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A study on prevalence of anemia in school going Yanadi tribal children of Nellore District, Andhra Pradesh, India

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ABSTRACT

Owing to the living condition, tribal community is at higher risk for diet-associated health disorders. The indigenous tribal populations like "The Yanadi", residing in state of Andhra Pradesh in India. Being in the lower economic strata, they are deprived of proper food and access to basic health facilities is also constrained. Yanadi tribal children exhibit characteristic features of IDA, stunted growth, wasting and lower cognitive skills, which significantly affects their education. The study investigated the prevalence of anemia in 384 male Yanadi tribal schoolchildren aged 6-14 years and multiple approaches were adopted for survey-based data on social, economic and environment variables of the study-cohort was gathered along with anthropometric information. It was observed that huge majority of the tribal parents lacked primary school education and economic condition of such families is under dilapidating state, leading to consumption of improper food. Strikingly, 56% of the children exhibited the commonest symptom of anemia, pale conjunctiva. Overall analysis of the study participating children, following the WHO grading, close to 28% were found to be anemic and hemoglobin content (g/L) was observed to be close in both age groups, 11 to 14 years (11.889±1.123) and 7 to 10 years (11.734±1.309). Largely, the Yanadi tribal children projected cognitive impairment in the form of poor memory function (33%), down regulated cognitive functions (46%), and impaired attention functions (74.5%). It is somewhat relieving to see that anemia amongst Yanadi male children is not as severe as observed in children of other populations, as reported. However, the study projects out impaired cognitive and behavior skills amongst the participants, emphasizing the need of extending the study in a larger cohort.

Keywords: anemia, tribal, Yanadi, children

INTRODUCTION

Anemia affects both developing and developed countries and it is a global health concern which causes serious impact on human health. Across the globe the complications of anemia vary greatly. The prevalence of anemia is highest in developing countries and common in industrialized countries [1]. Several previous studies have summarized the prevalence of anemia and its global consequences. The WHO estimated that about 30% of the world population was anemic in 1985, 37% of women were anemic in 1992 [2]. Anemia affected 25% of the global population that includes 42% of pregnant women, 30% of nonpregnant women and 47% of preschool children (as per WHO 2008). The recent, global anemia prevalence was estimated to be 29% among pregnant women, 38% in non-pregnant women, and 43% in children, with each group decreasing since 1995 [3]. Anemia was projected to account for 2% of all YLD (years of healthy life lost owing to disability) and 1% of 'disability-adjusted life-years' in the 'Global Burden of Disease' (GBD) 2000 study; similar figures were found in the GBD 2004 update (WHO 2015). According to WHO regional estimates for preschool-aged children, pregnant and non-pregnant

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women a total of 315 million people in these three populations were anemic. Similarly, the underdeveloped African nations have 48-68% of their population with anemia [4]. In India, the prevalence of anemia is estimated to be higher when compared to all other developing countries [5].

The symptoms associated with anemia are fatigue, dizziness, tiredness, lethargy, drowsiness, becoming breathless easily, headaches, irregular heartbeats (palpitations), tinnitus (ringing in the ears) and alteration in the taste. Both the mother and the neonate are affected during pregnancy, in anemia case with difficulties of low birth weight, preterm delivery and post-natal depression. Anemia is categorized in to Aplastic anemia, Iron-Deficiency Anemia (IDA), Pernicious anemia and Hemolytic anemia. Inadequate iron intake, respiratory infections, helminthic infestations, malaria, diarrhea, vitamin A and C deficiencies are among its multifactorial causes. Iron deficiency can also be caused by blood loss and sloughing of cells (menstrual flow) and transmission to the growing fetus [6].

Anemia is more prevalent in tribal community, preschool children, poverty conditions etc. However, tribal communities live in remote places that are inaccessible for the healthcare workers to identify a medical condition by routine health screening. Hence the exact prevalence percentage of any medical condition including IDA is not clearly known in this group. Their IQ, cognitive skills, mental and physical development is also relatively poor than their non-tribal counterpart. Hence estimating the root cause of IDA prevalence could be helpful to design appropriate strategies to address these issues [7].

Approximately two-thirds of preschool children were ingesting less than 50% of the daily iron intake, which is one of the primary causes of anemia in tribal children. The prevalence of anemia in indigenous children is likewise significantly higher than in the general population. According to the NFHS, approximately 77% of indigenous youngsters were anemic. In poverty-stricken tribal population world-wide and in India the IDA is majorly due to malnourishment and it is reasonably easy to treat it with dietary changes and health supplements. However, tribal communities live in remote places that are inaccessible for the healthcare workers to identify a medical condition by routine health screening.

The primary regulator of iron-homeostasis is a liver hormone-Hepcidin (peptide); mechanistically, it controls iron metabolism by binding with its receptor, "ferroportin (transmembrane iron-export protein), which is highly expressed on the reticuloendothelial macrophage membrane and on duodenal enterocytes.

MATERIALS AND METHODS

Diet Survey and Nutritional Assessment

The daily food consumption details were noted from the hostel. Simultaneously, one more food and Nutrition survey was performed on the families of the study participant. The survey team visited the Yanadi children residential area and collected the following data such as daily food consumption style, amount, number of meals served per day, information about the veggies or fruits or meat consumed. Also, the frequency at which the participants are consuming the diet. The survey team also noted the information about Yandi's traditional food habit and amount of money spent for daily diet.

Diagnosis of Nutrient intake

The tribal children nutrient intake data was entered into the validated software 'DietCal' version 3.0 (Profound Tech Solution; http://dietcal.in/), which is based on values from the Nutritive Value of Indian Foods [8]. The data was then compared to the 'Recommended Dietary Allowances' for Indian children. The calculation of nutrient intake has been done by the method of NAR (Nutrient Adequacy Ratio) [9].

Data Collections

School health check-up campaigns were organized post consultation and approval from the school head and data collected. The study participants were thoroughly interviewed and clinically examined by a senior pediatrician for demographic details, including age, and a detailed history of dietary habits, history of any medications, allergies, and associated with any signs of weakness, breathlessness, and anxiety were noted. The study participant age proof was confirmed from the students' school records. Signs of malnutrition and anemia were also observed in clinical examination. Students' performance and progress data were collected from the school teacher or parents. All these were documented into a pre-designed questionnaire sheet. All children were examined for signs of anemia; palpebral conjunctiva, lips, tongue, skin and nail beds for pallor, comorbid conditions, personal hygiene, physical status, nutrition, and physical activity. Anthropometric data (height and weight) of each child was obtained by Auxiliary Nurse Midwife (ANM) and social workers.

Cognitive Performance Data Collection

Cognitive development and scholastic performance data were collected by conducting the tests to each participant. Each of the below mentioned tests were selected depending on the paraphernalia that are supposed to incur due to the nutritional impact and will be a relatively "pure" measure of the specific cognitive ability of the Yanadi tribal children.

Social Communication

Communication capability of children was tested based on the communication in different situation and evaluated by different task performed in the school. Academic assessments include Thought process, Reading /Writing Skills, and Numeracy Skill.

Attention performance

The ability to inhibit interruption and remain focused with full attention is crucial factors for learning. Hence the attention performances of Yanadi children were assessed with the help of class teachers. This performance test reveals status of various forms of attention in Yanadi children which include – vigilance (sustained focus), ability to inhibit distraction and divided attention. To differentiate distractors from non-distractors the sensory modalities (visual, auditory and motor) were also assessed.

Socio-demographic Data

Socio-Demographic characteristics were noted from hindsight through a baseline household questionnaire during the study period. Before conducting the survey about the socio-demographic status of parent and children, the questionnaire was tested and conducted a model survey to obtaining the best from the participants. The questionnaires were set from various data which was available previously and followed the survey model practiced by the developed organizations. Also, the questionnaires were set as per the current scenario and were special consideration about the Yanadi's life style. All survey questionnaire and study model and field survey were performed based on the long-lasting experience of project coordinators in the study area.

Anthropometry Data Collection

Anthropometry Data of Yanadi Tribal children was collected by six membered survey team, which includes; 3 interviewers, 1 Ophthalmic surgeon 2 data collectors (measurers) and 1 supervisor. All the study team members are well-versed with the study protocol. During the school visit, the team members measured the children height and weight accurately. A measurer and an assistant, worked as a pair to perform two independent height measurements. The reference values were set by the gold standard trainer and measured each parameter twice for getting accurate information. If the data collected by the measurer matched with the trainer data, then it is considered as accurate. Post demonstrating accuracy in data collection, the measures were allowed to collect the data in larger population. All data that met the accuracy and precision requirements were considered.

RESULTS

There are 13 districts in the state of Andhra Pradesh and tribal communities inhabit all the districts. However, in the regions, Chittoor, Nellore and Rayalaseema, the tribal population is higher than the entire state. Among different groups of tribal communities within state, Yanadi is the most vulnerable community in terms of backwardness in several development indices. Tribal children are more susceptible group due to lack of social development, high illiteracy, inadequate food, health security, and high prevalence of malnutrition due to poverty. It is thus crucial from the public health view-point to collect data on health and malnutrition including the anemia prevalence and the risk factor associated in the vulnerable communities. So, the present study was initiated on children belonging to Yanadi tribal community and the occurrence of anemia to assert better management strategies in perspective of the impoverished of a certain portion of society and its detrimental consequences for their physical health.

DISCUSSION

The current study period was of a year, being initiated from July 2019 to June 2020. It was carried out by the "Department of Pediatrics, Narayana Medical College and Hospital", which has a MOU with Lincoln University, Malaysia. Total of 384 Yanadi male tribal children living in tribal hostels were involved in the study, which was initiated after proper approvals from the administrations of the State Health Department and participating schools and hostels. The protocol followed during the study was duly approved by Institutional Ethical Committee (IEC) of Narayana Medical College and Hospital and was completed by adhering to the guidelines laid out by the committee.

The Yanadi male tribal children studying in the schools of designated region and had been receiving mid-day meal were enrolled for the study. The meal served at the school was in accordance with the government's dietary recommendation for a balanced essential diet for the proper development and growth of children.

Aside from gender and age, this study investigated other probable risk factors linked with IDA among student participants, such as low-income households, occasional or no breakfast consumption, red meat, fish, poultry, vegetables, and fruits, and ignorance of anemia and its causes. Inadequate intake of dietary iron, low bio-availability, concurrent inadequate intake of other dietary micronutrients, lack of knowledge of iron deficiency, and poor nutritional status are all possible reasons of the high prevalence rate of IDA in the studied population.

TABLE 1. Quantitative analysis of Nutrient intake in study population

Nutrient	School-age (7 to 10 Years) (n=102)	Early Adolescence (11 to 14 Years) (n=282)
Total Energy (Kcal/d)	1020±150.9	1287±238.9
Carbohydrate (Kcal/d)	178±16.2	180±12.8
Protein (g)	27.2±11.7	34.3±13.6
Fat (g/1000 cal)	20.5±5.2	24.6±3.1
Micronutrient (mg)	3.2±1.7	4.5±1.5
Dairy products	13.5±5.8	16.8±3.6
Iron intake	8.2±2.8	7.8.±1.5
Other Nutrients	1.2±0.5	1.5±0.9

Adverse effects of anemia on brain development

The importance of nutrition on children's brain development and cognitive performance was purely dependent on the precise timing of all balanced nutrition intake. In this scenario, infancy and childhood timing are crucial for the development of the brain and cognitive performance. There is evolving interest in the effect of nutrition in cognitive enactment and cognitive development of children. Though there seems to be much importance on identifying vital nutrients for cognition and the contrivances by which they might affect the brain, there was comparatively little thought to the assortment of appropriate cognitive outcome measures. However, many studies have reported that iron is a vital element that has played a crucial role in cognitive performance.

Since nutrition deficiency, especially iron deficiency, has a significant role in children's learning ability, it is an essential parameter to assess the impact of iron deficiency on children's cognitive performance. In the study, the impact of nutrition on cognitive and behavioral efficiency was also evaluated. It was conducted through an interview-based questionnaire, an observational check-list and a rating scale with the teachers. The results divulged that impaired cognitive assessment scores (n = 104) were reported in (27.15%) sampled children. "Memory function scores" were poor in 34 (33.34%) of these total sampled children. The higher-level cognitive functions score was also observed to be very low (46.07%). Behavioral problems were identified in 23 (22.54 %) children, with 74.54% having impaired attention functions. Of all the anemic children, 23 (22.45%) had poor basic learning skills in reading while 12 (11.76 %) were assessed to have poor scores in the basic learning skills for numeracy. An overall picture reflects that the participating Yanadi children afflicted with anemia lacked cognitive and behavioral skills, directing towards adoption of good management policies to address the micronutrient deficiency. The percentage of students who ate breakfast every day was considerably greater among students with exceptional outcomes compared to those who failed or just passed their examinations, indicating that good nutrition promotes mental growth.

TABLE 2. Cognitive & Behavioral Test Performance of participating Yanadi children

Variable	Anemic students (n=104)	
	No of Students	Percentage of students
Social communication	78	76.47%
Learning and Memory functions	34	33.34%
Thought process	12	11.76%
Visuospatial Function	47	46.07%
Reading /Writing Skills	23	22.54%
Numeracy Skill	12	11.76%
Motor Skill	37	36.27%
Attention performance	76	74.50%
Intelligence Test	11	10.43%

Iron and anemia relationship

Iron is a trace element required for a number of cellular-metabolic functions, and the body of an adult contains 3–4 g of iron. Because iron is harmful in excess, strict management is necessary to avoid iron deficiency or iron overload. The uses of "serum iron and ferritin, and total iron-binding capacity" were generally using tools with the quantitative assessment of body iron stores.

Serum ferritin (SF), serum iron (SI) and serum TIBC (TIBC) levels were analyzed among the study population and their mean level were found to be 53.57±31.46, 336±73.70 and 25.76±22.64 respectively in the age-group of 7 to 10 years. Similarly, in the 11 to 14 years age-group, it was observed that 48.78± 27.81, 340±73.46 and 30.13±20.67 of SF, SI and TIBC respectively. There's no statistical difference between the age-group of Yanadi children. The SF value was, however, observed to be at the higher end for both the groups. As a result, in this current study, SF levels were increased in children from the IDA community. A significantly high blood ferritin level has been linked to inflammatory diseases and may lead to catastrophic effects, including cancer [11].

The disparity in Hb concentration could be explained partly by poor medical conditions and the standard of living in low-income nations. In contrast, to most previous investigations, we observed a significantly high SF value (an average of 72·6 ng/ml). Studies in other countries like South Africa and Colombia reported the decreased values than the current study (25·0 and 41·4 ng/ml, respectively). Increased living standards and health knowledge may also lead to higher SF status, as seen in China and the United States (NHANES, 2006).

TABLE 3. Distribution of Iron metabolism in the participating Yanadi children

Variables	School age (7-10 Years)	Early Adolescence
Sr. Iron (µg/dl)	53.57±31.46	48.78±27.81
Sr. TIBC (µg/dl)	336±73.70	340±73.46
Sr. Ferritin (ng/ml)	25.76±22.64	30.13±20.67

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Diet and Anemia relationship

Breakfast that contains both heme iron and non-heme iron like fat, meat, proteins, fiber, pulses, legumes, grains, fruits, vegetables, minerals and vitamins especially vit-C are required for providing energy and enhancing the iron absorption. Another study [12] Bengali students concluded that amongst the anemic students had regular (41%) and irregular (59%) breakfast intake compared to regular (68.7%) and irregular (31.3%) breakfast intake of non-anemic students. Interesting studies on Bengali students and also Saudi women have depicted that low intake of meat, or fruits, or vegetables have a link with IDA.

The high incidence of IDA in our community might be attributed to poverty, which has resulted in inadequate nutrition and treatment [13]. Aside from gender and age, this study looked into other probable risk factors linked with IDA among student participants, such as low-income households, occasional or no breakfast consumption, red meat, fish, poultry, vegetables, and fruits, and ignorance of anemia and its causes. Inadequate intake of dietary iron, low bioavailability, concurrent inadequate intake of other dietary micronutrients, lack of knowledge of iron deficiency, and poor nutritional status are all possible reasons of the high prevalence rate of IDA in the studied population.

The total energy-rich diet consumed by study participants in different forms were analyzed (Table 4) and it was found that the total energy taken during the hostel days was quite lower than the amount recommended. The total energy consumption was observed to be 1287±238.9 K/cal per day.

TABLE 4. Quantitative analysis of Nutrient intake in study population

Nutrients	School-age (7 to 10 Years) (n=102)	Early Adolescence (11 to 14 Years) (n=282)
Total Energy (Kcal/d)	1020±150.9	1287±238.9
Carbohydrate (Kcal/d)	178±16.2	180±12.8
Protein (g)	27.2±11.7	34.3±13.6
Fat (g/1000 cal)	20.5±5.2	24.6±3.1
Micronutrient (mg)	3.2±1.7	4.5±1.5
Dairy products	13.5±5.8	16.8±3.6
Iron intake	0	0
Other Nutrients	1.2±0.5	1.5±0.9

Whereas, the daily recommended level of energy consumption for healthy adolescents is ~1800 Kcal/day [14]. Intake of carbohydrate, protein, fat, other micronutrients, dairy-products, and other nutrients in the children 7 to 10 years were178±16.2, 27.2±11.7, 20.5±5.2, 3.2±1.7, 13.5±5.8, 1.2±0.5 respectively and the pattern was nearly similar in elder age-group children. Amount of carbohydrate intake amongst the groups was observed to be nearly equal. However, there has been a striking difference in total energy intake between the groups, but not as often as it ought to be if they followed the recommended diet.

Carbohydrates (180±12.8 K/cal per day), protein (34.3±13.6 g) and fa t(24.6±3.1g/1000 cal) were observed to below. The other essential nutrients (1.5±0.9), micronutrients (4.5±1.5) and dairy products (16.8±3.6) intake or consumption were also observed to be not following the standard amount.

Micronutrient deficiencies have long been a significant health-care issue in India. Nonetheless, significant changes in the region's demographics, economic, political, and social settings have influenced diet, nutrition, and health issues during the previous three decades. Many tribal groups and rural inhabitants are in the midst of a nutrition transition in which malnutrition coexists with non-communicable illnesses linked with various kinds of malnutrition. Micronutrient deficits and/or inadequacies, according to the WHO, have worsened the rising public health care issue posed by non-communicable illnesses, which account for 47 percent of morbidity and 52 percent of total death.

Children had an increased risk of death, high prevalence of anemia, stunting, and wasting as compared to non-Adivasis (http://rchiips.org/nfhs/NFHS-5Report_AP.shtml) for the duration of 2019-2020

These students may have iron deficiency, which might be due to the low bio availability of iron in Indian diet. Proper nutrition during infancy and adolescence is critical for developing health. Several studies have linked IDA to dietary changes [15].

TABLE 5. Subjects by adequacy of protein, mineral and vitamin intake (n=384)

Nutrient	Inadequacy (0.66)		Fairly adequate (0.66 to <1.00)		Adequate (≥1.00)	
	No	%	No	%	No	%
Protein	219	57.03	97	25.26	68	17.70
Calcium	248	64.58	95	24.73	40	10.41
Vit. A	253	65.88	96	25	36	9.37
Thiamin	291	75.78	50	13.02	43	11.19
Riboflavin	277	72.13	64	16.66	43	11.19
Niacin	280	72.91	52	13.54	38	9.89
Folic acid	276	71.87	64	16.66	42	10.93
Vit. C	265	69.01	85	22.13	34	8.85

Table 5 divulged the Nutrient intake data of study participants as per nutrient adequacy ratio (NAR). The results revealed that maximum number of study participants had inadequate or fairly adequate NAR ((≥ 0.66) in terms of protein (57.03%), calcium (64.58%), Thiamin (75.78%), riboflavin (72.13%), niacin (72.91%) vitamin C (69.01%), Vitamin A (6.9%) and Folic acid (71.87%). The adequate level of nutrient intake of the study participants was very less. This may be due to unavailability of balanced diet or the daily diet does not contain the daily recommended level of macro-as well micro-nutrient. Many studies suggest the tribal community availing the lower level of micronutrient because of poverty and lower economic status. The present study describes the dietary intake by the Yamada children was very low; only few percentages of children had adequate level of diet in terms of energy. The energy and protein intake were very low in Rajasthan those belongs to BPL girls. Also one more finding reports lower calorie intake as per recommended daily allowance (RDA) in lower socio-economic status adolescent [16].

The food intake pattern was very low in the current study: pulses, milk and milk products intake were less in the study group. This may be the possible causes of energy and protein deficit. Also, the intake of fruits and vegetables were very less in the study participants. This could be reason for deficiency of micronutrient.

In one whole, the Yanadi children were taking the diet not containing all the micronutrients and other essential supplements. The nutrient cap was wider in the study population. The status was comparable with many studies has been done with tribal community, it's just because of socio economic status of the many tribal communities in India observed to be nearly equal. However, there has been a striking difference in total energy intake between the groups, but not as often as it ought to be if they followed their commended diet.

Carbohydrates (180±12.8 K/cal per day), protein (34.3±13.6 g) and fat (24.6±3.1 g/1000 cal) were observed to below. The other essential nutrients (1.5±0.9), micronutrients (4.5±1.5) and dairy products (16.8±3.6) intake or consumption were also observed to be not following the standard amount.

Micronutrient deficiencies have long been a significant health-care issue in India. Nonetheless, significant changes in the region's demographics, economic, political, and social settings have influenced diet, nutrition, and health issues over three decades. The majority of tribal groups and rural inhabitants are in the midst of a nutrition transition in which malnutrition coexists with non-communicable illnesses linked with various kinds of malnutrition. Micronutrient deficits and/or inadequacies, according to WHO, have worsened the rising public health care issue posed by non-communicable illnesses, which account for 47 percent of morbidity and 52 percent of total death.

In this study, further analysis of the food items consumed by the participating Yanadi tribal children was initiated to know the source of nutrition they were taking, as depicted in Table.6. The nutrient and food intake survey has been conducted in the residential area of study groups. The results showed that the average consumption of cereals and millets were comparatively low in both the age-groups. The daily intake of cereals and millets was 245±46 in the 7 to10 year's boys and 428±20.7 in 11 to 14 years boys. Whereas, the quantitative intake of pulses was detected to 25±10.6 g/d in 7 to 10 years, and 30.7±2.5 g/d in 11 to 14 age-groups respectively.

Intake of qualitative food such as, tubers, nuts and oils were lower among 7 to 10 years age-group participants and was observed to be 34±16.7, 47±13 & 6±2 g/d respectively. However, average intake of green and leafy vegetables (26±7 g/d) was also slightly lower in 7 to 10 years boys. Likewise, it is perceived in the boys 11 to 14 years age-group, mean intake of tubers (66.03±5.8 g/d), nuts and oils (28.02±77.5 g/d) and green leafy vegetables (38.5± 2.6 g/d).

Overall, 27.86% (n=107/384) of children were found to be anemic. When analyzed following the WHO grading of anemia, 11 participants (2.86%)

TABLE 6. Mean Intake of different food stuffs by study participants of different age-groups (n=384)

Age-group	Cereals/Millets (g/d)	Pulses (g/d)	Green Leafy vegetables (g/d)	Other Vegetables (g/d)	Roots/Tubers (g/d)	Nuts/Oils (g/d)
7 to 10 years	245±46	25±10.6	26±7.0	34±16.7	47±13	6±2.0
11 to 14 years	428±20.7	30.7±2.5	38.5±2.6	72.12.3 ±3.6	66.03±5.8	28.02±77.5

TABLE 7. Various grades of Anemia across different age-groups of Yanadi tribal children participants (n=384)

Age-group	Severe Anemia	Moderate Anemia	Mild Anemia	Total (%)
7-10 Years	3 (2.94%)	2 (1.96%)	26 (25.49%)	31 (30.39%)
11-14 Years	4 (1.42%)	9 (3.19%)	63 (22.34%)	76 (26.95%)
Total	7 (1.82%)	11 (2.86%)	89 (23.18%)	107 (27.86%)

were found to have moderate anemia, while 89 (23.18%) had mild anemia and 7 (1.82%) had severe anemia in the overall cohort. The prevalence of anemia was found to be highest in the children at the age-group of 7 to 10years, at about 30.39% (31/102) when compared to the older children at the age-group of 11 to 14 years 26.95% (76/182). The present study found that the anemia prevalence in Yanadi tribal children was 27.86%. However, similar studies from other regions of India have shown overall higher prevalence in school-going tribal children. The study cohort was of small size and performed in an isolated site and the Yanadi tribal group is distributed in other districts in the state of Andhra Pradesh. The data obtained might change to a higher degree if the study has expanded to other regions in Andhra Pradesh, inhabited by the Yanadi tribal community.

CONCLUSION

The current study was unique in finding the prevalence of anemia among school-going Yanadi tribal children in only one locality of the Andhra Pradesh state. The study findings are strictly limited to one sub-tribe group tribal population and that too encompasses only the school-going tribal children. Additionally, the study included only the male children and might have missed those children who are school-dropouts. Despite the caveats in the study, it provided a very good initial picture of the anemic condition in the tribal children and its associated repercussions in terms of the physical and mental health of the tribal children. Assuming it a base, similar study needed to be undertaken in the entire Yanadi tribal population across all the Yanadi tribal children age-groups. Expanding the study in a larger cohort, coupled with molecular-genetic analysis would elucidate the gravity of the problem. This would provide better insights for formulating the screening and preventive measures against iron-deficiency anemia in the tribal children including Yanadi.

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