status, school health

## INTRODUCTION

Despite the well-known importance of nutritional health several cultural, social, political, economical and educational factors contribute to malnutrition among

children.<sup>[1]</sup> School going children constitute one-fifth of the total population and are the future of the nation. The health supervision of the school children is necessary and can help identify the magnitude of morbidity and malnourishment in a community.<sup>[2-5]</sup> Previous anthropometric profiles reported so far have focused on preschool children. While many studies on school going and adolescent age population are reported recently,<sup>[6-8]</sup> majority of these are either single center study or have a small number of subgroup cohort. We conducted a multi-center prospective study to evaluate the nutritional and health status of school going children by physical examination and anthropometric measurements.

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## MATERIALS AND METHODS

### Study population

A cross-sectional prospective study was designed to enroll all the primary government school children of an urban area of the western part of Ahmedabad city in western India. 5-13 years of school children of 31 primary schools present on the day of examination were selected.

### Data collection

Enrolled school children (standard 1-8) present on the examination day were examined by a health team consisting of five qualified medical practitioners from the department of pediatrics of AMC MET Medical College, Ahmedabad. All the findings were recorded in the predesigned and pretested questionnaires by interviewing the children for the case history. Clinical examination of the children was done, and the anthropometric measurements were taken.

Height of the children was measured using standardized steel anthropometric rod with parallel bar (accuracy  $\pm 0.1$  cm). Weight was measured with the electronic weighing scale (accuracy  $\pm 10$  g). The subjects were asked to remove their footwear and accessories before measuring their weights. Scales were calibrated after each measurement. Accuracy of weighing scale was verified from time to time against known weights. Body mass index (BMI) was calculated as body weight (in kilograms)/height (in meters) squared. Age and gender specific cut-off points for BMI recommended previously were applied.<sup>[9]</sup> Worm infestation was diagnosed on the basis of history given by the children. The mean weight and height of the children according to age and sex were compared with the median weight for age and height for age as per Indian Council of Medical Research (ICMR) standards.<sup>[10]</sup> Anemia was diagnosed by the presence of pallor at lower palpebral conjunctiva, mucous membrane, tongue, soft palate, skin surface and nail beds. Other diseases such as upper respiratory tract infection, skin diseases, dental caries, eye and ear diseases, cardiac and respiratory diseases were

diagnosed from the history and systemic examination. The child with anthropometric measurement falling below the normal range for their age/gender was counseled for their normal growth and development and the role of the appropriate combination of food stuff for proper nutrition. Any illness including associated infectious diseases was treated accordingly in the clinic set up. The patients who were diagnosed with minor ailments such as anemia, worm infestation, and upper respiratory tract infection were given on the spot treatment. Those children who had systemic diseases were referred to a higher center for further evaluation. Nutritional counseling and treatment of associated illness were also provided.

### Data analysis

Data thus generated were entered and analyzed using PH stat v 3.3. BMI for age was used for classifying the nutritional status. ICMR reference was used to assess the nutritional status.<sup>[10]</sup>  $\chi^2$  test was used for testing statistical significance. All tests of significance were two-tailed and level of significance was taken at  $t < 0.1\%$  and  $P < 0.05$ .

## RESULTS

Total 28,256 children between 5 and 13 years of age were enrolled in the study from December 2011 to February 2012. Only 395 (1.38%) children were absent on the day of examination. Out of total children 15,087 (53.4%) were boys and 13,169 (46.6%) were girls. The demographic profile of the study subject is provided in Table 1. Table 2 shows the comparison of mean weight and height of boys in the present study to ICMR standards, and Table 3 shows the similar comparison of anthropometric measurements of girls to ICMR standards.

### Comparison to Indian Council of Medical Research standards

In the present study, both, the mean weights and heights were lesser in the boys across the entire range of age as compared to ICMR standards. The deficit of mean weight of boys as per ICMR standards was highest for the age

**Table 1: Distribution of children as per age, sex, height and weight**

Age (years)	Total	Boys			Girls		
		Number (%)	Height (cm) mean	Weight (kg) mean	Number (%)	Height (cm) mean	Weight (kg) mean
5	615	333 (54.2)	106.43	15.83	282 (45.8)	105.93	15.32
6	3917	2092 (53.4)	110.42	17.48	1825 (46.6)	108.97	16.82
7	3744	1991 (53.1)	116.57	21.01	1753 (46.9)	115.23	20.37
8	3635	1945 (53.5)	124.27	23.93	1690 (46.5)	123.50	24.31
9	3538	1895 (53.6)	130.72	26.86	1643 (46.4)	131.12	25.71
10	3392	1818 (53.6)	136.48	29.54	1574 (46.4)	135.90	29.46
11	3261	1744 (53.5)	138.53	31.73	1517 (46.5)	141.41	33.15
12	3159	1677 (53.1)	145.89	36.27	1482 (46.9)	146.40	37.91
13	2995	1592 (53.2)	151.71	39.61	1403 (46.8)	149.20	41.50
Total	28,256	15,087 (53.4)	129.00	26.92	13,169 (46.6)	128.6	27.17

of 6 years (3.22) and lowest between the ages of 11 and 12 years (0.47 and 0.73). The deficit of mean height was highest for the age of 6 years (5.68) and lowest between the ages of 10 and 13 years (1.02-1.11) [Table 2]. Similarly, both the mean weights and heights were lesser in the girls across the entire range of age as compared to ICMR standards. The deficit in mean weight for girls as per ICMR standards was highest for the age of 6 years and lowest for the age of 8 years (0.49). The deficit of mean height was highest for the age of 6 years (5.63) and lowest for the age of 11 years (0.59) [Table 3].

### Comparison to body mass index standards

Total 8319 (29.44%) children were found underweight, in which 4041 (26.8%) were boys and 4278 (32.5%) were girls.

Boys: 72.3% boys between the ages of 5 and 13 years were healthy (BMI between 5 and <85<sup>th</sup> percentiles); 26.8% were underweight (BMI <5<sup>th</sup> percentile), 0.8% were overweight (BMI between 85<sup>th</sup> and <95<sup>th</sup> percentile) and only 0.01% were obese (BMI ≥95<sup>th</sup> percentile).

Girls: While 66.9% girls between the ages of 5 and 13 years were healthy; 32.5% were underweight and only 0.6% were overweight [Table 4]. Prevalence of overweight (>85<sup>th</sup> percentile) was 0.76% (0.8% boys and 0.6% girls). No significant difference was observed between the gender distributions in over-weight children however undernutrition was more pronounced in girls.

Morbidity pattern [Table 5]: Worm infestation was the commonest morbidity found in most children (42%) followed closely by upper respiratory tract infection (36.39%) and anemia (30.99%). Worm infestation (43.56%) and anemia (38.04%) were more common in girls. Dental caries were observed in 25.19% children and refractory error in 10.2% cases. Other diseases encountered were skin disorders, ear discharge, lower respiratory tract infections and abdominal pain. All the children with abnormal results were further investigated. The children with infective etiology were treated by the pediatrician at the time of visit. Nutritional counseling was provided to the children with malnutrition and anemia. Emphasis on correction of refractive error by glasses and importance of the dental hygiene was also done. Other diseases needing investigation and treatment by subject experts were referred to the concern higher center for the further treatment. Total 1355 children including those with Squints (54), Dental caries requiring further treatment (1268), orthopedic problems (3), heart diseases (9), handicap (3), kidney diseases, (10), central nervous system disorders (6) and cancer (2) were referred to the concerned higher center.

## DISCUSSION

Majority of children in India have underprivileged childhood starting from birth. Since independence, Central and State Government Health Ministries of

**Table 2: Comparison of weight and height of boys with ICMR standards**

Age (years)	Mean weight (kg)	Weight (ICMR)	Deficit	P	t	Mean height (cm)	Height (ICMR)	Deficit	P	t
5	15.83	18.7	2.87	<0.01*	-131.97**	106.43	109.9	3.47	<0.01*	-50.17**
6	17.48	20.7	3.22	<0.01*	-206.17**	110.42	116.1	5.68	<0.01*	-197.10**
7	21.01	22.9	1.89	<0.01*	-104.79**	116.57	121.7	5.13	<0.01*	-170.22**
8	23.93	25.3	1.37	<0.01*	-57.97**	124.27	127.0	2.73	<0.01*	-97.17**
9	26.86	28.1	1.24	<0.01*	-66.39**	130.72	132.2	1.48	<0.01*	-40.24**
10	29.54	31.4	1.90	<0.01*	-68.75**	136.48	137.5	1.02	<0.01*	-37.25**
11	31.73	32.2	0.47	<0.01*	-19.31**	138.53	140.0	1.47	<0.01*	-35.06**
12	36.27	37.0	0.73	<0.01*	-31.25**	145.89	147.0	1.11	<0.01*	-52.49**
13	39.61	40.9	1.29	<0.01*	-36.08**	151.79	153.0	1.21	<0.01*	-55.08**

\*\*t value significant at 0.1% level, \*Significant, ICMR: Indian council of medical research

**Table 3: Comparison of weight and height of girls with ICMR standards**

Age (years)	Weight (kg)	Weight (ICMR)	Deficit	P	t	Height (cm)	Height (ICMR)	Deficit	P	t
5	15.32	17.7	2.38	<0.01*	-80.84**	105.93	108.4	2.47	<0.01*	-38.20**
6	16.82	19.5	2.68	<0.01*	-135.54**	108.97	114.6	5.63	<0.01*	-210.94**
7	20.37	21.8	1.43	<0.01*	-70.60**	115.23	120.6	5.37	<0.01*	-168.54**
8	24.31	24.8	0.49	<0.01*	-19.89**	123.50	126.4	2.90	<0.01*	-92.28**
9	25.71	28.5	2.79	<0.01*	-141.24**	131.12	132.2	1.08	<0.01*	-39.47**
10	29.46	32.5	3.04	<0.01*	-105.93**	135.90	138.3	2.40	<0.01*	-66.30**
11	33.15	33.7	0.55	<0.01*	-18.98**	141.41	142.0	0.59	<0.01*	-11.24**
12	37.91	38.7	0.79	<0.01*	-33.26**	146.40	148.0	1.60	<0.01*	-66.40**
13	41.50	44.0	2.5	<0.01*	-63.76**	149.20	150.0	0.8	<0.01*	-45.47**

\*\*t value significant at 0.1% level, \*Significant, ICMR: Indian council of medical research

**Table 4: Classification of boys and girls according to BMI for age**

Age (years)	Sex	Under weight (%)	Healthy (%)	Over weight (%)	Obese (%)	Total
5	Male	67 (20.1)	265 (79.6)	1 (0.3)	0 (0)	333
	Female	90 (31.9)	192 (68.1)	0 (0)	0 (0)	282
6	Male	628 (30.0)	1461 (69.9)	3 (0.1)	0 (0)	2092
	Female	638 (35.0)	1185 (64.9)	2 (0.1)	0 (0)	1825
7	Male	495 (24.9)	1486 (74.6)	10 (0.5)	0 (0)	1991
	Female	665 (37.9)	1083 (61.8)	5 (0.3)	0 (0)	1753
8	Male	538 (27.6)	1382 (71.1)	25 (1.3)	0 (0)	1945
	Female	471 (27.9)	1209 (71.5)	10 (0.6)	0 (0)	1690
9	Male	342 (18.0)	1531 (80.8)	20 (1.1)	2 (0.1)	1895
	Female	504 (30.7)	1122 (68.3)	17 (1.0)	0 (0)	1643
10	Male	647 (35.6)	1153 (63.5)	18 (0.9)	0 (0)	1818
	Female	533 (33.9)	1033 (65.6)	8 (0.5)	0 (0)	1574
11	Male	430 (24.7)	1287 (73.8)	23 (1.3)	4 (0.2)	1744
	Female	520 (34.3)	985 (64.9)	12 (0.8)	0 (0)	1517
12	Male	481 (28.7)	1177 (70.2)	19 (1.1)	0 (0)	1677
	Female	426 (28.8)	1041 (70.2)	15 (1.0)	0 (0)	1482
13	Male	413 (25.9)	1165 (73.2)	14 (0.9)	0 (0)	1592
	Female	431 (30.7)	959 (68.4)	13 (0.9)	0 (0)	1403
Total	Male	4041 (26.8)	10,907 (72.3)	133 (0.8)	6 (0.1)	15087
	Female	4278 (32.5)	8809 (66.9)	82 (0.6)	0 (0)	13169

BMI: Body mass index

**Table 5: Morbidity pattern of children under study**

Sickness	Boys (n = 15,087)	Girls (n = 13,169)	Total (n = 28,256)
	Number (%)	Number (%)	Number (%)
Worm infestation	6132 (40.64)	5736 (43.56)	11,868 (42.00)
Upper respiratory infections	5545 (36.75)	4740 (35.99)	10,285 (36.39)
Anemia	3750 (24.86)	5009 (38.04)	8759 (30.99)
Dental caries	3672 (24.34)	3448 (26.18)	7120 (25.19)
Refractive errors	1673 (11.09)	1209 (9.18)	2882 (10.2)
Skin diseases	848 (5.62)	649 (4.93)	1497 (5.29)
Ear discharge	412 (2.73)	379 (2.88)	791 (2.80)
Respiratory diseases	126 (0.84)	100 (0.76)	226 (0.80)
Abdominal pain	73 (0.48)	96 (0.73)	169 (0.59)
Squint	54 (0.36)	31 (0.24)	85 (0.30)
Heart diseases	9 (0.06)	8 (0.06)	17 (0.06)
Conjunctivitis	5 (0.03)	9 (0.07)	14 (0.05)
Kidney diseases	10 (0.07)	4 (0.03)	14 (0.05)
CNS problems	6 (0.04)	4 (0.03)	10 (0.04)
Handicap	3 (0.02)	2 (0.02)	5 (0.02)
Orthopedic disorders	3 (0.02)	0 (0)	3 (0.01)
Cancer	2 (0.01)	0 (0)	2 (0.01)

CNS: Central nervous system

India implemented many schemes primarily targeting the nutritional and health status of children, sometimes in collaboration with international agencies like WHO and United Nations international children's emergency fund. One of the recent initiatives by the central government is National Rural Health Mission and was essentially designed to provide effective health care services to the entire population of the country. The school Health Program is a part of NRHM and is intended to cover 1,288,750 government and private aided schools covering around 220 million students all over India. The Gujarat State chapter of School Health Program is a single, largest time framed health program covering all 26 districts and 18568 villages (including 7 corporations) of the state.

As per the study design, we selected school going children of 31 different primary government schools of Ahmedabad city. The private school children were excluded from the study, because we wanted to enroll the cohort subject, which is nearly representative of largest possible pool of this age group across the entire nation, and then only we can either compare or extrapolate our result and observation. While there are some small scale studies published from our country,<sup>[11-14]</sup> the cohort size of the study population has been the major limitation, except for the study which enrolled children across the 16 states and constituted the base of ICMR standards. Our study, with >25,000 children represents one of large observational study aimed at identifying the present status of health and nutritional

status of school going children. Nearly half of the study patients were girls in the government sector schools, was reassuring observation that the girl child education is no more neglected, and gender bias is probably eliminated at least in the urban schools. While, such observation was either not apparent or was not concordant in previous studies, and could be just concluded as an early and aggressive gender balancing phenomena in the Gujarat region. The underlying reasons are multifactorial, including effective campaign by the government and nongovernment agencies to cultural issues. One of the latest study by Gupta *et al.*,<sup>[6]</sup> had significant male predominance in their study cohort while other studies<sup>[15,16]</sup> had a female predominance.

The most remarkable observation of this study was far inferior measurement of anthropometric measurement of height and weight of school children across the entire range of ages, when matched with the ICMR standards, which is largely representative of the average of Indian children. Similar observations were also found in the study by Hunshal *et al.*<sup>[17]</sup> in contrast to the more than ICMR values found in the study by Singh *et al.*<sup>[18]</sup> Additional striking analysis was that the 6<sup>th</sup> year age group measurements were worse among both the group of boys and girls. Our observation enlightens the fact that still the schemes or projects are not yielding the results either because of implementation limitation or underestimation of the basic issue of widely prevalent malnourishment in the underprivileged children. The most obvious reason for the striking evidence of pronounced differences in the nourishment status of 6<sup>th</sup> year students is the extended reflection of malnourishment and neglecting the issues pertaining health of <5 years of children. Therefore, we conceptualize that the paradigm shift in the nutritional and health status of children across the ages can better be achieved by concentrating and utilizing all possible resources for the under 5 children. In contrast to other studies, where the anthropometric measurements have either matching or sometimes higher standards than even ICMR, however, had a cohort, which was from the private school which is the least representative of the national average. The lowest difference in measurement was observed with increasing age in the school going students in both male and female group. Such trend was not surprising because these age group children tend to be more self-sustained and less dependent, are an easy target for the educational enforcement of better cultural and social habits including food and hygiene.

WHO<sup>[19]</sup> has recommended BMI for age as the best indicator for use in children and adolescents. It has been validated as an indicator of total body fat at the upper percentiles, and it provides continuity with recommended adult indicator. Under nutrition was little more pronounced in girls (32.5%)

compared with boys (26.8%). This probably reflects the prevailing social and familial pattern prioritizing the boys in the society, and needs only educational motivation to the society, the matter so many agencies including government are prioritizing to balance the gender difference in every aspect. Even though, obesity is now becoming a challenge in an affluent class worldwide, we had only 0.1% of boys with obesity, and none of the girls were found obese. This reflects that in developing the country like India malnutrition is still a major concern despite several measures initiated by the government to overcome it.

About 31% of total children were found to be anemic in contrast to the study done by Fernando *et al.*<sup>[20]</sup> reporting higher incidence of anemia among rural children. Parasitic infections such as hookworm and Plasmodium species may contribute to anemia in addition to dietary deficiencies. Our finding of diseases among school children are consistent with the previous study<sup>[21]</sup> reporting incidence of Upper respiratory tract infection, worm infestation and dental caries as the most commonly prevailing diseases. Eye, skin and ear diseases form the next more common diseases in these children. These health problems make learning difficult and may seriously hamper the education and child's intellectual growth. Moreover, this can also lead to low school enrolment, early drop out, high absenteeism and poor classroom performance.

### Limitation

As our study represents a relatively large cohort of children in the government school, the children of the affluent class has not been evaluated.

## CONCLUSION

This is one of the largest studies conducted for the school children in Indian so far. Nutrition and health standards of government school children are still far inferior to the ICMR standards and warrants large scale multicentric study to identify the limitations and lacunae of the programs implemented at present. Concerned and co-ordinated health education measures should be included through different programs to improve the personal hygiene, poor sanitary practices and to provide nutritional supplements to school children during periods of poor food intake which may benefit children and help to prevent acute under nutrition.

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