Trends of Nutritional Anaemia Among Adolescents of Kukna Tribal Community of Gujarat, India

Abstract: Background: Iron-deficiency anaemia is the most common form of anaemia affecting adolescents in rural and urban setting in India. This condition has worsening effects on overall growth and cognitive development of children and adolescents. The paper evaluates sex and age-wise prevalence of anaemia in adolescents of Kukna tribe of Valsad, Gujarat.

Methodology: Cross-sectional study on 296 Kukna adolescents(168 females and 128 males)aged 14-18 years was conducted. Dietary preference along with height, weight and haemoglobin status were taken. Statistical analysis was done using SPSS18.0. Result: Overall prevalence was estimated as 61.5%. Sex-wise prevalence was found to be 45.3%(females) and 16.2%(males). Frequency of anaemia was observed to be higher in vegetarians(n=112) than mix-diet individuals(n=68). Frequency of anaemia was reported to be greater in normal body mass index(BMI) females(n=55) and underweight males(n=37) with respect to females and males lying in other BMI categories. Prevalence rates of current study were greater than national prevalence of anaemia(55%) and greater proportion of females were found to be anaemic. Conclusion: There is a dire need for more micro-level and community-based studies for assessment of anaemia which will enhance the understanding about the vulnerable groups in the country.

Key Words: Anaemia, haemoglobin, tribal community, adolescents, Gujarat, India

Introduction: Iron-deficiency anaemia (IDA) is the most common form of anaemia globally, however, there are other conditions such as folate, vitamin B12, vitamin A deficiencies, chronic inflammation, haemoglobinopathies and parasitic infections which may also cause anaemia (1-3). IDA is regarded as second leading cause of disabilities and the most common nutritional disorder globally (4-6). In India, IDA is most prevalent in children under age of five years, pregnant women and girls in the reproductive age in rural and urban areas, making these groups vulnerable on various health parameters (3,7). In 2008, World Health Organization (WHO) estimated the global prevalence of anaemia which indicates that 24.8% of the world’s population is affected by anaemia, out of which 42% are pregnant women, 30% are non-pregnant women, and 47% are preschool children (8). National Family Health Survey (NFHS)-4 (2015-2016) data highlights that the prevalence of anaemia in India is highest among children under five years of age (58.6%), followed by 53.1% among females (non-pregnant and pregnant aged 15-49 years) and 22.7% among men (aged 15-49 years) (9). Anaemia at any age may have worsening effects on health of individuals and can result in poor concentration, cognitive impairment and frequent bouts of sickness (6, 10-12). Lack of concentration especially in scholastics, low work capacity and degeneration in cognitive abilities along with other worsening effects of anaemia make children and adolescents most vulnerable to this condition (13-15).

Adolescence is a phase of rapid physiological and psychological transitions in human body such as attainment of sexual maturity, onset of pubertal changes and reproductive cycle along with behavioural changes (16). Anaemia poses to be a major health hazard among adolescents especially in rural and tribal areas resulting in higher chances of mortality (17-19). The NFHS-3 (2005-2006) data show as much as 65% tribal women aged 15-49 years and 77% children (0-59 months old) are anaemic in comparison to women and children of other caste categories (20). Indian tribal communities are socially and economically disadvantaged and thus, they are unable to suffice their nutritional needs due to uncertainty of food supply, lack of awareness regarding health and nutrition policies, poor availability of health facilities and poor standard of living (19, 21, 22). Studies related to assessment of anaemia indicate high prevalence in urban as well as rural communities especially in females (17-19, 23-29). The extent of discrimination on the basis of gender is huge in India and thus, females suffer from widespread nutritional deprivation (9, 30-32). Few studies have tried to assess the prevalence rates of anaemia in both the sexes and have shown deterioration in health status of females (33-39). Thus, major research studies have taken females into consideration due to their declining health conditions. Despite of several intervention programmes currently being implemented and working on National and State levels,
maternal and child health problems and insufficient intake of micronutrient leading to anaemic conditions still continue to prevail in tribal areas (40-42). High prevalence of anaemia in school going children especially in tribal communities is a matter of huge concern. Herewith, we attempted a community based study to evaluate the age and sex-wise prevalence of anaemia in adolescent males and females among the Kukna tribe of South Gujarat in order to assess the relationship of different grades of anaemia with dietary preference and categories of body mass index (BMI).

Materials and Methods
Ethical approval: Prior to the study, ethical clearance was obtained from the Institutional Review Committee, Department of Anthropology, University of Delhi. Verbal consent of the parents and principal and written consent from each participant was obtained before starting the study. Subjects who were willing to participate in the study were included and those with any type of growth and development disorder or health issues in the past year were not included in the study.

Study design and population: A cross-sectional study was conducted on 168 females and 128 males aged 14-18 years belonging to Kukna tribe residing in Valsad district of Gujarat. A pre-designed and semi-structured schedule was used to collect the demographic information regarding age, sex, tribe, clan, family type, family size and other household details.

Anthropometric and haematological measures:
Anthropometric measurements were taken using standard techniques (43). Stature was measured to the nearest of 0.1 cm using a movable anthropometer. Body weight was recorded to the nearest 0.1 kg with Omron body composition analyser. Height and weight were used to calculated body mass index. BMI is defined as weight in kilograms divided by height in metres squared. 2 ml blood was drawn intravenously from each individual in ethylene diamine tetra-acetic acid (EDTA) coated vial and the haemoglobin level was determined by Drabkin’s haemoglobin cyanide (HiCN) method (44).

Individual classification: Body Mass Index (BMI) was classified on the basis of percentile criteria for BMI by Cole & Lobstein. 50th, 85th and 90th percentile values for BMI for the present data were calculated as 17.52 kg/m², 20.11 kg/m², 20.87 kg/m², respectively. BMI was categorized into four categories: (a) undernutrition (less than 50th percentile), normal (50th to 85th percentile), overweight (85th to 90th percentile) and obese (≥90th percentile) (45).

Table 1: Prevalence of anaemia in the studied population group

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Male (n=24)</th>
<th>Female (n=36)</th>
<th>Total (N=296)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14+</td>
<td>Male (n=29)</td>
<td>12.26±1.49</td>
<td>10.35±1.41</td>
<td>32.4%</td>
</tr>
<tr>
<td>15+</td>
<td>Female (n=31)</td>
<td>13.33±1.09</td>
<td>10.88±1.30</td>
<td>45.3%</td>
</tr>
<tr>
<td>16+</td>
<td>Male (n=27)</td>
<td>13.26±1.69</td>
<td>10.46±1.89</td>
<td>50.9%</td>
</tr>
<tr>
<td>17+</td>
<td>Female (n=35)</td>
<td>14.06±1.82</td>
<td>10.94±1.96</td>
<td>50.0%</td>
</tr>
<tr>
<td>18+</td>
<td>Male (n=24)</td>
<td>14.47±1.72</td>
<td>11.20±1.76</td>
<td>45.3%</td>
</tr>
</tbody>
</table>

Results
Table 2 shows age and sex-wise differences for mean haemoglobin. The t-test was used to compare the anaemic and non-anaemic adolescents in each age group. Statistically significant differences for mean haemoglobin are observed for both sex in all age groups at p<0.05. It is also observed that the mean haemoglobin levels increased gradually in males with age and ranged towards normal Hb levels, however, the mean haemoglobin values in females increased gradually with age but still remained categorized in mild anaemia category.

Table 2: Mean differences of haemoglobin value between the two sexes for each age group (N=296)

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Haemoglobin (Mean±S.D.)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>14+</td>
<td>Male (n=29)</td>
<td>12.26±1.49</td>
<td>5.285</td>
<td>0.000</td>
</tr>
<tr>
<td>15+</td>
<td>Female (n=31)</td>
<td>10.35±1.41</td>
<td>7.407</td>
<td>0.000</td>
</tr>
<tr>
<td>16+</td>
<td>Male (n=27)</td>
<td>13.33±1.09</td>
<td>5.885</td>
<td>0.000</td>
</tr>
<tr>
<td>17+</td>
<td>Female (n=35)</td>
<td>10.88±1.30</td>
<td>6.458</td>
<td>0.000</td>
</tr>
<tr>
<td>18+</td>
<td>Male (n=24)</td>
<td>13.26±1.69</td>
<td>10.46±1.89</td>
<td>0.000</td>
</tr>
<tr>
<td>14+</td>
<td>Female (n=35)</td>
<td>14.06±1.82</td>
<td>10.94±1.96</td>
<td>0.000</td>
</tr>
<tr>
<td>15+</td>
<td>Male (n=27)</td>
<td>14.47±1.72</td>
<td>11.20±1.76</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*The values are considered statistically significant if the p-value is ≤ 0.05 (p<0.05). The mean values were compared between boys and girls for each age group.

Table 3 shows age and sex-wise prevalence of different grades of anaemia classified according to WHO, 2007. Highest prevalence of anaemia is reported in 14+ years age group for males (32.4%) as well as females (50.0%). The prevalence of anaemia in males gradually decreased with age. It was observed that in all age groups, the prevalence of anaemia in females was higher in comparison to males. Chi-square test indicated that sex-wise differences in each age group for different grades of anaemia were statistically significant at p<0.05.

Statistical Analysis: Data entry was done in Microsoft Excel 2016, and further analyses were carried out using SPSS version 18.0 for windows (SPSS Inc., Chicago, Illinois, USA). Cross-tabulation was used to assess the frequency of anaemic and non-anaemic males and females, to calculate the frequency of vegetarians and mixed diet consumers and to categorise the participants into different BMI categories. Test of significance such as student’s t-test and chi-square test were also performed to check whether the differences were statistically significant or not.
Table 3: Age and sex-wise prevalence of different grades of anaemia classified according to world health organization (N=296)

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Non-anaemia</th>
<th>Mild anaemia</th>
<th>Moderate anaemia</th>
<th>Severe anaemia</th>
<th>Total anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>14+</td>
<td>Male (n=29)</td>
<td>8 (27.6%)</td>
<td>17 (58.6%)</td>
<td>4 (13.8%)</td>
<td>0 (0%)</td>
<td>21 (32.4%)</td>
</tr>
<tr>
<td></td>
<td>Female (n=36)</td>
<td>3 (12.5%)</td>
<td>9 (33.3%)</td>
<td>22 (82.1%)</td>
<td>2 (7.9%)</td>
<td>27 (38.9%)</td>
</tr>
<tr>
<td>15+</td>
<td>Male (n=24)</td>
<td>15 (62.5%)</td>
<td>9 (37.5%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>15 (62.5%)</td>
</tr>
<tr>
<td></td>
<td>Female (n=31)</td>
<td>5 (16.1%)</td>
<td>7 (22.5%)</td>
<td>19 (61.3%)</td>
<td>0 (0%)</td>
<td>16 (51.6%)</td>
</tr>
<tr>
<td>16+</td>
<td>Male (n=27)</td>
<td>18 (66.7%)</td>
<td>7 (25.9%)</td>
<td>2 (7.4%)</td>
<td>0 (0%)</td>
<td>20 (74.1%)</td>
</tr>
<tr>
<td></td>
<td>Female (n=31)</td>
<td>5 (16.1%)</td>
<td>16 (51.6%)</td>
<td>3 (9.7%)</td>
<td>26 (83.9%)</td>
<td>21 (67.7%)</td>
</tr>
<tr>
<td>17+</td>
<td>Male (n=24)</td>
<td>19 (79.2%)</td>
<td>4 (16.7%)</td>
<td>1 (4.2%)</td>
<td>0 (0%)</td>
<td>24 (91.7%)</td>
</tr>
<tr>
<td></td>
<td>Female (n=45)</td>
<td>12 (26.7%)</td>
<td>13 (28.9%)</td>
<td>17 (37.8%)</td>
<td>3 (6.7%)</td>
<td>25 (55.6%)</td>
</tr>
<tr>
<td>18+</td>
<td>Male (n=24)</td>
<td>20 (83.3%)</td>
<td>8 (33.3%)</td>
<td>4 (16.7%)</td>
<td>0 (0%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td></td>
<td>Female (n=25)</td>
<td>11 (44.0%)</td>
<td>3 (12.0%)</td>
<td>11 (44.0%)</td>
<td>0 (0%)</td>
<td>25 (100%)</td>
</tr>
</tbody>
</table>

*The values are considered statistically significant if the p-value is < 0.05.

In Table 4(a), we have categorized males and females on the basis of their dietary preferences to understand the relationship of dietary preference and different grades of anaemia for both sexes. Majority of the participants were consuming vegetarian diet (60.1%; n=178), while 39.9% (n=118) reported consumption of mixed diet which involved eggs, meat as well as vegetables. Prevalence of severe anaemia was reported only in females in comparison to their male counterparts. It was observed that the frequency of occurrence of total anaemia was more in vegetarians females (n=86) than the females consuming mixed diet (n=46) and also in males (n=26) in vegetarian category. Overall, frequency of anaemia in individuals consuming vegetarian diet was greater than those consuming mixed diet. Chi-square analysis indicated that sex-wise differences for different grades of anaemia for each category of dietary preference was statistically significant at p≤0.05.

Table 4(b) shows the prevalence of anaemia in males and females for different categories of body mass index. Overall, the prevalence of anaemia was clearly evident in greater proportion in females for all BMI categories in comparison to their male counterparts. Males showed mild and moderate anaemia, while anaemia in females ranged from mild to severe category. No males were found to be obese in the studied population. It was seen that frequency of anaemia in females with normal BMI (n=55) was more than females in overweight, underweight and obese categories. On the other hand, underweight males had greater frequency of anaemia (n=37) in contrast to the males falling in normal, overweight and obese BMI category. Chi-square test showed that sex-wise differences for different grades of anaemia in different BMI categories was statistically significant at p≤0.05. Test of significance cannot be performed for obese category, as no male individual was found to lie in that category.

Discussion

The present study attempts to evaluate the prevalence of nutritional anaemia among adolescent Kukna of Gujarat, India. The overall prevalence of anaemia in the current study is found to be 61.5%, and sex-wise prevalence is found to be 45.3% and 16.2% in females and males, respectively. Such high prevalence rates of anaemia in a community indicate towards the vulnerable status of tribal adolescents to nutritional anaemia. The prevalence rates of anaemia in this study are much higher than the global and national estimates. The estimated global prevalence of anaemia is 24.8%, adding to which WHO Global Database on Anaemia shows the prevalence of anaemia in school going children to be 25.4% (8). The Indian National Survey NFHS-4 (2015-2016) assessed that 53% of the population suffers from anaemia (9). However, our study shows relatively low sex-wise prevalence rates of anaemia in comparison to state-wise factsheet of Gujarat which indicates the prevalence rate in rural women (age 15-49 years) as 57.5% and 25% in men aged 15-49 years (47). These differences in trends of prevalence rates in our study versus the prevalence rates in the state-wise survey conducted during NFHS-4 might be possibly due to difference in age groups taken and ethnicity.

In the current study, mean value of haemoglobin gradually increases with age in males (12.26 mg/dl to 14.47 mg/dl) and females (10.35 mg/dl to 11.20 mg/dl), but females still remain in the mildly anaemic category. Mean value of haemoglobin in adolescent girls in the present study is in concordance with study conducted on adolescent girls as well as college girls in urban and rural settings (48-51). It has been observed that overall prevalence of anaemia in adolescents is 42.1% and in adolescent girls alone is found to be 56% (52), which is slightly higher than the estimated prevalence among girls in the present study. High proportion of anaemia in adolescent girls is due to biological transitions with the onset of menarche, commencement of
menstruation and changes in other bodily functions (35). Therefore, lower mean values of haemoglobin and high prevalence of anaemia in school going children especially in tribal communities is a matter of huge concern.

The present study also estimated the age-wise prevalence of anaemia among boys and girls which reported highest prevalence in the age-group 14-15 years old in both the sexes. Also, the prevalence of anaemia decreased with age in males as well as females, higher prevalence rates were observed in females across all age-groups in comparison to their male counterparts. All female participants in the current study had attained menarche. During the period of adolescence, a healthy human being achieves more than 20% of their total growth in stature and 50% of adult bone mass (35, 53). It is also reported that the iron requirement in boys and girls increase dramatically in adolescence, due to expansion of total blood volume, increase in lean body mass (54) and the onset of menstruation in females which leads to loss of blood causing anaemia (33, 55). Hyder et al. (2007) also reports that the iron requirements are highest among boys during the peak pubertal development due to a greater increase in blood volume, muscle mass and myoglobin (56). This could be a possible explanation of the high prevalence of anaemia in age group 14-15 years in males and females.

In this study, frequency of different grades of anaemia on the basis of WHO classification was also done and a relationship of dietary preference and Body Mass Index with different categories of anaemia was seen. The frequency of severe anaemia was only found in females in comparison to their male counterparts. It was observed that the prevalence of anaemia was greater in individuals consuming vegetarian diet in contrast to those consuming non-vegetarian diet. These findings were in agreement with the observations in several other studies conducted on assessment of nutritional status of adolescents in India (57-59). The studied population sustained majorly on root and cereal based diet which is deficient in iron content due to low iron absorption. Since, majority of studied individuals were reported to follow vegetarian diet, the poor bioavailability of iron coupled with a low intake of iron derived from animal products might possibly be a major etiological factor for anaemia (60).

We also observed that higher frequency of anaemia was found in females lying in normal BMI category and males falling under low BMI (underweight) category. Gupta et al. (2013) estimated the prevalence of anaemia in varied BMI categories and found 44.78% adolescent boys who were categorised as underweight and thin (less than 5th percentile, according to CDC BMI cut-off) were anaemic (35). Some more studies on adolescent boys have observed higher prevalence of anaemia in underweight BMI category in boys (61-63). On the other hand, studies conducted among adolescent females have found that proportion of apparently healthy individuals have high prevalence of anaemia which is in concordance to the results of the present study (21, 33, 64, 65). Faulty eating habits such as consumption of poor-quality diet, cheap packaged fried snacks and the rising trend of consuming junk snacks which supply empty calories may be attributable to high prevalence of iron and micronutrient deficiencies in underweight and normal weight individuals (33, 64).

The overall findings of the present study indicated strikingly high prevalence of anaemia in females in comparison to their male counterparts, which may be accounted due to the existence of gender disparity among Indian population groups. Larger portion of food, more nutritious food items and better cuts of meat are provided to male members of a family, while females get less food and fewer meals in comparison to males (60, 62). Iron requirement in all age-groups is the highest in menarche in females, due to lack of nutrition rich food, low socio-economic status, and high rates of illiteracy, rural adolescent girls are found to be more severely anaemic than their male counterparts (68-70). Nutritional needs to suffice the loss of volumes of blood is often ignored and hence, adolescent girls suffer from severe health consequences, and anaemia is one of the most common and major condition (5, 27).

World Health Organization (2008) states that if the rate of prevalence of anaemia in any community is reported to be greater than 40%, it is considered as a problem of high magnitude for a nation on the parameters of health and overall development (8, 71). Several studies conducted on adolescents of age 14-18 years among various tribal communities in India have reported a prevalence range of 25% to 99% for anaemia (36, 37, 72-75). The overall prevalence of anaemia in the current study is greater than 40% and lies in the prevalence range of 25% to 98.9% as reported in the above-mentioned studies. Higher prevalence of nutritional anaemia in younger ages leads to growth retardation, deterioration in cognitive functions and morbidity (6, 10, 12). The prevalence rates in various studies among rural as well as urban communities are indicative that children, adolescents and females in reproductive age are most vulnerable to anaemic conditions and the fatal risks attributable to nutritional anaemia (2, 7).

Consequently, rising prevalence of anaemia in tribal communities due to lack of awareness, low rates of compliance of nutritional interventions, monetary constraints, food insecurity and insufficiency, social issues such as early marriages leading to early age of conception among females and poor access to health facilities is resulting in the increasing rate of undernourishment and mortality (19, 21, 60).

Though the researcher employed quality control measures in the assessment of all the parameters and tried to remain bias free, the study has a few limitations. Firstly, this study only estimates the prevalence of anaemia and does not take into account the social determinants and other factors affecting anaemia. Secondly, the dietary pattern was recorded using recall method and free-listing which relies heavily on the memory of the respondent. Nevertheless, it is worth mentioning that the current research work is one of its kind in the adolescent age group of Kukna tribal community of Gujarat. The findings in this study confirms and echoes with the existing literature about nutritional anaemia among adolescents.

Conclusion
The overall prevalence of anaemia is reported as 61.5% in the studied community. Greater proportion of females were found to be anaemic than males. There is a need for dietary diversification for the prevention of nutritional anaemia among the adolescents as the requirement of iron and other micronutrients increases in this phase. Anthropologists, academicians and social workers should work to design nutritional interventions and check the compliance of the existing intervention programmes on regular basis especially among the vulnerable and disadvantaged groups. The issues of gender biasness and food sharing should also be addressed by conducting workshops and educating people about the need for proper and balanced nutrition intake. Additionally, more micro-level and community-based studies to assess the prevalence and determinants of anaemia need to be undertaken for better healthcare delivery.

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