Research Article

# Vitamin A deficiency and anemia: alarming public health problems among the tribal *Rathwa* adolescents of Chhota Udaipur, Gujarat, western India: a cross-sectional study

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**Abstract**

**Background:** There are 573 scheduled tribes living in India and 15% of Gujarat's population is tribal. They are particularly vulnerable to undernutrition because of their geographical isolation, socioeconomic disadvantage and inadequate health facilities

**Objective:** To assess the nutritional status of the ***Rathwa*** tribal adolescents registered under the government-run schools of the newly formed district of Chhota Udaipur, Gujarat, western India.

**Materials and Methods:** It was a cross-sectional study where five tribal schools were selected purposively in Chhota Udaipur. All the students attending 6th and 7th standards ($n$ = 280) were enrolled for nutritional status assessment; however, due to lack of attendance, final data were presented for 150 subjects. Background information, dietary profile, anthropometric indices, and biochemical estimations on a subsample for hemoglobin, complete blood count and red cell morphology ($n$ = 60) were included for nutritional status assessment.

**Results:** Boys (44.9%) and girls (44.4%) were found to be equally suffering from severe thinness (44.7%). Overall prevalence of night blindness (26.7%), conjunctival xerosis (1.3%), Bitot's spot (21.3%), corneal xerosis (0.7%), and corneal scar (2.7%) highlights that Vitamin A deficiency is a public health problem in this area. Besides low hemoglobin, over 90% subjects had a diminutive MCH and MCV levels indicative of anemia other than iron deficiency such as microcytic anemia.

**Conclusion:** Considering the alarming public health prevalence of micronutrient malnutrition among the tribal adolescents, urgent measures to improve their living and dietary conditions are needed. Improving the quality of free meals along with nutrition education is immediately recommended.

**KEY WORDS:** Tribal adolescent school children, iron deficiency anemia, Vitamin A deficiency, nutritional status, mid-day meal program, *Rathwas*, Chhota Udaipur

## Introduction

The Indian Constitution assigns special status to the scheduled tribes (STs). Traditionally referred to as *adivasis, vanbasis, tribes, or tribals*, STs constitute about 8% of the Indian population. There are 573 scheduled tribes living in different parts of the country, having their own languages different from the one mostly spoken in the state where they live. There are more than 270 such languages in India.[1] Approximately 8 million persons comprising 15% of Gujarat's population is tribal. Tribal population is mainly concentrated in rural areas in dispersed, hard to reach settlements[2] and they are particularly vulnerable to undernutrition because of their geographical isolation, socioeconomic disadvantage and inadequate health facilities.[3]

With one-third children in the developing world being either underweight or stunted and more than 30% of the

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developing world's population micronutrient deficient, malnutrition remains the world's most serious health problem. Deficiencies of key vitamins and minerals continue to be pervasive and they overlap considerably with problem of general under nutrition.[4] In growing children, malnutrition affects intelligence and physical capacity. These in turn reduces productivity, slows economic growth, and aggravates poverty. The economic cost of malnutrition is very high.[5]

Higher prevalence of under nutrition in tribal population is due to poverty and consequent under nutrition; lack of awareness about access to and utilization of the available nutrition supplementation programs; social barriers preventing the utilization of available nutrition supplementation program and services; poor environmental sanitation and lack of safe drinking water, leading to increased morbidity from water-borne infections; environmental conditions that favor vector-borne diseases; lack of access to health-care facilities resulting in increased severity and/or duration of illnesses.[6]

Of the many major tribes of Gujarat, the *Rathwa Bhils* is a distinct tribe dwelling in the *Chhota Udaipur, Naswadi, Jetpur, and Sankheda* region of Gujarat. However, no data on the nutritional status of the adolescent school going children belonging to this tribe are available.

The ***broad objective*** of the present study was to evaluate the nutritional status of the *Rathwa* tribal adolescents registered under the government-run schools of Chhota Udaipur, Gujarat, western India. Socioeconomic conditions, clinical signs and symptoms of nutritional deficiencies, dietary patterns, anthropometric indices, and biochemical parameters (CBC and red cell morphology) were assessed to understand the nutritional status of the children.

## Methods and Materials

A cross-sectional study was conducted in two phases where five schools (*Khadakwada, Rangpur, Kacchel, Moti Sadhli, and Gunata)* out of the 216 in the Chhota Udaipur block of rural Vadodara, Gujarat, western India representing the Rathwa tribals were purposively selected. All the students attending 6th and 7th standards ($n$ = 280) were enrolled for nutritional status assessment; however, due to gross attendance shortage, the final enrollment figure was 150. Exclusion criteria included the students who could not be contacted in three consecutive visits. Data on anthropometric indices, clinical signs and symptoms of micronutrient deficiencies, food frequency patterns, and biochemical estimations for hemoglobin were carried out to assess the nutritional status of the school going adolescents. The indicator used for assessing long-term energy deficit was height for age.[7,8] All the children were individually examined for the presence of clinical signs and symptoms of various micronutrient deficiencies. For iron deficiency, clinical signs assessed were swollen and red tongue, brittle nails, pale skin color, angular stomatitis, fatigue, and pallor signs. For Vitamin A deficiency, conjunctival xerosis, Bitot's spot, corneal ulceration, xeropthalmic fundus, night blindness, corneal xerosis, corneal scar, and eye infection were assessed. For Vitamin C deficiency, bleeding and swollen gums were recorded. Clinical signs for B-complex deficiency included cheilosis, glositis, angular stomatitis, dermatitis, and edema. For iodine deficiency, the goiter stage, if evident, was noted down. A pretested food frequency questionnaire comprising a list of food items rich in iron, vitamin A, and vitamin C selected from the nutritive value of Indian foods was used. To measure iron deficiency anemia, hemoglobin levels were estimated for the children by the gold standard Cyanmethaemoglobin method. Out of the 150 children, only 60 children submitted the signed consent form and gave blood sample for the study of complete blood count and red cell morphology. Following parameters were assessed: WBC: white blood cell count; RBC: red blood cell count; HGB: hemoglobin concentration; HCT: hematocrit (%); MCV: mean corpuscular volume (fL); MCH: mean corpuscular hemoglobin (pg); MCHC: mean corpuscular hemoglobin concentration (g/dL); PLT: platelet count.

The study was approved (FCSc/FND/ME/29) by the Medical Ethics Committee of the Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda. Necessary permissions were obtained from the District Education Board. Written permissions were obtained from the school authorities and consent forms were signed from the students enrolled for the study.

## Statistics

*Z*-scores were calculated for the anthropometric measures using the WHO AnthroPlus software. Statistical analyses were conducted using SPSS version. Mean and standard deviation was used to describe the group. Correlation was used to quantify the association between two variables and Chi-square test was used to calculate the approximate $p$ values and the level of significance ($p < 0.05$ – significant; $p < 0.01$ – highly significant; $p < 0.001$ – very highly significant).

## Results

*Background information*: The results revealed that agriculture is the major occupation of the people of Chhota Udaipur, and the *Rathwas* depend on the forest for agricultural land, wild animals for prey, and wood for fuel and house building. A majority of students' mothers (50.7%) and fathers (72.7%) earned their living through agricultural activities.

*Anthropometric indices*: Based on the BMI for age, only 30% of the students were categorized as normal (boys 32.1% vs. girls 27.8%); whereas 25.3% of the students suffered from thinness (girls 27.8% vs. boys 23.1%) and 44.7% suffered from severe thinness (boys 44.9% vs. girls 44.4%) [Figure 1]. These differences, however, were non-significant. Similarly, based on the height for age parameters, chronic malnutrition was recorded. Only 48% had a normal height for age, 25.3%

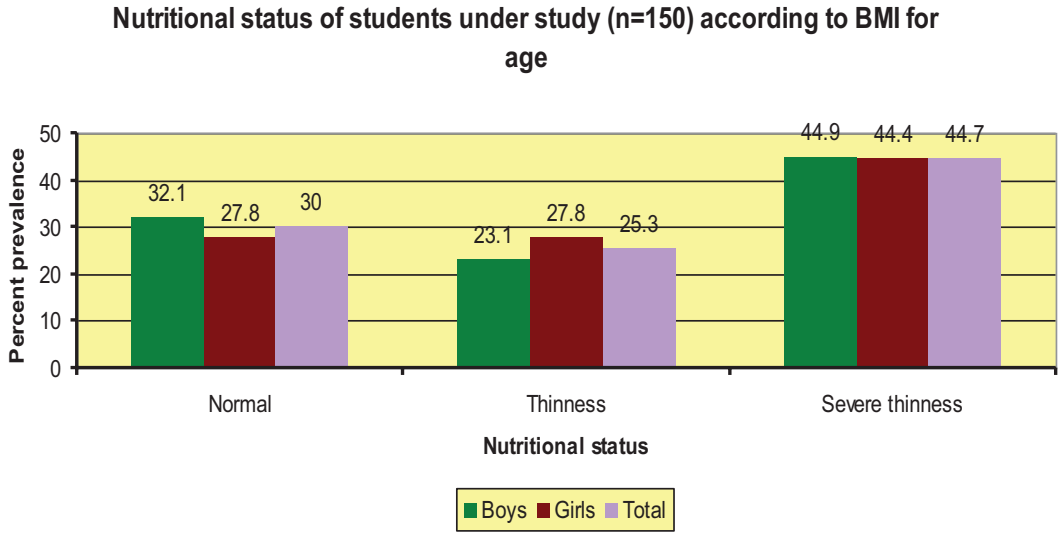


**Figure 1:** Nutritional status of students according to BMI for age.

were stunted (girls 26.4% vs. boys 24.4%), and 26.7% were severely stunted (girls 29.2% vs. boys 24.4%), wherein the differences between the gender were non–significant, indicating that malnutrition was equally prevalent among *Rathwa* boys and girls [Figure 2].

*Clinical signs and symptoms*: Symptoms of anemia such as pale nails (43.3% -boys, 46.8% vs. girls 39.7%), pale conjunctiva (18.7%); pale palm and pale tongue, which was found to be more in girls (32.9% and 8.2%) than the boys (28.6% and 5.2%) were recorded [Figure 3]. About 14% reported breathlessness, which was accompanied by fatigue; prevalence of spoon-shaped nails (koilynchia) was observed in one subject. In-depth inquiry revealed that 26.7% adolescents reported to suffer from night blindness, which was more in girls (31.5%) compared to boys (22.1%).

The prevalence of Bitot's spot, corneal xerosis, and corneal scar was found to be higher among boys (26%, 1.3%, and 3.9%) than girls (16.4%, 0%, and 1.4%) among school children indicating vitamin A deficiency to be a public health problem [Figure 4]. Clinical signs of vitamin B-complex such as angular stomatitis (girls 6.8% vs. boys 1.3%); glossitis (boys 11.7% vs. girls 4.1%); dermatitis (9.6% vs. 5.2%) were also reported. Diarrhea was found to be higher among girls (12.3%) than boys (11.7%). About 10.7% of the students had swollen and bleeding gums indicative of vitamin C deficiency (scurvy), which was reported equally by boys and girls.

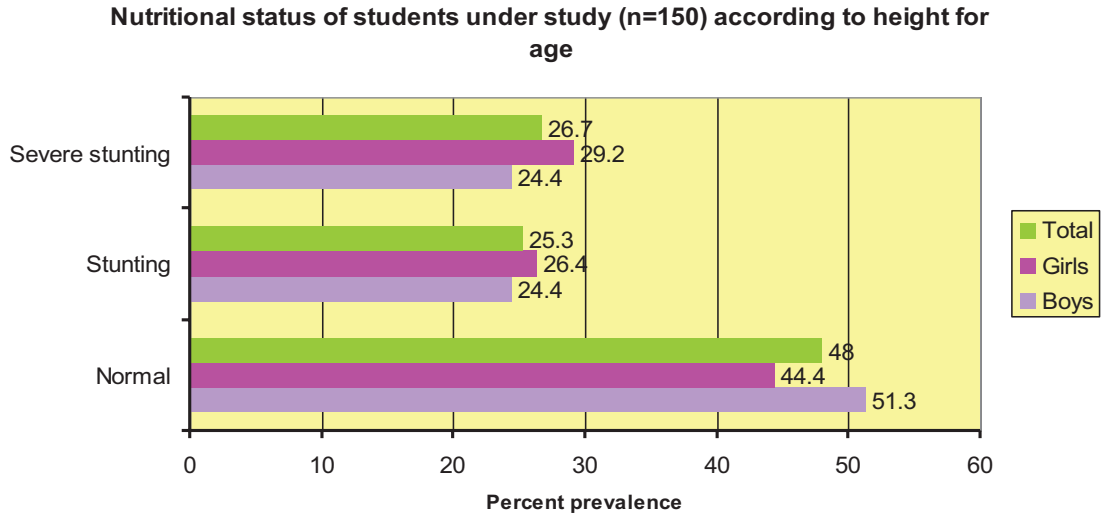


**Figure 2:** Nutritional status of students according to height for age.

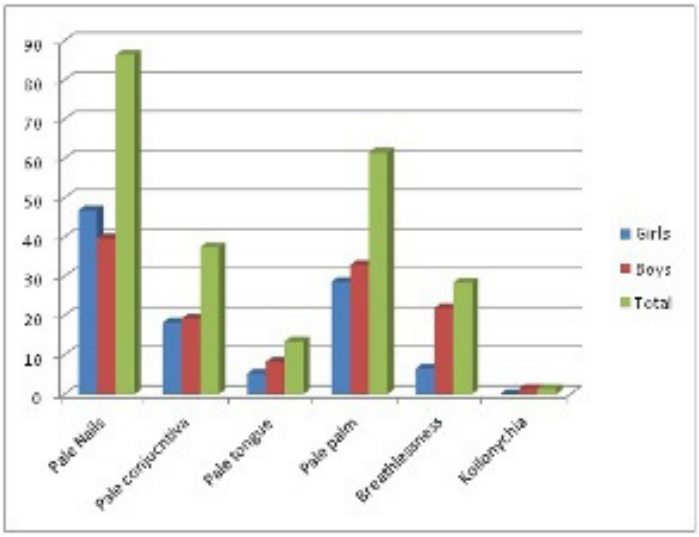


**Figure 3:** Prevalence of ocular signs of IDA among the subjects.

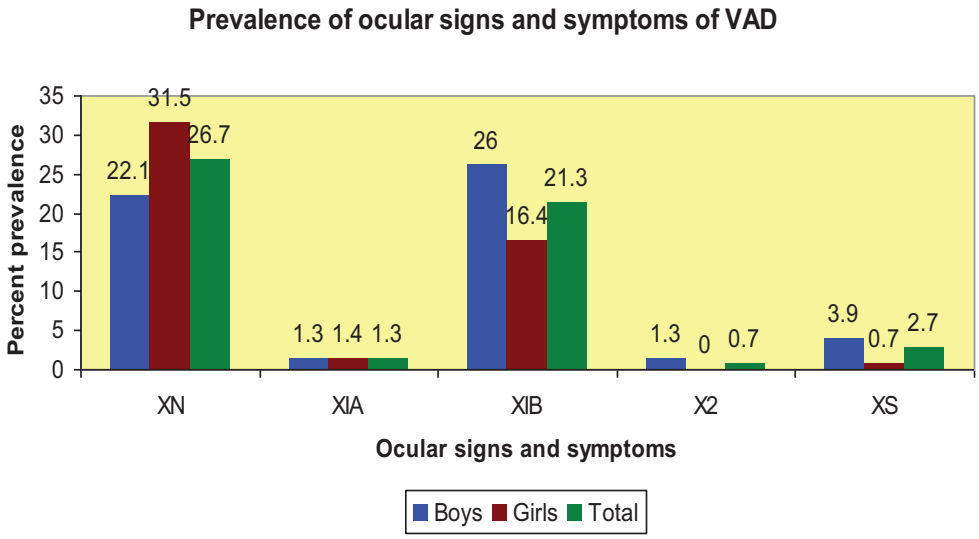


**Figure 4:** Prevalence of ocular signs and symptoms of VAD.

*Dietary patterns*: About 79.3% students were vegetarians followed by 16% of the students consuming non-vegetarian items. Almost all the students (99.3%) reported consumption of corn or corn-based food every day. Rice flakes were consumed usually in breakfast or evening snack with maximum consumption on a weekly basis by 52% of the students. However, pulses and lentils, which are the protein sources for vegetarians, were not consumed daily by any subject and consumed just once a week by 38% and 58% reported that they had never eaten any form of lentil. There were very few students who consumed fruits rich in essential micronutrients on a daily basis. Mango was the only fruit that recorded the highest consumption on a daily basis by 48.6% of the students during season of availability. However, other vitamin A- and C-rich fruits were consumed only by 4.7–9.3% children. Wednesday is the only day in the week where a local market *(haat)* is set up and the children can consume fruits. The consumption of green leafy vegetables was almost

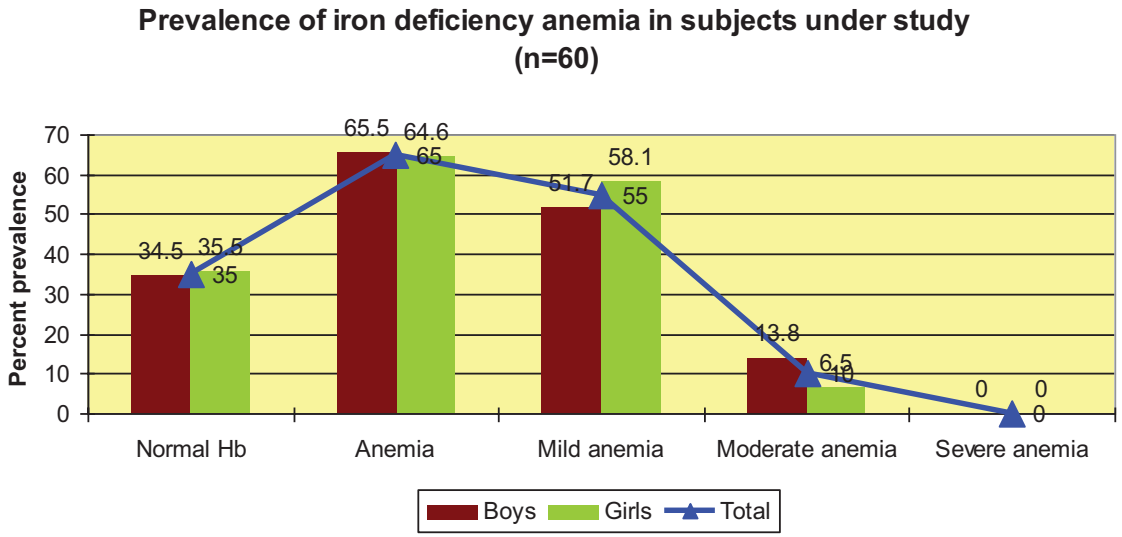


**Figure 5:** Prevalence of iron deficiency anemia among the subjects.

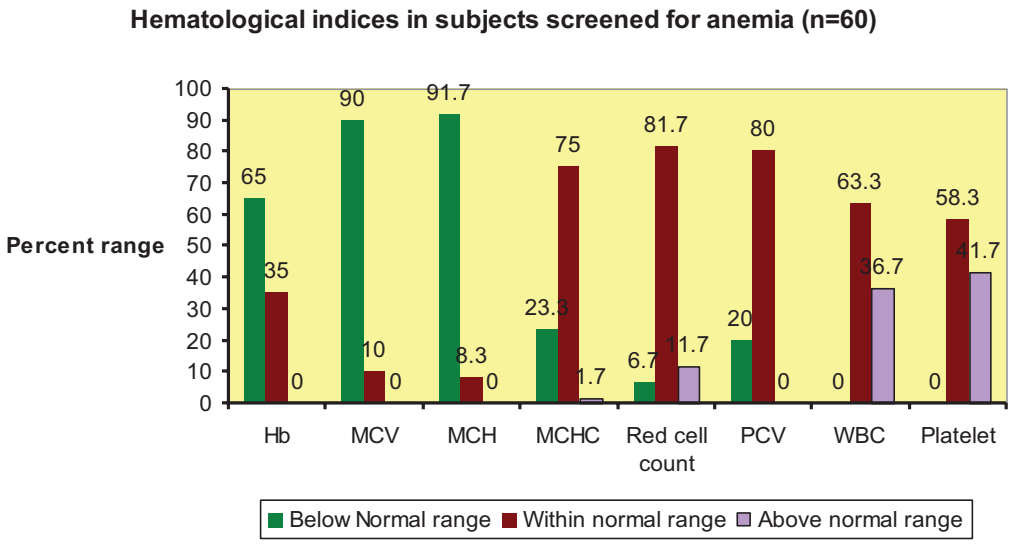


**Figure 6:** Hematological indices in subjects screened for anemia.

negligible. This data supports the fact that several children were suffering from micronutrient malnutrition as validated by the data on the presence of clinical signs and symptoms of IDA, VAD, and vitamins C and B-complex deficiencies. Roots and tubers especially onions were consumed on a daily basis as they are available at a reasonable price and due to seasonal availability.

*Biochemical parameters*: Hemoglobin estimation revealed a majority of the subjects (65%) were anemic (65.5% boys, 64.5% girls). Out of these, 55% were mildly anemic, 10% moderately anemic, and none had severe anemia [Figure 5]. The difference was found to be non-significant between both the groups. The mean RBC count of the subjects was within the normal range (5.28) with normal mean RBC count for boys (5.42) and girls (5.16). The mean MCV of the subjects (68.61 fl) was well below the normal range (79–101 fl), with much lower MCV value for boys (67.11 fl) than girls (70 fl). The mean MCH value (21.7 pg) was well below the

reference value (26–36 pg). The mean hemoglobin was 11.39 g/dl indicative of iron deficiency in both the genders (boys 11.42 g/dl and girls 11.35 g/dl). The mean WBC count of the subjects was 11030/cumm, slightly above the normal reference values (4000–11000/cumm). The mean platelet count of the subjects was within the reference value (370133/cumm), but the mean value for girls (403741) was above the reference value (1.5–4.0 lacs/cumm) [Figure 6].

*Relationship between various parameters*: Table 5 reveals that lesser mothers' were illiterate (82%) of the subjects diagnosed with anemia were than non anemic subjects (85.7%). The result was found to be not significant. Maximum prevalence of severe thinness (61.5%) was found in children who had hemoglobin below 12g/dl. A significant difference was found between severity of thinness and hemoglobin status of the subject. Severe stunting was more prevalent

**Table 1:** Prevalence of signs and symptoms of vitamin B-complex deficiency in subjects under study (*n* = 150)

| Deficiency symptoms | Total % (*n* = 150) | Boys % (*n* = 77) | Girls % (*n* = 73) | Chi square |
|---|---|---|---|---|
| **Vitamin B-complex deficiency** | | | | |
| Angular stomatitis | 4 (6) | 1.3 (1) | 6.8 (5) | 3.1 $^{NS}$ |
| Glossitis | 8 (12) | 11.7 (9) | 4.1 (3) | 2.7 $^{NS}$ |
| Dermatitis | 7.3 (11) | 5.2 (4) | 9.6 (7) | 1.1 $^{NS}$ |
| Diarrhoea | 12 (18) | 11.7 (9) | 12.3 (9) | 0.3 $^{NS}$ |

NS = Not significant.
Note: Figures in parenthesis indicate number of subjects.

**Table 2:** Frequency of consumption of essential foods rich in various micro nutrients by the subjects under study (*n* = 150)

| Food groups | Daily % | Once a week % | Monthly/occasionally % | Never % |
|---|---|---|---|---|
| **Cereals** | | | | |
| Corn | 99.3 (149) | 0.7 (1) | 0 (0) | 0 (0) |
| Bajri | 6.7 (10) | 32 (48) | 0.7 (1) | 60.7 (91) |
| Rice flakes | 2 (3) | 52 (78) | 4.7 (7) | 41.3 (62) |
| **Pulses and legumes** | | | | |
| Lentil | 0 (0) | 38 (57) | 4 (6) | 58 (87) |
| Fruits | | | | |
| Lemon | 4.7 (7) | 64 (96) | 4 (6) | 27.3 (41) |
| Guava | 9.4 (14) | 73.4 (110) | 2.1 (3) | 15.3 (23) |
| Orange | 4.7 (7) | 29.4 (44) | 0.7 (1) | 65.3 (98) |
| Amla | 14.7 (22) | 36 (54) | 3.4 (5) | 46 (69) |
| Mango | 48.6 (73) | 46 (69) | 1.4 (2) | 4 (6) |
| Papaya | 5.3 (8) | 70 (105) | 6.7 (10) | 18 (27) |
| **Green leafy vegetables** | | | | |
| Spinach | 4 (6) | 55.3 (83) | 0.7 (1) | 40 (60) |
| Shepu | 0.7 (1) | 29.3 (44) | 0.7 (1) | 69.3 (104) |
| Fenugreek | 4 (6) | 82 (123) | 1.3 (2) | 12.7 (19) |
| Colocasia | 0.7 (1) | 11.3 (17) | 0 (0) | 88 (132) |
| Mint | 0 (0) | 14.7 (22) | 0.7 (1) | 84.7 (127) |
| Drumstick leaves | 4 (6) | 58.6 (88) | 2 (3) | 35.4 (53) |
| **Roots and tubers and other vegetables** | | | | |
| Tomato ripe | 37.4 (56) | 55.3 (83) | 3.4 (5) | 4 (6) |
| Onion | 100 (150) | 0 (0) | 0 (0) | (0) |
| Carrot | 6 (9) | 58.7 (88) | 2.7 (4) | 32.7 (49) |
| Pumpkin | 2.7 (4) | 56 (84) | 8.6 (13) | 32.7 (49) |
| **Meat and poultry** | | | | |
| Meat | 0 (0) | 5.4 (8) | 3.3 (5) | 91.3 (137) |
| Fish | 2 (3) | 1.3 (2) | 0 (0) | 96.7 (145) |
| Chicken | 0 (0) | 13.3 (20) | 2.7 (4) | 84 (126) |
| Egg | 0 (0) | 2. (3) | 2.7 (4) | 95.3 (143) |

Note: Figures in parenthesis indicate number of subjects.

**Table 3:** Mean (Mean ± SD) haematological values of the subjects under study (*n* = 60)

| | Total (*n* = 60) | Girls (*n* = 31) | Boys (*n* = 29) |
|---|---|---|---|
| **Hb** (12g/dl) | 11.4 ± 1.3 | 11.4 ± 1.2 | 11.4 ± 1.5 |
| **RBC count** (M: 4.6-6.5 f 3.9-5.6) | 5.3 ± 0.6 | 5.2 ± 0.5 | 5.4 ± 0.7 |
| **PCV** (34–54%) | 36 ± 4.0 | 35.9 ± 3 | 36.3 ± 4.9 |
| **MCV** (79–101 fl) | 68.6 ± 6.7 | 70 ± 7.2 | 67.1 ± 5.8 |
| **MCH** (26–36 pg) | 21.7 ± 2.5 | 22.2 ± 2.8 | 21.1 ± 2 |
| **MCHC** (31–37 g/dl) | 31.6 ± 1.3 | 31.6 ± 1.3 | 31.6 ± 1.4 |
| **Total WBC** (4000–11000/cumm) | 11030 ± 3019 | 11235 ± 3033.3 | 10810 ± 3043.4 |
| **Platelet count** (1.5–4.0 lacs/cumm) | 370133 ± 81561 | 403741 ± 69645.3 | 334206 ± 78949.9 |

**Table 4:** Red cell morphology of subjects screened for anemia (*n* = 60)

| Red cell morphology | Types | Subjects % |
|---|---|---|
| **Normal** | Normocytic normochoromic | 53.3 (32) |
| **Abnormal** | Microcytic hypochromic | 43.3 (26) |
| | Microcytic hypochromic severe | 1.7 (1) |
| | Microcytic normochromic | 1.7 (1) |

Note: Figures in parenthesis indicate number of subjects.

in anemic subjects (25.6%), whereas more students with normal height for age were found in the non-anemic category. However, the difference was not significant. The prevalence of ocular signs and symptoms of IDA was higher in subjects diagnosed with anemia, but it was not significant. The prevalence of ocular signs and symptoms of VAD (night blindness and Bitot's spot) was higher in non-anemic subjects than their anemic counterparts. However, the result was not significant.

More anemic subjects were nonvegetarians (15.4%) and non-anemic subjects were vegetarians (85.7%). This may be likely due to insufficient and infrequent consumption of heme-rich nonvegetarian items by the subjects.

## Discussion

School children of the tribal area of western India were surveyed and assessed in this study. It was observed while surveying about sociodemographic profile of the students that majority of the students' family were indulged in agricultural activities and earned their living from it. So intervention in agricultural sector can bring significant changes in the livelihood of the children as well as their family in the tribal area of western India. No poor country has ever successfully reduced poverty through agriculture alone, but almost none have achieved it without first increasing agricultural productivity.[9]

In this study, only 30% of the students were categorized as normal based on the BMI for age and 48% had a normal height for age. The India State Hunger Index (ISHI) has categorized 12 of the 17 states in the "alarming" rates of hunger category, and unfortunately, Gujarat state is one of them. The report further stated that ISHI scores were closely aligned with poverty, but there was little association with state-level economic growth. High levels of hunger were seen in states that were performing well from an economic perspective.[10] A study from Karnataka on tribal children also reported high prevalence of mild (41.5%) and severe (6.7%) stunting.[11]

In-depth study of the clinical signs and symptoms reveals the presence of VAD as well as anemia, which may be of iron deficiency or vitamin B-complex deficiency in nature. The prevalence of Bitot's spot was much higher in comparison to the figures reported by NNMB,[12] where 0.1% children in Gujarat had Bitot's spot. A study[13] had reported the prevalence of ocular signs of IDA in tribal areas of Rajasthan where 95.1% of the children had clinical anemia, pale conjuctiva (77.6%), flat and pale nails (24.3%), atrophic lingual papillae (12.4%), and koilynchia (44.3%).

Though 99.3% students reported consumption of corn or corn-based food everyday, which is the staple crop of Chhota Udaipur and this area can boast of at least 20 varieties of corn. However, the amount of vitamin A/beta carotene content in this corn and its bioavailability need to be assessed since the prevalence of the clinical signs and symptoms of VAD are exceeding the tolerable limits concluding it to be a public health problem.

High prevalence of IDA reported in the study could be due to poor dietary intake of iron, poor bioavailability of iron coupled with high intake of inhibitors and poor intake of enhancers, infections and parasitic infestation and also the high requirements of iron during adolescence.[15]

High prevalence of anemia was also reported from Rajasthan,[14] where (60.2 %) of the children were moderately anemic (7–10 g/dl/), 32.9% were severely anemic (<7 g/dl) and 0.6% mildly anemic (10–11.5 g/dl). In another tribal area of Orissa, almost all children of age group 5–14 years were anemic, among them 59.4% were moderately anemic and 5.4% were severely anemic.[15] Thus, the problem of hidden hunger

**Table 5:** Correlation between essential parameters in subjects screened for biochemical estimations (*n* = 60)

| Variables | Total % (*n* = 60) | Anemic subjects % (*n* = 39) | Non anemic subjects % (*n* = 21) | Chi-square |
|---|---|---|---|---|
| **Mothers educational status** | | | | |
| Illiterate | 83.9 (50) | 82.1 (32) | 85.7 (18) | 4.23$^{NS}$ |
| < 7th Standard | 6.1 (3) | 2.6 (1) | 9.5 (2) | |
| 7–9th Standard | 0 (0) | 0 (0) | 0 (0) | |
| 10–12th Standard | 3.7 (2) | 2.6 (1) | 4.8 (1) | |
| Dead | 0 (0) | 0 (0) | 0 (0) | |
| Don't know | 6.4 (5) | 12.8 (5) | 0 (0) | |
| **BMI for age** | | | | |
| Severe thinness | 42.7 (29) | 61.5 (24) | 23.8 (5) | 8.09* |
| Thinness | 30.4 (16) | 17.9 (7) | 42.9 (9) | |
| Normal | 26.9 (15) | 20.5 (8) | 33.3 (7) | |
| **Height for age** | | | | |
| Severe stunting | 22.3 (14) | 25.6 (10) | 19 (4) | 0.33$^{NS}$ |
| Stunting | 37 (22) | 35.9 (14) | 38.1 (8) | |
| Normal | 40.7 (24) | 38.5 (15) | 42.9 (9) | |
| **Signs and symptoms of IDA** | | | | |
| Pale nails | 49.5 (30) | 51.3 (20) | 47.6 (10) | .073$^{NS}$ |
| Pale conjunctiva | 19.9 (13) | 25.6 (10) | 14.3 (3) | 1.03$^{NS}$ |
| Pale tongue | 11.2 (7) | 12.8 (5) | 9.5 (2) | 0.14$^{NS}$ |
| Pale palm | 34.8 (22) | 41 (16) | 28.6 (6) | 0.91$^{NS}$ |
| Breathlessness | 19.8 (12) | 20.5 (8) | 19 (4) | 0.01$^{NS}$ |
| Koilynchia | 1.3 (1) | 2.6 (1) | 0 (0) | 0.54$^{NS}$ |
| **Signs and symptoms of VAD** | | | | |
| Night blindness | 39.4 (23) | 35.9 (14) | 42.9 (9) | 0.28$^{NS}$ |
| Bitot's spot | 22.2 (13) | 20.5 (8) | 23.8 (5) | 0.08$^{NS}$ |
| Conjunctival xerosis | 1.3 (1) | 2.6 (1) | 0 (0) | 0.54$^{NS}$ |
| Corneal xerosis | 1.3 (1) | 2.6 (1) | 0 (0) | 0.54$^{NS}$ |
| **Type of diet** | | | | |
| Vegetarian | 82.6 (49) | 79.5 (31) | 85.7 (18) | 0.42$^{NS}$ |
| Non-vegetarian | 12.5 (8) | 15.4 (6) | 9.5 (2) | |
| Ovo-vegetarian | 4.9 (3) | 5.1 (2) | 4.8 (1) | |

*$p < 0.05$ = significant, NS = not significant.
Note: Figures in parenthesis indicate number of subjects.

must be rampant in tribal areas. But lower prevalence of anemia was reported from tribal regions of Maharashtra, where 32.47% children aged 5–15 years were categorized as anemic.[16]

The study suggests that measures to combat macro- as well as micronutrient malnutrition (vitamin A deficiency, anemia as well as vitamin B-complex deficiency) need to be initiated immediately as acute malnutrition may hamper both growth as well as development in these tribal adolescents. The mid-day meal program supported by the Government of India needs to be strengthened using non-pharmacological measures such as behavior change communication, positive deviance and understanding the knowledge attitude, and practices of the grass root level workers associated with it.[17–21] Because in previous studies observations made on students revealed that neither they wash hands before having MDM nor did they remove shoes while consuming MDM. Also they don't like to consume vegetables and remove it from food and they threw the leftover inside the school premises itself.[17] So only making the facilities or implementing the schemes is not important, along with that awareness about those facilities as well as education about proper hygiene and sanitation has to be made. Then only proper utilization of food will be possible and all the macro- and micronutrients will be absorbed in the body to combat with all the alarming public health problems that are existent in the community.

## Conclusion

This study highlights the poor state of health and nutrition among tribal children and highlights that due to poor, monotonous dietary habits, these children, whose families are mainly involved in bonded or daily wage labor, and still suffering from public health problems such as anemia or vitamin A deficiency. Health-care measures and school health programs need to actively reach these children, and school-based interventions

for prevention of malnutrition are required effectively. Though several government schemes and programs exist for the tribal population, they need to be monitored and executed well so as to have a significant impact on the health and nutrition of the population.

## Acknowledgments

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