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HAEMATOLOGICAL STATUS AND ANAEMIA PREVALENCE AMONG CHILDREN AGED 5 TO 11 YEARS IN SCHOOL CANTEENS IN ABIDJAN (CÔTE D'IVOIRE)

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ABSTRACT

In Côte d'Ivoire, as in most developing countries, anaemia is a public health problem. The country possesses 5259 canteens in more than 8000 primary schools. Children attending schools with canteens are they concerned with public health problem that is anaemia? Their haematological profile conforms to the standards set by international organizations? To answer these questions, a study was conducted and aimed to determine the prevalence of anaemia in a school population and to study the typology. The work has focused initially on 350 subjects and 310 children (172 girls and 138 boys) aged 5 to 11 years were selected from three municipilities of Abidjan. Blood samples were taken from each child in order to search for the parameters of the blood count and the electrophoretic profile of hemoglobin. The results of study revealed that 82.9 % of children have indicated abnormal haematological status. The prevalence of anaemia (hemoglobin < 11.5 g/dl) was 30.3 % with 33.3 % of males and 29.1 % for girls. Moreover, the mean values parameters of the blood count were compared in accordance with standards established by international organizations. In addition, haemoglobinopathies was found in these children (16.1 %), including sickle cell trait and hemoglobin C traitThe prevalence of anemia among school children selected in Abidjan is more considerable. This could be explained by a deficiency of micronutrients. In view of the results obtained, it is important to extend the work to all school canteens in order to assess the factors of anaemia and to determine normal values parameters of the blood count of children in such environment.

Keywords: Anaemia, Typology, Norms of Blood Cells Count, Children, School Canteens/Abidjan (Côte d'Ivoire)

INTRODUCTION

In Côte d'Ivoire for several years, children benefit from meals at schools like some nations in the world. The number of school canteens to 5259, is for these children a strong opportunity which should guarantee good nutrition in over 8000 primary schools in the country. To this end, school canteens should resolve the concerns of nutritional deficiency and overload. Nutritional deficiencies and overloads represent in school children a real concern for public health (El-Hioui *et al*., 2008a). They may lead to anaemia and obesity (Kuyumcu *et al*., 2007; Handa *et al.*, 2008; Mohamed, 2008; Ramzan *et al*., 2009; Mirhosseini *et al*., 2011). Anaemia is the most common health problem in the world (Maitland *et* *al*., 2005; Al-Assaf, 2007). It is the greatest common nutritional disorder worldwide and particularly in Africa, where pregnant women, infants and young children are most affected (Dillon, 2000; Gur *et al*., 2005; Hazarika *et al*., 2012; Chhabra et al., 2012). The prevalence of anaemia in the world is 24.8 % (WHO, 2008). The preschool children are most affected with a prevalence of 47.4 %, followed by pregnant women (41.8 %), non pregnant women (30.2 %) and school age children (25.4 %). In each age group and sex studied, the highest prevalence is found in Africa (McLean *et al*., 2006). Anaemia has multiple consequences which can be extremely severe (Goudarzi *et al*., 2008; WHO, 2008; Ahmadi *et al*., 2010). This is the disturbance of physical and mental development often irreversible in infants and children, of least resistance to infections, tiredness and decreased physical and intellectual abilities (Colomer *et al*., 1990; Scholl and Hediger, 1994; Sakande *et al*., 2004; Unsal *et al*., 2007; Hadipour *et al*., 2010). Despite the multiple consequences of this disease, few investigations are conducted at schools in Côte d'Ivoire. The aim of this study was to determine the prevalence of anaemia and its typology in a population of children aged 5 to 11 years in three municipalities of Abidjan. The study has also conducted the possible changes in the complete blood count of these children in schools. Studies have equally indicated the sex was most exposed to anaemia. In addition, the investigations have proposed standards for parameters blood cell counts among this fringe of school children. Moreover, the investigations have evenly presented hemoglobin profile of these children.

MATERIALS AND METHODS

Setting and study population

In total of 350 school children were selected to achieve a definitive size of 310 pupils including 172 girls and 138 boys (Figure 1). The mean age of the study population was 7.7 ± 0.1 years and ranged from 5 to 11 years (Table 1). The investigation was a cross sectional and descriptive study in school children living in three municipalities in Abidjan. This study occurred at the school group "Libanais Yopougon Ananeraie", primary school "BAD Cocody Belle Côte" and the School Group "Agbékoi Abobo" (Figure 1). This work was carried out during a period from September 2010 to December 2012. The collection of anthropometric data of this study was done from a questionnaire sent to children with free and informed consent of parents, following an explanation of the interest of the study. For the requirements of handling, criteria for inclusion and exclusion have been applied for subject selection. It comes to mainly haematological and gastrointestinal complications and inflammation in the three months preceding the study. All these observations were carried out by a medical team from the National Institute of Public Health (INSP) in Abidjan (Côte d'Ivoire).

Blood samples and determination of biological parameters

Samples of venous blood from each child are taken into tubes containing an anticoagulant, ethyl diamine tetra acetic acid (EDTA) in the morning. The determination of haematological parameters was performed immediately after homogenization to Coulter, by an automatic analyzer "Sysmex KX 21N". Moreover, in order to establish the standards parameters of the blood count, all anaemic children were excluded in the second phase of data processing. Criteria defined by the World Health Organization (WHO) were used to estimate different prevalences of the main haematological parameters. In addition, an electrophoretic profile of hemoglobin for each child was conducted from a volume of packed red blood cells at alkaline pH to cellulose acetate by"Helena".

Statistical analysis

For statistical analysis, data were entered and analyzed by the STATISTICA software

(Windows version 7.1). The mean values of different investigated parameters in school children were compared using the non parametric Mann Whitney U. The comparisons of different proportions of the main obtained biological parameters from the blood count and hemoglobin electrophoresis were performed by the test Loglikelihood ratio (Test "G") with the statistical software "R" version 2.0.1 Windows. $p < 0.05$ was considered as indicative of significance.

RESULT

Changes in haematological parameters

The values were in accordance with the normal physiological reference values from the literature except for the rate of lymphocytes which is higher overall and by sex. All the parameters did not indicate significant differences between girls and boys (Table 2). In contrast, mean corpuscular volume and mean corpuscular hemoglobin have been statistically different by sex. These two haematological parameters were higher in girls compared to boys. All of 216 non anemic school children showed normal mean values compared with the standards established by international organizations (Table 3). However, the proportion of lymphocytes has been sufficiently high relative to the reference value. Furthermore, no significant differences were observed between girls and boys for all the parameters of the blood count. Conversely, a significant difference was shown at the mean corpuscular hemoglobin between the two sexes. In this context, girls reported a mean value of mean corpuscular hemoglobin more increased compared to boys.

Prevalence, typology of anaemia and hemoglobin phenotype

The results of the study showed that 82.9 % of school children reported that at least one parameter of the blood count, was abnormal (Table 4). The haematological status was the same for girls (82.6 %) than in boys (83.3 %) with no statistically significant difference between these two groups of children. The prevalence of anaemia was 30.3 % in total population. It was observed in 33.3 % of boys and 28.1 % of girls with no statistically significant difference. Among these anaemias, 57.5 % are hypochromic (18.1 % microcytic hypochromic anaemia and nornocytic hypochromic anaemia 39.4 %), 18.1 % are microcytic (microcytic hypochromic anaemia) and 4.3 % macrocytic (macrocytic normochromic anaemia). In addition, normocytic anaemia was observed in 77.7 % of children and normochromic anaemia in 42.6 %. Microcytic hypochromic anaemia in boys (25 %) was significantly higher compared to girls. Normocytic hypochromic anaemia and macrocytic normochromic anaemia were also more observed in boys than girls with no significant difference. However, normocytic normochromic anaemia was higher among girls than boys with a significant difference. Macrocytosis and microcytosis were indicated respectively in 5.2 % and 10.3 % of subjects with no significant difference between the two sexes. But hypochromia was observed in 35.5 % of children with a significant difference between girls and boys. The proportion of subjects whose hematocrit was below 36 % is 29.4 %. These rates do not change significantly by sex. The results of studies have also shown in Table 5 that 4.2 % and 0.7 % respectively of the children had leukopenia and leukocytosis. Similarly, high neutropenia, lymphocytosis, and thrombocytosis were reported respectively in 44.8 %, 88.7 % and 20 % of study subjects. In contrast, the total population of the investigations has reported normal levels of eosinophils, low proportions of lymphopenia (0.3 %), of monocytopenia (6.5 %) and thrombocytopenia (1.9 %). In the two groups of children, no significant differences were reported for all proportions of leukocyte and thrombocyte parameters. However, girls presented slightly higher proportions of leukocytosis, neutropenia, lymphocytosis and thrombocytosis compared to boys. In contrast, boys reported more or less elevated rates of leukopenia and monocytopenia compared to girls. Screening for hemoglobin disorders in school children revealed that 16.1 % of them are carriers of these anomalies (Figure 2). The most observed abnormalities were the sickle cell trait AS, hemoglobin C trait and sickle cell trait. The observed deficiencies have not significantly different between sex.

DISCUSSION

This study examined the extent of anaemia and its typology in a population of school children aged 5 to 11 years and attending school canteens in three municipalities of Abidjan. This work also helps to design appropriate monitoring in order to avoid the early onset of anaemia among school children. In this context, different mean values of haematological parameters are similar to physiological values reported in literature by standards of World Health Organization (WHO) except for lymphocytes. These different means are similar to those obtained in Saudi Arabia among children of school age (El-Hazmi and Warsy, 2001). According to these Saudis authors, no significant differences between girls and boys for all parameters of the blood count were observed. Mean value of hemoglobin obtained in this study is similar to that indicated in a rural population of school children of Vietnam (Le *et al*., 2007). Same results were also reported on a similar population of children with the same age group in Dublin (Ireland) (Taylor *et al*., 1997).

From data available in accordance with the literature, anaemia is very common among school age children and these investigations confirm this. Prevalence of anaemia in this study population was 30.3 %. This rate is relatively lower than that obtained in Côte d'Ivoire in children with same age (46 %) (Asobayire *et al*., 2001). This decrease could be explained by the fact that study was extended to rural population with different demographic characteristics from those of these subjects. In addition, other studies reported higher prevalences of anaemia in school children (Gomber *et al*., 1998; Verma *et al*., 1998; Sudhagandhi *et al*., 2011). In the same vein, urban African Cameroon recorded a rate of anaemia (42.8 %) among children aged 5-10 years by considering the pathological rate of hemoglobin to 11g/dl (Mbanya *et al*., 2008). Conversely, the prevalence of anaemia in this study is higher than that specified elsewhere. Such is the case from work which indicated a lower rate of anaemia (12.2 %) in a population of children in Morocco, but no significant difference between girls and boys as in this study (El-Hioui *et al*., 2008b). This could be explained by the socioeconomic and cultural development of children in each study areas (UNICEF/WHO/UNU/MI, 1998; Singh and Sachan, 2011). Moreover, the presence of canteens in selected schools for needs of our study may reflect low observed prevalence in children. Mean values of MCV and MCH are statistically different by gender. These values are higher for girls than for boys. This result is contrary to that which revealed no significant difference between girls and boys (Rakoto *et al*., 2000). There is no severe anaemia in this study group. This result is similar to that carried out among school children in India (Sudhagandhi *et al*., 2011).

The hypochromia and microcytosis in this population are higher in boys than in girls. This decrease in MCV and MCH might indicate a deficiency in micronutrients including iron and vitamins in this population (Ugwuja *et al*., 2007; Ramzan Ali and Salam, 2009). Anaemia has multifactorial causes (Veghari *et al*., 2007; Porniammongkol *et al*., 2011). The main reason for the onset of anaemia is of a food (Dillon, 2000). Food in populations of developing countries is deficient in micronutrients (Oguntona and Akinyele, 2002; Yapi *et al*., 2005a; Mohamed, 2008). The content and composition of meals in canteens could explain reduction in prevalence of anaemia in subjects of this study compared to work above mentioned (Zaidi *et al*., 1999; El-Hioui *et al*., 2008a; Mamat *et al*., 2012). All nutrients (macronutrients and micronutrients) that could include daily diet are the cause of decline in rate of hemoglobin in children of these investigations (Kuyumcu *et al*., 2007; Amuta and Houmsou, 2009; Kooshki *et al*., 2010).

However, changes in leukocyte and thrombocyte parameters are modified compared to standards. Côte d'Ivoire is situated in an area with high malaria endemicity (Yapi *et al*., 2005a et b; Mfonkeu *et al*., 2008; Yapi *et al*., 2010). Furthermore, influence of malaria on anemia in populations is demonstrated (Umar *et al*., 2007). Infectious and inflammatory syndromes and haemoglobinopathies degrade haematological status of populations (Ahmed *et al*., 2006; Shehu *et al*., 2006; Singotamu *et al*., 2006; Odebunmi *et al*., 2007; Inocent *et al*., 2008; Pourfallah *et al*., 2011). In this same way, screening for haemoglobinopathies in children revealed that 16.1 % of children are carriers of these anomalies in this study. This is lower than that observed respectively 19 % and 22.5 % in Côte d'Ivoire (Asobayire *et al*., 2001; Sakande *et al*., 2004). This could explain alteration of haematological parameters of children in this study. In addition, the proposed standards parameters of the blood count should consider all these factors and represent those obtained in the case of the study. It would be judicious to extend this study to 5259 canteens in over 8000 primary schools in Côte d'Ivoire.

CONCLUSION

The investigations carried out among school children in Abidjan indicate that the prevalence of anaemia is significant with established standards. However, the rate of anaemia is low compared to previous work by other authors in Côte d'Ivoire. It is also clear from this study that the haematological status of these children is strongly altered. In selected circumstances of the study, the different blood count parameters of children in school canteens should be better than the results reported in other investigations elsewhere in developing countries. The crisis that the country has experienced since 2002 has had to reduce the efforts of officials in charge of school meals supported by international agencies (World Food Programme, World Bank). It is suitable for us to regain the growth dynamics of school meals which should be maintained in any school in the Côte d'Ivoire. Moreover, it must be determined through several work standards parameters of blood count, even if we have given up only those children in three municipalities of Abidjan. We intend to participate in a larger project including all 5259 school canteens for one hand to obtain a true prevalence of anaemia involving the standards of the blood count and also to indicate the micronutrient status (minerals and vitamins), nutritional status and the bioavailability of nutrients in the meals served to children. This advised us to avoid the early onset of nutritional deficiency and overload in children that can impede their physical and intellectual capacity.

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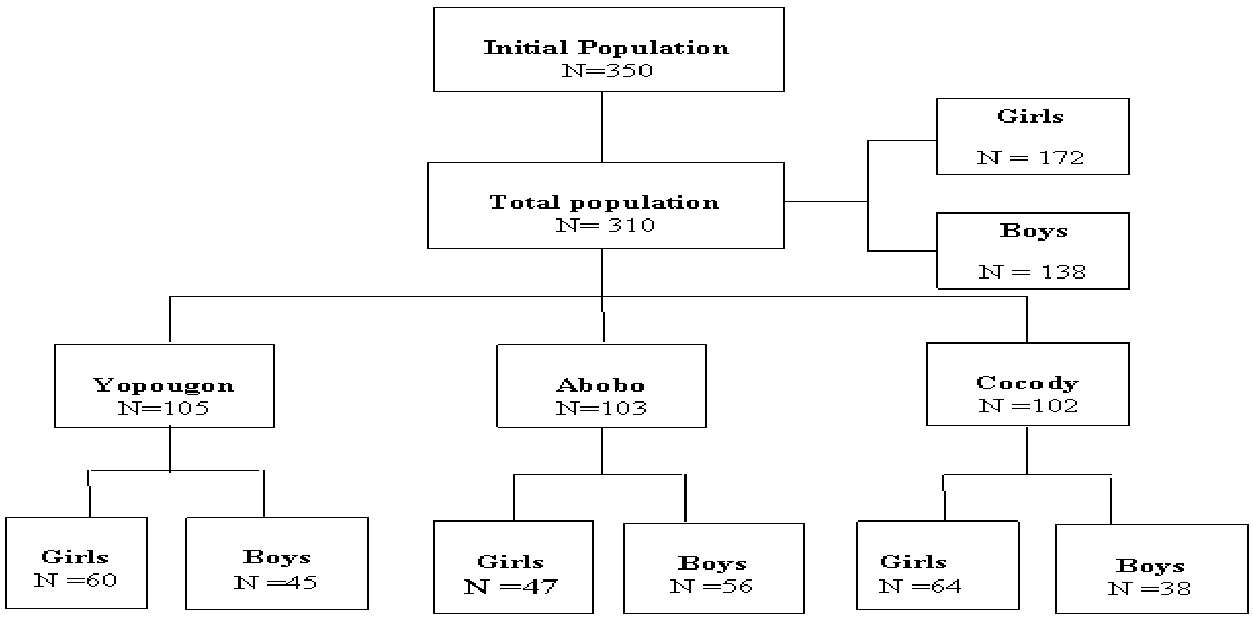

Fig 1: Size of selected populations for the study
N: Size of subject groups

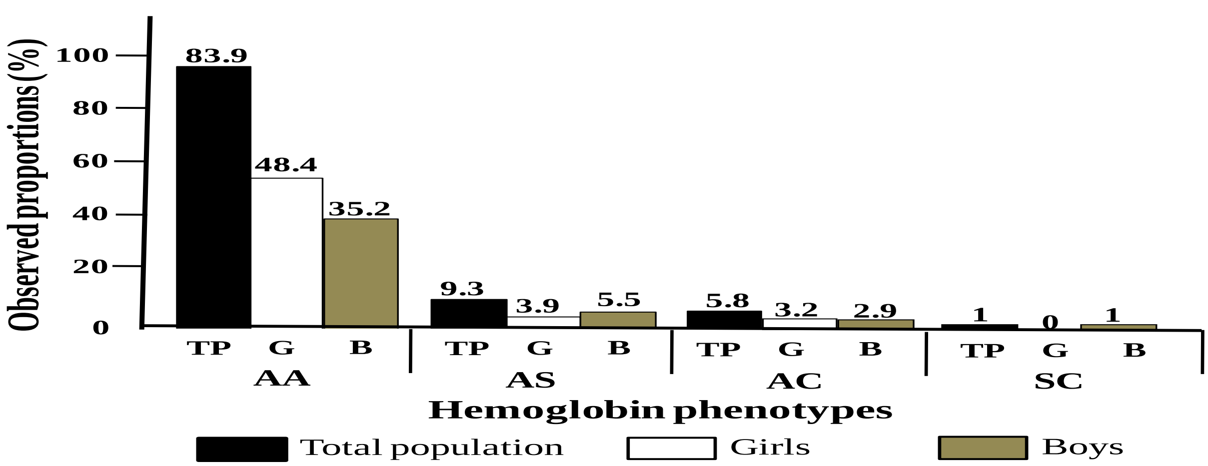

Fig 2: Evolution of Hemoglobin phenotypes in different groups of subjects
TP: Total population; G: Girl; B: Boys; AA: Normal form of hemoglobin; AS, AC and SC: Forms of haemoglobinopathies

Table 1: Characteristics of study population

General characteristics	Total population N=310	Girls N=172	Boys N=138
Age (ans)	7,7 ± 0,1	7,8 ± 0,1	7,6 ± 0,2
5 – 6	27,3 % (99)	27,3 % (47)	37,7 % (52)
7 - 11	68,1 % (211)	72,7 % (125)	62,3 % (86)
Height (cm)	124,5 ± 0,6	125,9 ± 0,9	122,8 ± 0,2
Weight (kg)	22,7 ± 0,3	23,3 ± 0,4	21,8 ± 0,04
Wasting (W/A)			
(Z-score rated, mean)	-0,9 ± 0,6	-0,8 ± 0,1	-1,1 ± 0,1
< -2Z	15.5 % (48)	13.4 % (23)	18.1 % (25)
= –2Z	84.5 % (262)	86.6 % (149)	81.9 % (113)
> -2Z	0 % (0)	0% (0)	0 % (0)
Stunting (T/A)			
(Z-score rated, mean)	-0,14 ± 0,01	0,0 ± 0,1	-0,3 ± 0,1
< -2Z	5.5 % (17)	4.1 % (7)	8 % (11)
= –2Z	87.7 % (272)	86.1 % (148)	89.1 % (123)
> 2Z	6.8 % (21)	9.9 % (17)	2.9 % (4)
BMI			
(Z-score rated, mean)	-1,3 ± 0,01	-1,2 ± 0,1	-1,5 ± 0,1
< -2Z	26.8 % (83)	23.8 % (41)	30.4 % (42)
= –2Z	72.9 % (226)	75.6 % (130)	69.6 % (96)
> 2Z	0.3 % (1)	0.6,% (1)	0 % (0)

(): Observed numbers in each group of subjects are in brackets; N: Size of subject groups

Table 2: Mean values of haematological parameters in total population

Haematological parameters	Total population N=310			Girls N=172			Boys N=138			p value	Reference values
	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max		
Red blood cells (10^{12}/l)	4.8 ± 0.02	3.6	6.5	4.2 ± 0.003	3.7	6.5	4,9 ± 0,004	3.6	5.9	0,3(NS)	3,5 - 5
Hemoglobin (g/dl)	11,9 ± 0,1	8.6	14.3	12,04 ± 0,1	8.7	14.3	11,8 ± 0,1	8.6	14.2	0,09(NS)	11,5 - 16
Hematocrit (%)	37.2 ± 0.2	27.8	42.7	37.4 ± 0.2	27.8	42.7	37 ± 0.2	30.2	42.4	0,3(NS)	36 - 44
MCV (fl)	77.3 ± 0.3	56	90.6	77.9 ± 0.4	56	88.4	76.6 ± 0.5	64.5	90.6	0,01(S)	70 - 86
MCH (pg)	24.9 ± 0.1	16.6	37.9	25.2 ± 0.2	17.6	37.9	24.6 ± 0.2	16.6	33.6	0,01(S)	24 - 31
MCHC (g/dL)	32.1 ± 0.8	25	35.5	32.2 ± 0.1	27.6	35.5	31.9 ± 0.1	25.1	35	0,1(NS)	32 - 36
Leucocytes (10^{6}/l)	6.04 ± 0.1	3.1	13.1	6 ± 0.1	3.5	13.1	6.1 ± 0.1	3.1	10.4	0,4(NS)	4 - 12
Neutrophils (%)	41.5 ± 0.5	21	75	40.8 ± 0.5	23	75	42.3 ± 0.8	21	63	0,1(NS)	40 - 70
Eosinophils (%)	2.1 ± 0.1	1	5	2.1 ± 0.1	1	5	2.1 ± 0.1	1	5	0,4(NS)	1 - 5
lymphocytes (%)	51.3 ± 0.5	15	75	52.02 ± 0.5	15	72	50.4 ± 0.9	26	75	0,2(NS)	20 - 40
Monocytes (%)	5.2 ± 0.1	2	8	5.1 ± 0.1	2	8	5.2 ± 0.1	2	8	0,2(NS)	4 - 10
Thrombocytes (10^{6}/l)	324.1 ± 5.1	87	589	328.1 ± 7	100	589	319.2 ± 7.6	87	575	0,3(NS)	150 - 400

N: Total number of each subjects group; MCV: Mean Corpuscular Volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; SEM: Standard error of mean; Min: Minimum; Max: Maximum; S: Statistically different for p value < 0.05; NS: Not statistically significant for p value < 0.05

Table 3: Normal haematological mean values in non anaemic subjects

Haematological parameters	Total population N=216			Girls N=122			Boys N=94			p value	Reference values
	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max	Mean ± SEM	Min	Max		
Red blood cells (10^{12}/l)	4.9 ± 0.03	4.3	6.02	4.9 ± 0.04	4.27	6.02	4.9 ± 0.04	5.13	5.91	0,3 (NS)	3.5 - 5
Hemoglobin (g/dl)	12.5 ± 0.1	11.5	14.3	12.5 ± 0.1	11.5	14.3	12.4 ± 0.1	11.5	14.2	0,1 (NS)	11.5 - 16
Hematocrit (%)	38.4 ± 0.1	33.7	42.7	38.5 ± 0.2	33.7	42.7	38.3 ± 0.2	34.8	42.4	0,5 (NS)	36 - 44
MCV (fl)	78.3 ± 0.3	66.6	90.6	78.7± 0.5	66.9	88.4	77.8 ± 0.5	66.6	90.6	0,1 (NS)	70 - 86
MCH (pg)	25.4 ± 0.1	19.5	30.3	25.7 ± 0.2	19.6	29.6	25.1 ± 0.2	19.5	30.3	0,04 (S)	24 - 31
MCHC (g/dL)	32.4 ± 0.1	28.7	35	32.6 ± 0.1	28.7	35	32.3 ± 0.1	28.8	35.2	0,1 (NS)	32 - 36
Leucocytes (10^{6}/l)	6 ± 1	3.2	12.4	6 ± 0.1	3.5	12.4	6 ± 0.2	3.2	10.4	0,8 (NS)	4 - 12
Neutrophils (%)	41.7 ± 0.6	21	64	41.2 ± 0.7	23	64	42.4 ± 0.9	21	63	0,3 (NS)	40 - 70
Eosinophils (%)	2.1 ± 0.6	1	5	2.1 ± 0.1	1	4	2.1 ± 0.1	1	5	0,6 (NS)	1 - 5
lymphocytes (%)	50.9 ± 0.6	26	75	51.5 ± 0.8	26	72	50.1 ± 0.9	26	75	0,4 (NS)	20 - 40
Monocytes (%)	5.2 ± 0.1	2	8	5.2 ± 0.1	2	8	5.31 ± 0.1	3	8	0,4 (NS)	4 - 10
Thrombocytes (10^{6}/l)	321.5 ± 5.8	87	570	324.8 ± 7.7	109	570	318.1 ± 8.6	87	556	0,5 (NS)	150 - 400

N: Total number of each subjects group; MCV: Mean Corpuscular Volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; SEM: Standard error of mean; Min: Minimum; Max: Maximum; S: Statistically different for p value < 0.05; NS: Not statistically significant for p value < 0.05

Table 4: Proportions (%) of the main erythrocyte parameters

Erythrocytes parameters	Total population N=310		Girls N=172		Boys N=138	
Haematological status	n	% (CI 95 %)	n	% (CI 95 %)	n	% (CI 95 %)
Normal	53	17.1 (12.9-21.3)	30	17.4 (11.7-23.1)	23	16.7 (10.5-22.9)
Abnormal	267	82.9 (78.7-87.1)	142	82.6 (76.9-88.2)	115	83.3 (77.1-89.5)
Hemoglobin (g/dl)						
8.6 - 11.5	94	30.3 (25.2-35.4)	50	29.1 (22.3-35.9)	44	31.9 (24.12-39.7)
11.5 – 14.3	216	69.7 (64.6-74.5)	122	70.9 (64.1-77.7)	94	68.1 (60.32-75.88)
Types of anaemia						
Light	55	58.5 (48.5-68.5)	32	64** (50.7-77.3)	23	52.3 (37.5-67.0)
Moderate	39	41.5 (31.5-51.5)	18	36** (22.7-49.8)	21	47.7 (32.9-62.5)
MHA	17	18.1 (10.31-25.9)	6	12 (2.9-21.0)	11	25* (12.21-37.8)
NHA	37	39.4 (29.5-49.3)	18	36 (22.7-49.3)	19	43.2 (28.6-57.9)
NNA	36	38.3 (24.5-48.1)	24	48* (34.1-61.8)	12	27.3 (14.1-40.5)
mNA	4	4.3 (0.2-8.4)	2	4 (-1.4-9.4)	2	4.5 (-1.63-10.6)
Hematocrit (%)						
27.8 - 36	91	29.4 (24.3-34.5)	48	27.9 (21.2-34.6)	43	31.2 (23.47-38.9)
36 – 42.7	219	70.7 (65.6-75.8)	124	72.1 (65.4-78.8)	95	68.8 (61.1-76.5)
MCV (fl)						
56 - 70	32	10.3 (6.9-13.7)	12	07 (3.2-10.8)	20	14.5 (8.63-20.4)
70 - 86	262	84.5 (80.5-88.5)	151	87.8 (82.9-92.7)	111	80.4 (73.78-87.0)
86 – 90.6	16	5.2 (2.7-7.7)	9	05.2 (1.9-8.5)	7	05.1 (1.43-8.77)
MCH (pg)						
16.6 - 24 and 31 – 37.9	110	35.5 (30.2-40.8)	47	27.3* (20.6-33.9)	63	45.7* (37.39-54.0)
24-31	200	64.5 (59.2-69.8)	125	72.7 (66.04-79.4)	75	54.4 (46.1-62.7)

N: Total number of each subjects group; n: subjects number observed in each group; CI: Confidence interval; MCV: Mean Corpuscular Volume; MCH: Mean corpuscular hemoglobin; *: Groups with differences were significant at $p < 0.05$, **: Groups with differences were significant at $p < 0.01$; MHA: Microcytic Hypochromic Anaemia; NHA: Normocytic Hypochromic Anaemia; NNA: Normocytic Normochromic Anaemia; mHA: macrocytic Hypochromic Anaemia

Table 5: Proportions of main white blood cells and thrombocytes parameters

Leukocytes and thrombocytes Parameters	Total population N = 310		Girls N = 172		Boys N = 138		p values
Leucocytes (10^6/l)	n	% (CI 95 %)	n	% (CI 95 %)	n	% (CI 95 %)	
3,1 - 4	13	4.2 (2-6.5)	5	1.6 (0.2-3.5)	8	2.6 (-0.1-5.3)	0.6 (NS)
4 - 12	295	94.2 (91.6-96.8)	165	53.2 (45.7-60.7)	130	41.9 (33.7-50.1)	0.2 (NS)
12 – 13,1	2	0.7 (0.2-1.5)	2	0.7 (-0.6-1.9)	0	0.00 (0-0)	0.3 (NS)
Neutrophils (%)							
21- 40	139	44.8 (39.3-50.4)	78	25.2 (18.7-31.7)	61	19.7 (13.1-26.3)	0.4 (NS)
40 - 70	170	54.8 (49.3-60.4)	92	29.7 (22.87-36.5)	78	25.2 (17.9-32.4)	0.5 (NS)
70 - 75	1	0.3 (0.1-1)	1	0.3 (-0.5-1.1)	0	0 (0-0)	0.5 (NS)
Eosinophils (%)							
1 – 5	310	100	172	100	138	100	-
Lymphocytes (%)							
15 - 20	1	0.3 (0.3-1)	1	0.3 (-0.5-1.1)	0	0 (0-0)	0.5 (NS)
20 – 40	34	11 (7.5-14.5)	12	3.9 (1.0-6.8)	22	7.1 (2.8-11.4)	0.3 (NS)
40 - 75	275	88.7 (85.2-92.2)	159	51.3 (43.8-58.8)	116	37.4 (29.3-45.5)	0.1 (NS)
Monocytes (%)							
2 - 4	20	6.5 (3.7-9.2)	8	2.6 (0.2-4.9)	12	3.9 (0.7-7.1)	0.6 (NS)
4 – 10	290	93.6 (90.8-96.3)	164	52.9 (45.4-60.4)	126	40.7 (32.5-48.9)	0.2 (NS)
Thrombocytes (10^6/l)							
87 - 150	6	1.9 (0.4-3.5)	4	1.3 (-0.4-2.9)	2	0.7 (-0.7-2.1)	0.6 (NS)
150 – 400	242	78.1 (73.5-82.7)	130	41.9 (34.5-49.3)	112	36.1 (28.1-44.2)	0.5 (NS)
400 - 589	62	20 (15.6-24.5)	38	12.3 (7.4-17.2)	24	7.7 (3.3-12.1)	0.3 (NS)

N: Total number of each subjects group; SEM: Standard error of mean; NS: Not statistically significant for p value < 0.05