Prevalence and Determinants of Anaemia among Adolescent Girls in Secondary Schools in Yala Division Siaya District, Kenya

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Abstract Approximately half of adolescent girls living in Sub-Saharan Africa are anemic. Anaemia is associated with lower physical work capacity, impaired cognitive functioning and lower school achievement among adolescents. This study was done to determine factors associated with the prevalence of anaemia among adolescent girls aged 14-18 years old within Yala division, Siaya District, Kenya. A mixed method multistage sampling was used to select 230 female students. Blood and stool samples were analysed for anaemia, malaria and worm infestation respectively. Questionnaires were used to assess intake of dietary iron. Results showed 26.5% , 41.3%, 7.4% prevalence anaemia (Hb <12.0 g/dl), malaria and ova of ascaris respectively. Factors that were significantly(P≤0.05) associated with anaemia were: the respondent's age (OR 3.38), educational status of the fathers', primary (OR=0.313) post-secondary (OR=0.343) inadequate daily dietary iron intake (OR=8.87), presence of malaria parasites (OR=3.68) and ova of ascaris (OR=11.94). The study concluded that anaemia is a public health problem among adolescents in this area. Interventions and strategies aimed at addressing effectively anemia in this population should therefore be targeted at the associated factors including parents especially fathers who should provide more bio available iron for the respondents in the diet.

Keywords Dietary Iron-deficiency, Adolescence, Anaemia

1. Introduction

Anaemia continues to be a major health problem worldwide [1]. World Health Organisation (WHO) and the United Nations (UN) estimates that approximately 1.3 to 2.2 billion people (more than 30% of the world's population) are suffering from anaemia [2], United Nations, 1990 [3], World Health Organization, 1992 [4], WHO 2003 [5]. Similarly, approximately 50% of women and children in less developed countries are anaemic [6].

In developing countries, the prevalence of anaemia is particularly high. It is estimated that 9 out of 10 anaemia sufferers live in developing countries [7], at the same time, about half of adolescent girls living in sub-Saharan Africa are anaemic [8]. In addition, the world bank report of 2003 [9], states that WHO estimates that 27 percent of adolescents in developing countries are anaemic. The same document reports that the International Center for Research on Women (ICRW) documents higher rates of anaemia among adolescents in India (55 percent), Nepal (42 percent), Cameroon (32 percent) and Guatemala (48 percent). According to Leenstra [10], prevalence of iron deficiency (serum ferritin <12 μg/l) in Western Kenya is 19.8% while anaemia (Hb <12 mg/dl) is 21.1% among school going girls.

Anaemia is a condition in which the blood contains low levels of haemoglobin as evidenced by low quality or quantity of Red Blood Cells (RBCs). Haemoglobin is an iron-rich protein that gives the red colour to blood. It carries oxygen from the lungs to the rest of the body. In people with anaemia, the blood does not carry enough oxygen to the rest of the body because the body does not have enough iron to form haemoglobin. Anaemia causes fatigue, reduces work capacity, and makes people especially adolescents more susceptible to infection. [7].

Adolescence is a period of intense physical, psychosocial, and cognitive development. Iron needs become higher in adolescent girls because of the increased requirements for expansion of blood volume associated with the adolescent growth spurt and the onset of menstruation [11]. If an adolescent girl who is anaemic becomes pregnant, the risks are even greater since they have not yet achieved full growth. These risks include competing for nutrients between the mother (who is still growing) and the infant, raising the infant's risk of low birth weight (defined as a birth weight of less than 2,500 grams) and early death [20]. Data shows that the damage done by under nutrition very early in life, to both physical growth and brain development, is largely irreversible [21] which

may lead to the cycle of malnutrition throughout the generation. Anaemia in this age group is therefore of particular major concern because it has a direct and immediate effect on productivity, cognitive functioning, lowers school achievement and lowers physical work capacity [9], [5], [12],[13][14][15]. This condition also has a indirect effect on the future economy of the individual hence the nation.

Dreyfuss et al., indicates that direct causes of anaemia in the population are; inadequate dietary iron intake, hookworm infestation and presence of malaria; with variations because of sex, age and population which are not well described in many populations [16]. Nutritional deficiencies in this case are regarded as the most important cause of anemia in the world and in sub-Saharan Africa, it is a major potential contributor to anemia among adolescent girls [9].

Many studies have examined anaemia among pregnant women and pre school children but have often left out adolescents as they are thought to be less vulnerable to nutritional deprivation than the other groups [22]. This has led to a paucity of data on the prevalence of anaemia among adolescent girls. Studies done among adolescent girls in Western Kenya focused on biochemical assessment of iron adequacy leaving out assessment of dietary iron intake and the contribution of this to the prevalence of anaemia hence this study [23-27].

In Yala Division, there was a rising concern among teachers and school administrators because there was an increase in the number of girls who were fainting in schools especially during assembly and games time. When they were taken to hospital, most were diagnosed with anaemia hence this study.

This study was conducted with the objectives to determine the prevalence and severity of anaemia and to establish factors associated with the prevalence of anaemia among adolescent girls in Yala division.

2. Methodology

The study used a descriptive study design which used quantitative methods of data collection. A combination of purposive sampling and simple random sampling were used. Purposive sampling was employed to ensure that Mutumbu girls' secondary school was included in the survey as it is the only day school in the division for girls that is not of mixed sex while the simple random sampling was employed for all the other eligible schools. The number of adolescent girls selected per school into the study was determined through a proportional calculation based on the number of female students in each school so as to come up with a sampling frame that would ensure that each school is represented according to its total eligible population. Simple random sampling was done by randomly allocating numbers to all the eligible students per class based on the class attendance register then computer generated random

tables produced the final list of respondents.

Structured interviewer administered pre tested questionnaires were used to collect information on the study variables that included demographic characteristics (age, marital status of parents, and age at menarche) and social economic factors (parents education level, income level and occupation and size and composition of the household) from the students. A two-way communication was employed so that the meaning of the responses was clarified by probing. The language used was English. The interviews were done in the school in a room requested for by the interviewer.

Blood samples were drawn from the antecubital vein of the respondents' arm after proper antisepsis, with alcohol and sterile cotton swabs. Two milliliters of blood was drawn by a lab technician from a nearby hospital. The content of the syringe was placed in a tube with Ethylene Diamino Tetra Acetic acid (EDTA) as anticoagulant.

The respondent was also asked to provide a fresh stool sample, which was kept in a Polly pot and covered. Blood and stool specimens were transported to the laboratory at a nearby hospital and analysed within 2-4 hours. Those unable to produce a stool sample at the time were given the information and asked to give a fresh stool sample the following day in the morning. The poly pots were taken to the school very early the following morning by the lab technician for sample collection.

One drop of blood was placed on a cuvette and inserted into a HemoCue Hb 201+ Analyzer for hemoglobin level (Hb) analysis.

This collected specimen was used to measure the amount of Hemoglobin in peripheral whole blood. Hb value was read and recorded. Later the reading was classified as normal, mild, moderate or severe anemia based on the WHO recommended cut off points [28].

Stool samples were examined for hookworm and other helminthic ova or cysts within 2-4 hours of collection using Kato's cellophane-covered thick-smear method or the Kato-Katz method [29] and recorded as either positive or negative for worm infection.

3. Data Analysis

Collected data was cleaned, entered and analysed using descriptive, bivariate and multi variate analysis. Comparisons of the results were made between respondents with anaemia and those who were not anaemic.

From the analysis, frequencies, percentages, means, standard deviations, chi square test of association and logistic regression (binary) were generated and used to determine the significant variables affecting the prevalence of anaemia among the adolescents. T- test was used to draw associations between iron intake and iron inadequacy. A p value of <0.05 was considered significant in all the analysis.

To get the average amount of daily nutrient intake from

the FFQ a nutrient calculator; a computer based calculator locally developed using Microsoft Access programme based on Kenya Food Composition Tables was used [30]. This was the main outcome variable, which was classified into normal (without anemia) (Hb ≥12g/dl) and anemic (Hb <12g/dl). HemoCue Hb 201+ Analyzer gives immediate results that were copmared with reference values as given by WHO, 2001[28]. Mean of the results was calculated. A paired sample t-test was used to compare the mean Hb level with the recommended WHO ranges [28]. Cross tabulation between Hb status and various independent variables was followed by a test of trend variable. Variables with p values below 0.05 from this tabulation were included in logistic regression for multivariate analysis. Independent variables were dietary iron intake, intestinal worm and malaria infestation and age.

The study variables analyzed included; demographic characteristics (age, marital status of parents, household head, and age at menarche), dietary intake (adequacy of iron compared to the EAR), and economic characteristics (parents education level, income level, and size of the household). Clearance was sought from the School of Public Health through the Head of Department, Epidemiology and Nutrition before the commencement of the study. An approval from the Institutional Research and Ethics Committee (IREC) of Moi University/ Moi Teaching and Referral Hospital (MTRH) was obtained prior to the commencement of this research.

4. Results

The study was conducted among 230 secondary school adolescent girls in Yala Division of Siaya District aged between 14 and 18 years.

4.2. Descriptive Results of the Study

4.2.1. Demographic Factors

regarding the age and grace of study of the respondents, a larger proportion, 152(66.1%) of these respondents were found lower grades (in forms 1 and 2) compared to 78(33.9%) in forms 3 and form 4. Overall, the highest percentage were in form 2 [87(37.8%)]. Almost all (94.3%) of the respondents were aged above 15 years. The mean age (±SD) of the respondents was 16.4 (±1.2) years and the median age was 16.0 years.

Half of the girls started their menstrual periods between ages 14 and 15 years followed by 70(30.4%) who started at between ages 10-13 years. Those who started their menstrual period beyond age 16 were 39(16%), while 6(2.6 %) had not yet started their menses at the time of the study. The mean age (±SD) of starting menses was 14.26 (±1.6). Similarly the median age at menarche was 15.0 years.

In this study when the highest educational level attained by the parents of respondents was enquired, 28(12.1%) said their mothers had completed post-secondary education compared to 76(33%) of their fathers. Similarly, 94(40.9%) of the mothers versus 55 (23.9%) of the fathers had completed primary education, while 5(2.2 %) of the mothers and 2(0.9%) of the fathers had informal education. The educational status of 28(12.2%) mothers and 31(13.5%) of the fathers could not be established as the respondents did not know.

Almost all of the respondents 224(97.4 %) got their lunch at school as part of a school feeding programme while only Six (2.6%) respondents often carried packed lunch or returned home for lunch. Most 206 (89.6%) of the respondents had experienced food shortage in their homes at one point or another during the previous one year. More than half, 129(56.1%), of the respondents had gone without a meal a at least once the whole day during the previous twelve months due to food shortage in the household. Further, 68(46.3%) and 39(26.5%) of the respondents went without a meal the whole day at least once every week and at least once every month respectively due to food scarcity in their households.

When nutrient intake was assessed, the daily dietary iron intake of study participants ranged from 2.21 to 47.82 mg with a mean of 16.15 mg, and standard deviation of 10.30. In this study, the extent of overall iron intake adequacy was 87.5%. The intake of heme versus none-heme iron was likely to be 10.7% and 74.7% respectively adequate. When further analysed based on the percent of iron absorbable, extent of inadequacy was likely to be 100% for both heme and non-heme iron. The mean (± SD) intake of vitamin C (µg) was 116.3(±68.0) with a median of 106.46 (µg) per day per respondent. Protein intake had a mean (± SD) of 80.2(±49.6) (gm) with a median of 19.5(gm) per day per respondent. The median intake of plant protein was 43.6gm while the mean (± SD) intake was 55.7(±41.3) (gm). On the other hand, animal proteins mean (± SD)] intake was 24.5 (±19.4) (gm) with a median of 19.5gm

4.3. Prevalence and Severity of Anaemia among Study Respondents

The mean Hb (± SD) of the respondents was 12.3 (± 2.19) with a range from 6.3 to 15.4g/dl. The study respondents who had Hb level of at least 12.0 g/dl were classified as normal i.e. non – anaemic while those who had Hb less than 12.0 g/dl were classified as anaemic. Overall, 61 (26.5%) girls were anaemic, while 169 (73.5%) had normal Hb levels. Anaemia classification was based on WHO recommendation where Hb 9.0-11.9g/dl is mild anaemia, Hb 7.0-8.9 g/dl is moderate anaemia and Hb <7.0 g/dl is severe anemia, respectively. The prevalence of mild anemia among all participants was 40(17.4%), moderate anemia was 17(7.4%) and 4(1.7%) were severely anaemic. However, among anaemic participants, 40(65.6%) had mild anemia, 17(27.9%) were moderately anaemic, and 4 (6.5%) were severely anaemic as shown in Table 1.

Table 1. Prevalence and severity of anaemia among respondents

Prevalence of anemia (N=230)	n.	%
Non anaemic (hb≥120g/dl)	169	73.5
Anaemic (Hb<120g/dl)	61	26.5
Total	230	100
Severity of anaemia (n=61)		
Mild (Hb 9.0-11.9g/dl)	40	65.6
Moderate (Hb 7.0-8.9 g/dl)	17	27.9
Severe (Hb <7.0 g/dl)	4	6.5
Total	61	100

4.4. Determinants of Anaemia among the Study Participants

Table 2. Determinants of anaemia among the study sample.

Variable	Total N=230	Anemic n=61	Odds Ratio (OR)	95% C.I for OR	P value
Age in years	N (%)	n (%)			
≤16	120(52.2)	21(34.4)			
≥17	110(47.8)	40(65.6)	2.69	1.46-4.96	0.001
Iron Intake					
Adequate	131(57.0)	24(39.3)			
Inadequate	99(43.0)	37(60.7)	10.30	5.2-20.37	< 0.0001
Ova of ascaris test					
Positive	17(7.4)	12(19.7)			
Negative	213(92.6)	49(80.3)	8.03	2.69-23.92	< 0.0001
Malaria slide test					
Positive	95(41.3)	43(70.5)			
Negative	135(58.7)	18(29.5)	5.38	2.84-10.19	< 0.0001
Fathers' education					
Don't know	31(13.5)	4(6.6)			
Informal	2(0.9)	1(1.6)	0.15	0.008-2.87	0.21
Primary	55(23.9)	20(32.8)	0.26	0.08-0.03	0.04
Secondary	69(30)	11(18)	0.78	0.23-2.68	0.69
Post secondary	73(31.7)	25(41)	2.84	0.008-2.87	0.05

When the socio-demographic characteristics of respondents who were anaemic were compared to the non-anaemic, the following factors were not statistically different (p>0.05): these were, marital status of parents (OR=1.79, 95% CI=0.45-1.83, p=0.90), whether the head of family was the mother (OR=0.90, 95% CI=0.41-2.23, p=0.92) or father (OR=1.55, 95% CI=0.73-3.26, p=0.25) and the highest achieved level of education of the mother.

However, respondents whose fathers' had completed primary level of education were 65.7% less likely to develop anaemia (OR=0.313, 95% CI=0.104-0.938, p=0.03) compared to those who had not. Respondents whose fathers' had completed post-secondary education were 68.7% less likely to develop anaemia (OR=0.343, 95% CI=0.118 -0.997, p=0.04) compared to the respondents whose fathers had not completed the same. On the other hand there was no statistical significant difference between respondents who had anaemia and those who did not.

Regression analysis was run and the likelihood of those above 17 years developing anaemia was two and a half times more (OR=2.69, 95% CI=1.46-4.96, p=0.001,) as opposed to those aged 16 years and below. The respondents who had inadequate daily dietary iron intake were 10 times more likely to develop anaemia (OR=10.30, 95% CI=5.2-20.37, p< 0.0001) compared to the respondents who had adequate daily iron intake. Similarly respondents who tested positive for ova of ascaris were 8 times more likely to develop anaemia (OR=8.03, 95% CI=2.69-23.92, p< 0.0001,) compared to those who tested negative.

The outcome was the similar among respondents who tested positive for malaria parasites. In this case, those who tested positive for presence of malaria parasites were 5 times more likely to develop anaemia (OR=5.38, 95% CI=2.84-10.19, p< 0.0001) compared to those respondents who tested negative as shown in Table 2

4.5. Multivariate Analysis of Predictor Variables for Anaemia

Table 3. predictor variables for anaemia

Variable	Odds Ratio (OR)	95% confidence interval	P value
Age	3.38	1.53-7.44	0.003
Iron inadequacy	8.87	3.97-19.83	≤0.0001
Worm infestation	11.94	2.71-52.57	0.001
Malaria parasitemia	3.68	1.69-7.98	0.001
Fathers Education			
Primary	0.214	0.081-0.571	0.002
Postsecondary	0.326	0.130-0.818	0.017

In multivariate analysis, factors found to be the independent significant predictors of anaemia in this study sample were six. When all other factors were adjusted for, the risk of anaemia was significantly increased among respondents aged 17-18 years old threefold (OR=3.38,

95%CI=1.53-7.44, P=0.003). Those with inadequate iron intake were almost nine times likely to develop anaemia compared to those with adequate iron intake (OR=8.87, 95%CI=3.97-19.83, P=≤0.0001). Presence of malaria parasitemia increased the risk of one developing anaemia by three times (OR=3.68, 95% CI=1.61-7.53, P=0.001). Those who had worm infestation were almost twelve times more likely to develop anaemia than those who did not have worm infestation (OR=11.94, 95%CI=2.71-52.57, P=0.001). The risk of anaemia was however reduced by 78.6% among participants whose fathers had at least primary level of education (OR=0.214, 95%CI=0.081-0.571, P=0.002) and by 67.4% among participants whose fathers had at least post-secondary level of education (OR=0.326, 95%CI=0.130-0.818, P=0.017) as shown in Table 3

5. Discussion

5.1. Prevalence of Anemia

The prevalence of anemia was found to be 26.5% in this study. This is consistent with the WHO estimate of 27% anaemia prevalence among adolescent girls in developing countries [17], and the results of a study among adolescents of a rural community of Sabah, Malaysia [31]. These results are also similar to the outcome of a study among adolescents from Bangladesh [32].

On the other hand this prevalence is significantly higher than that found by Tjalling Leenstra's study among adolescent school girls in Western Kenya [10] and Massawe's study among adolescent girls in a Tanzanian suburban [33]. Moreover the prevalence is higher than that found by results of the Third National Health and Nutrition Examination Survey (NHANES III) data, where the prevalence of iron deficiency among U.S. adolescent females aged 12-15 years and 16-19 years was 9% and 11% respectively [34]. This prevalence is also higher than the results of a study found by [35] in Western Iran where the prevalence of anemia (Hb<12 g/dl) among adolescent school girls was 21.4%. However this prevalence is lower than the prevalence found among adolescent girls in Benin which was 43% [36].

In this study the prevalence of mild, moderate and severe anemia was 17.4%, 7.4% and 1.7% respectively. The respondents who suffered from mild and moderate anemia were 93.5% of the total anemic respondents. This percentage is quite high considering that these respondents could easily slip into the severe anaemia state. The total number of those with severe anemia was higher than that found by Leenstra [10] in a study among adolescents in Western Kenya.

In this study, 33(14.4%) of the study respondents were orphaned unlike in the district statistics where only 5.4% were orphans [28]. This could probably contribute to the higher levels of anaemia prevalence in the study.

The mean hemoglobin in the present study was 12.3(±2.2g/dl) which was higher than the mean of 10.6±1.2mg/dl found by Mehta [32], among adolescents in Bombay and 11.8 ±1.4g/dl that was reported by [37]. The higher mean Hb was probably as a result of the study having been carried out during a post-harvest season. The harvesting season is normally during the month of August which means that food was available at home in higher quantities from the farms in the month of September. During this season, food is usually plenty and cheap thus available even in the market.

5.2. Determinants of Anaemia

Malaria infection is associated with a reduction in haemoglobin levels, frequently leading to anemia [38]. Malaria-related anaemia results from an increased destruction of both infected and uninfected erythrocytes and the decreased production of red blood cells, although the various mechanisms involved depend on age, antimalarial immune status, genetic constitution and local endemicity of malaria [39]. In this study, those who tested positive for malaria parasite were 5 times more likely to develop anaemia compared to those who tested negative. These results are similar to those found by other studies, where malaria is often the strongest cause of anaemia in schoolchildren [38]. In this study, respondents tested were those that were seemingly healthy but the prevalence of malarial infection was still high (41.3%). According to Bloland [40] 60-80% of schoolchildren living in high transmission areas are parasitaemic at any one time though this does not result in fever. Studies in school-age populations suggest that anaemia is associated with asymptomatic P. falciparum infection, as well as helminth infections and iron-deficiency [38]. Similar results were found in this study with ascaris, malaria and inadequate iron intake being significantly related with iron deficiency anemia.

Though the respondents did not have mature worms and only ova of ascaris were seen among 17 (7.3%) of the respondents, this was still significantly associated with anaemia. In bivariate analysis, a person infected by worms was 8 times more likely to develop anaemia as opposed to a person who was not infected. After adjusting for other confounding factors, adolescents who were infected by worms were 11 times more likely to develop anaemia as opposed to those who did not have worm infestation. This in essence means that worm infestation was the strongest predictor of anaemia in this study population. This was consistent with a study in schoolchildren in Tanga Region, Tanzania where infections with hookworm was the most significant factor associated with anaemia [14]. In this study age of the respondent was the other independent factor associated with anaemia among adolescents aged above 17-18 years. After adjusting for other confounders, respondents aged 17-18 years were 3 times more likely to develop anaemia as opposed to younger respondents (14-16

years). This result was consistent with results of other studies where the highest prevalence was observed among older girls 15 to 19 years [41] or 15-17 years old who were menstruating [42]. This is probably because the older respondents have more regular periods than younger respondents which may lead to iron loss. This is contrary to studies by Alton [43], and Mehta [32], who reported that age, was not a significant correlate of anemia in their study results.

Level of education of parents is likely to determine their occupation and income through its influence on the employment potential and may have an impact on dietary intake. Fathers educational achievement was found to be independently inversely associated with anaemia among adolescents whose fathers had achieved primary (P=0.002) and post primary levels of education (P=0.017) but not among those whose fathers had achieved secondary level of education. This is a striking outcome in contrast to other studies where it was the mother's level of education that was significantly inversely associated with an adolescent developing anaemia [44]. Though in the present study, education status of the father was significantly associated with anemia, this was in contrast to a study [34] where there was no significant difference between the presence of anemia and the level of education of parents.

Respondents whose fathers had completed primary and postsecondary level of education in this study had a negative association with a respondent having anaemia. Probably the education of the fathers determined consumption of foods rich in iron either through informed choices or higher incomes leading to provision of meats and fish in the diet. Respondents whose fathers had achieved at least primary education were 78.6% less likely to develop anaemia as opposed to those whose fathers had informal education. This may suggests that primary school completion, in essence basic education contributes to dietary diversity and quality.

Findings in this study revealed that the number of women who had completed primary and secondary education was higher at 40.9% and 32.6% respectively, compared to that of men at 23.9% and 28.7% respectively. However, the number of mothers who had completed post-secondary level of education was lower at 12.2% compared to that of fathers at 33%. This could be because the education of girls until recently was taken lightly or ignored altogether as the district is still experiencing low average secondary school attendance years among girls (2.4 years) and a high (40%) drop out rate [27].

Although the mean iron intake among these respondents was above the EAR, most reported that they took tea together with their meals (97.4%). This is the same number of respondents who took lunch at school. Lunch offered in all the schools was mixed maize and beans together with a mug of black tea. The intake of the black tea together with the meals counters the benefit of the dietary iron intake as absorption of iron is inhibited by tannins which are present in tea. Other studies have indicated that consumption of 1 or 2 cups of tea decreased iron absorption in the control subjects by 49% (P < 0.05) or 66% (P < 0.01), respectively, and in the IDA group by 59% or 67% (P < 0.001 for both), respectively [45].

It is important to note that there was a possibility of confounding factors such as sickle cell anaemia that could have influenced the prevalence of anaemia to be high though this was not assessed in this study.

6. Conclusions

In conclusion therefore the study revealed that there was high prevalence anaemia (26.5%) among the study sample which is consistent with the WHO estimate but higher than that found by some community based studies from the rest of the world. Considering that anemia development is a consequence occurring at a later stage of iron deficiency, the high anaemia prevalence therefore indicates a serious iron deficiency problem among these respondents. There was a high prevalence of mild and moderate anemia among the respondents. This group if not addressed could easily slip into the severe anaemia. The high prevalence of mild and moderate anemia observed cannot be under emphasized. This needs attention so as to bring down total prevalence of anemia among the respondents.

The other factors that were significantly associated with the presence of anaemia (p≤0.05) among the respondents were the age of the respondent and the educational attainment of the father. At the same time, consistent with other studies respondents who tested positive for malaria were significantly (p≤0.05) more likely to develop anaemia than the respondents who tested negative. Similar results were observed for respondents who tested positive for worm infestation.

Based on the results of this study, anaemia is a major problem among adolescent girls in Yala Division. There is inadequate dietary iron intake as well as a high dietary iron absorption inadequacy. Findings suggest that dietary factors superimposed on physical growth spurt may be playing a larger role in causation of anaemia than diet alone. However a detailed dietary survey is required to address these issues.

7. Recommendations

Considering the high prevalence of iron inadequacy and anemia during adolescence in this study, there is need for anemia prevention, and control in Yala division. Efforts should be made to prevent adolescent anemia and its damaging consequences using an appropriate mix of interventions that address the multiple causes of anemia and iron inadequacy identified in this study among this population as recommended below.

- There is need for Ministry of Public Health and local health based non- governmental organizations to ensure continued periodic deworming in Yala division so as to eradicate the prevalence of ova ascaris.
- Attention should be given to adolescent girls as they grow older ($\geq$17 years) since they are prone to anaemia. This could be done by regular supplemention with ferrous and folic acid through the schools and health facilities.
- There is need of an ongoing nutrition education programme targeting the school cooks and school heads, adolescent girls' mothers and caregivers. They should be taught by nutritionists the counter effect of tannins, fiber and phytates on dietary iron absorption. Therefore the respondents should consume foods and beverages which contain substances that inhibit iron absorption from plant foods at least one hour after meals (e.g. tea, milk and milk products) and take fruits and vegetables rich in Vitamin C or plain safe drinking water together with their meals.
- Since asymptomatic malarial parasitemia contributes to anaemia reducing concentration and learning in the classroom, efforts should be put in place to encourage the use of long lasting insecticide treated bed nets and the spraying of areas surrounding households to discourage breeding of mosquitoes. Intermittent Preventive Treatment (IPT) nets delivered through schools is a simple intervention, which can be readily integrated into broader school health programmes. Anaemia attributable to malaria may also be reduced by giving antimalarial chemoprophylaxis in the schools through the ministry of public health.
- These results may be used in policy formulation regarding adolescents in this area and other similar areas in the country.

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