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PREVALENCE AND SEVERITY OF ANEMIA AMONG CHILDREN AND ADOLESCENTS AGED 0–18 YEARS AT GATUNDU HOSPITAL

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ABSTRACT

Anemia is regarded as a priority public health problem with more health consequences in both children and adults. Therefore, its evaluation to determine the prevalence and magnitude is necessary. The aim of this study was to identify the prevalence, type of anemia and severity level of anemia among children and adolescents in Gatundu Level 5 Hospital. A cross-sectional study design was used with the study population being all the complete blood count results of children of 0–18 years at Gatundu Level 5 Hospital. Of the 384 the anemia prevalence was 42.7% of which 9.9%, 23.2% and 9.6% were for 0–1 years, 2–10 years and 11–18 years, respectively. Anemia cases in 0–1 years were not severe, 9% of the cases in 2–10 years had severe and moderate anemia while 12.7% had moderate and severe anemia in 11–18 years. Microcytic was common in 0–1 years (56%) and in 2–10 years (79%) while Normocytic was common in 11–18 years (60%). In conclusion, higher prevalence of anemia was in children (2–10 years) and in female adolescents (11–18 years). Further studies are recommended in order to identify the causes and prevention of further complications.

***Keywords*:** Adolescents, Anemia, Prevalence and severity, Kenya

INTRODUCTION

Anemia, as per the World Health Organization, is defined as a condition in which the population of erythrocytes or their oxygen-carrying capacity is less to meet the body's requirements (Deivita *et al.* 2021). This condition is regarded to be a major public health

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problem with a total of about 200 million people being reported to be suffering from anemia globally (Sherova *et al.* 2020). The distribution of anemia conditions in low- and middle-income countries indicates that 47% are children aged 6–59 months and 30% are women of childbearing age 15–49 years (Sun *et al.* 2021).

The etiology of anemia is multifactorial with factors such as iron deficiency, infections, genetics and other malnutrition contributing to its emergence (Van, Kraemer and Melse 2021). Among these factors, iron deficiency is regarded as the main etiology in almost half of the anemia cases that are reported in children (Wang 2016). The deficiency may arise due to insufficient dietary intake of iron, difficulties in the absorption of iron, high demand for iron mostly in children during rapid growth, and also chronic loss of blood (Subramaniam and Girish 2015). The deficiency of folate vitamin B12 and vitamin A also is a nutritional factor that contributes to the emergence of anemia (Sherova *et al.* 2020). Infection as an etiology of anemia is ranked as the second factor after iron deficiency. Infections such as malaria, helminthiasis, viral, chronic conditions, blood loss and bone marrow-related are reported to contribute to the pathogenesis of anemia (Chaparro and Suchdev 2019).

In low-income countries, the prevalence of anemia is high among children and is considered as severe health issue (Hasan *et al.* 2021). This anemic problem is alarming in Sub-Saharan African nations including Kenya at 48.9%, Mali at 55.8% and Tanzania at 79.6% (Assefa, Mossie and Hamza 2014). The main contributing effects are inadequate awareness among families about the problem linked with illiteracy, poor nutritional practices, inappropriate food habits, low to none of the iron in diets, lack of physical exercise and infections caused by parasitic agents (Lufungulo *et al.* 2020). These factors are associated with reduced levels of Haemoglobin (Hb) in children.

Despite anemia being spread all over the world and remaining a public health issue both in developing and developed countries, very little has been done to identify its prevalence as well as severity. In many studies conducted, almost all have investigated the prevalence of anemia in adults. From these studies, it has been revealed that young school-going children and adolescents have been largely left out (Van, Kraemer and Melse 2021). This has been due to thoughts that young children and adolescents are less prone to nutritional deficiency. In Kenya, very few studies tackling the prevalence of anemia, its severity and types among children and adolescents have been conducted. No study has been done on the same in Gatundu Level 5 Hospital. In children, the consequences of anemia on cognitive development as physical growth are of concern and there is a need of investigation of the prevalence and the severity. Hence, the main aim of the current study will be to establish the prevalence of anemia and the severity level of children and adolescents visiting Gatundu Level 5 Hospital in Kiambu County, Kenya.

METHODS

Study Design

This study used a hospital-based cross-sectional design to determine the prevalence and severity index of anemia among children and adolescents in Gatundu Hospital. This retrospective study was conducted in Gatundu Hospital. This is a level five facility located along Gatundu-Kinare road in Gatundu town, Gatundu South Sub-County within Kiambu. The facility was founded in the year 1996 by the first president of the Republic of Kenya and it has transformed to the level five status it attained in the year 2017. This facility has a bed capacity of about 300 and offers both inpatient and outpatient services.

Study Population

This study's targeted population was all the complete blood count results submitted to the lab at the Gatundu Level 5 Hospital by children and adolescents of age between 0–18 years within a period of December 2022 to February 2023. To determine the sample to be used in this study, the calculations followed the use of the Jain and Gupta formula (Jain, Gupta and Jain 2015).

$$n = \frac{Z^2 pq}{E^2}$$

Where n is the minimum number of samples, Z is the confidence interval at 95% (1.9 for this study), p is the percentage of the population with characteristics of interest (valued 0.5), q is the estimated proportion of failures or 1–p, E is the maximum allowance of error (valued 0.5) and therefore, the sample size will be 384.

Inclusion and Exclusion Criteria

Inclusion criteria

This study only included the authorised full blood count results that were obtained from children and adolescents in the age bracket of 0–18 years at the Gatundu Level 5 Hospital laboratory.

Exclusion criteria

The authorised full blood count results of the blood samples obtained from patients with previous history of chronic diseases were not included in this study.

Data Collection

Data for this study was obtained from the laboratory information system database. Data was collected by extracting specific files for a period of the last three months (December 2022–February 2023) from the system with the help of the information system manager in charge at Gatundu Level 5 Hospital. Based on the levels of Hb, the sample was segregated as being anemic or not. Categorisation of anemia was done based on the mean corpuscular volume (MCV) levels determined through the blood count. Age, gender and mean MCV were considered as independent variables and the level of Hb and type of anemia were considered as the dependent variables to estimate the statistical correlation by Chi-square test.

Statistical Analysis

Data obtained is analysed for comparative variation between selected parameters by using the Chi-square test and one-way ANOVA with the help of Graph Pad Prism ver. 8.0 (Graph Pad software La Jolla, CA); p-value less than 0.05 was considered significant. Significance is indicated by using, $p < 0.05$ is *, $p < 0.01$ is **, $p < 0.005$ is *** and $p > 0.05$ is considered as non-significant (ns).

Ethical Approvals

Ethical clearance certificates to conduct the present study were sought from the County Government of Kiambu (KIAMBU/HRDU/23/07/06/RA_NGUGI) University ethics review committee (MKU/ISERC/2815) and National Commission for Science, Technology & Innovation (259737).

RESULTS

Demographics in Population

A total of 384 blood count samples corresponding to the 384 respondents in this study were used. The age groups 0–1 years and 2–10 years were regarded as children while the age group 11–18 years was categorised as adolescents (Lucas 2023) as indicated in Figure 1. Majority of the respondents were falling into the age group of 2–10 years category (48.7%).

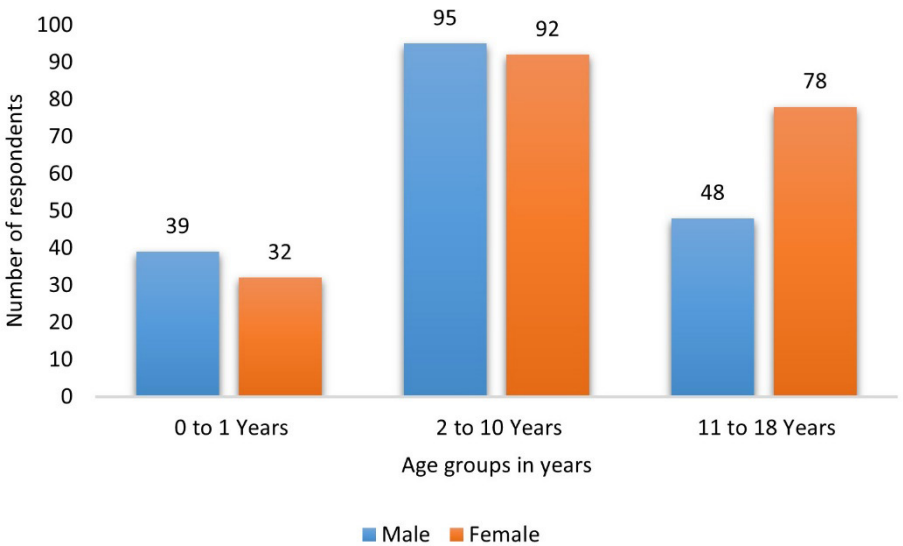

Figure 1: Demographic characteristics of respondents.

Prevalence of Anemia

The overall prevalence of anemia among children in Gatundu Level 5 Hospital was at 42.7% (see Table 1). The prevalence among the age groups was 9.9%, 23.2% and 9.6% within 0–1 years, 2–10 years and 11–18 years, respectively. The correlation of anemia prevalence with age group was found to be significant with a *p*-value of 0.0008. This indicates the clear influence of the age on anemia prevalence. The study indicated a small variation in prevalence of anemia in response to gender. Prevalence was found to be 51.2% in male

and 48.8% in female. In adolescent age group (*n* = 37), the prevalence was found to be more in female (72.9%) than male (27%).

Table 1: Prevalence of anemia among the respondents.

Demographics	Prevalence of anemia	
	Yes (Hb < 12g/dL)	No (Hb >12g/dL)
Age group		
0–1 (N = 71)	38 (9.9%)	33 (8.6%)
2–10 (N = 187)	89 (23.2%)	98 (25.5%)
11–18 (N = 126)	37 (9.6%)	89 (23.2%)
Total	164 (42.7%)	220 (57.3%)
Chi-square Value (DF)	14.4 (2)	
p-value	0.0008^{***}	
Gender		
Male (N = 182)	84 (46.7%)	98 (53.3%)
Female (N = 202)	80 (39.6%)	122 (60.4%)
Total	164 (42.7%)	220 (57.3%)
Chi-square Value (DF)	1.679 (1)	
p-value	0.195^{ns}	
Male 11 to 18 years (N = 47)	10 (21.3%)	37 (78.7%)
Female 11 to 18 years (N = 79)	27 (34.2%)	52 (65.8%)
Chi-square Value (DF)	2.4 (1)	
p-value	0.124^{ns}	

Note: N = frequency; DF = degree of freedom; ns = non-significant; * = $p < 0.05$, ** = $p < 0.01$ is, *** = $p < 0.005$.

Severity of Anemia

The severity of anemia in different age groups was also determined. This was determined by monitoring the level of Hb and then describing the anemia as mild, moderate and severe (see Table 2). Among the respondents, 2.9% and 8.8% are falling into severe and moderate anemic groups, respectively. Adolescent group is showing higher portion of severe anemia cases than the other age groups. A major proportion of 88.3% fall into the mild anemia category. Mild anemia is higher in the 2–10 years' age group at 44.3%, in females at 46.9% and MCV values between 75–100fL at 55.5%. The effect of gender and age on Hb content were found to be significant. With the increase in age, severity of anemia was found to decrease significantly (p = 0.0042). Mild anemia (Hb > 10g/dL) was found to be more prevalent in females (p = 0.0015). Effect of MCV on severity of anemia was found to be non-significant (p = 0.1686).

Table 2: Anemia severities among the respondents.

Demographics	Severity of anemia		
	Severe (Hb < 7 g/dL)	**Moderate (Hb 7 g/dL to 9.9 g/dL)**	**Mild (Hb >10 g/dL)**
Age group			
0–1 (N = 71)	0 (0%)	12 (16.9%)	59 (83.1%)
2–10 (N = 187)	3 (0.2%)	14 (0.7%)	170 (90.9%)
11–18 (N = 126)	8 (6.3%)	8 (6.3%)	110 (87.3%)
Chi-square Value (DF)		15.27 (4)	
p-value		0.0042**	
Gender			
Male (N = 182)	6 (3.3%)	17 (9.3%)	159 (87.4%)
Female (N = 202)	5 (2.5%)	17 (8.4%)	180 (89.1%)
Chi-square Value (DF)		12.9 (2)	
p-value		0.0015**	
MCV (fL)			
< 75 (N = 141)	4 (2.8%)	19 (13.5%)	118 (83.7%)
76 to 99 (N = 234)	7 (3%)	14 (6%)	213 (91.0%)
> 100 (N = 9)	0 (0%)	1 (11.1%)	8 (88.9%)
Chi-square Value (DF)		6.4 (4)	
p-value		0.1686ns	
Total (N = 384)	11 (2.9%)	34 (8.9%)	339 (88.3%)

Note: N = frequency; DF = degree of freedom; ns = non-significant; * = $p < 0.05$, ** = $p < 0.01$ is, *** = $p < 0.005$.

Type of Anemia

All the 3 types of anemia (microcytic, normocytic and macrocytic) are present in all the age groups. In children within the age bracket of 0–1 years and 2–11 years, microcytic anemia is dominating at 54.9% and 79.7%, respectively. However, in children of 11–18 years, normocytic anemia is dominating at 60.3% (see Table 3).

The categorisation of anemia in the respective age groups and gender is given in Table 3. In young age groups, microcytic anemia cases are more and in adolescent (11–18 years), normocytic anemia cases are more. 62.6% of microcytic anemia was found to be in the age group of 2–10 years. Age effect on type of anemia was found to be significant with a *p*-value of 0.0045. Based on the gender, male respondents (54.2%) were found to have slightly more microcytic anemia than female respondents (45.8%). Gender effect on type of anemia was found to be highly significant with a *p*-value < 0.0001.

According to the age group and the gender variation, mean values of Hb are presented in Figure 2. The Mean value of Hb is less for both male and female in their age of 2–10 years. The values were found to be 11.7 ± 1.9 g/dL and 12.0 ± 1.8 g/dL for male and female, respectively.

Table 3: Distribution of type of anemia based on gender at each age group.

Demographics	Type of anemia		
	Microcytic	**Normocytic**	**Macrocytic**
Age group			
0–1 (N = 71)	39 (54.9%)	25 (35.2%)	7 (9.8%)
2–10 (N =187)	149 (79.7%)	36 (19.2%)	2 (1.1%)
11–18 (N =126)	50 (39.7%)	76 (60.3%)	0 (0%)
Chi-square Value (DF)		10.9 (2)	
p-value		0.0042**	
Gender			
Male (N = 182)	129 (70.9%)	51 (28.0%)	5 (2.7%)
Female (N = 202)	109 (53.9%)	86 (42.6%)	4 (2%)
Chi-square Value (DF)		77.4 (4)	
p-value		< 0.0001***	
Total (N = 384)	238 (62%)	137 (35.7%)	9 (2.3%)

Note: N = frequency; DF = degree of freedom; ns = non-significant ; * = $p < 0.05$, ** = $p < 0.01$ is, *** = $p < 0.005$.

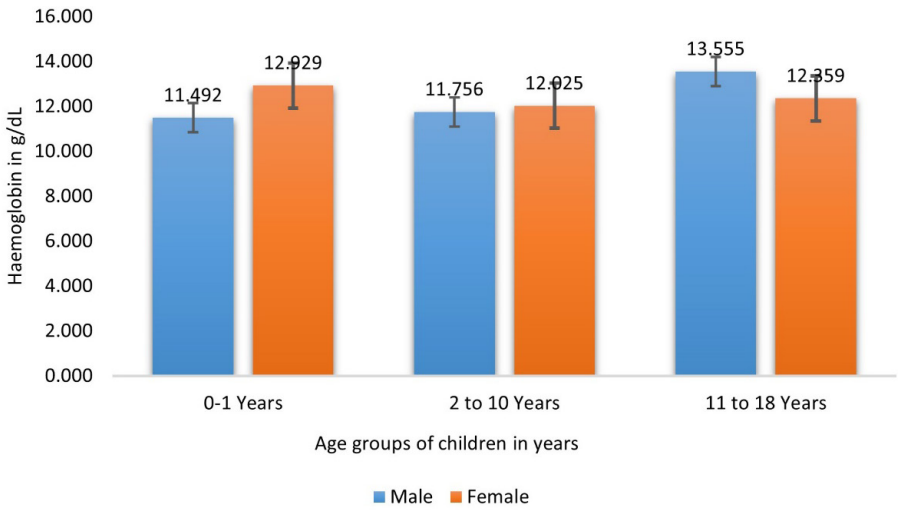

Figure 2: Mean Hb content among the respondents according to age and gender where F (2,37) value is 7.004 with $p = 0.001$***.

DISCUSSION

Anemia is among the selected health problems that are of public concern among children globally. Anemia in children is linked with the immune system, motor and cognitive functions, and diseases like autism, thalassemia and attention deficit hyperactivity disorder (Xue, Oiong and Jie 2023; Zheng, Lui and Yang 2021). Therefore, understanding the prevalence and severity of anemia as well as identification of the type of anemia is of importance in the development of relevant policies that will aid in the fight against anemia. A report by UNICEF in 2022 reported that, 50% of Kenya population are children (UNICEF 2022). In Kenya, Nairobi County and Kiambu county are expected to be the top 2 counties in population by the year 2045 (Kenya National Buraeu of Statistics [KEBS] 2019). Gatundu is one of the largest areas in Kiambu county and was selected as the suitable site for the current study to represent the target population.

From the blood count sampled from the total blood count database in the hospital and selection based on the inclusion and exclusion criteria total of 384 total blood count data was selected. Of the 384 blood count data, the study revealed overall anemia prevalence is 42.7% (N = 384) and is in near accordance with the reported literature. The prevalence of anemia is more among children with an age bracket of 2–10 years. This was significantly higher than the infant and adolescent groups. These results were in agreement with those reported in the year 2015, which investigated the prevalence of anemia and risk factors involved among children of six months to 14 years in Kenya (Ngesa and Mwambi 2015). Similar observation was made in another study on the anemia among Kenyan children (Emelda *et al.* 2020). However, the findings of this study deviated from those conducted in Saudi Arabia that indicated an increase in the prevalence of anemia with an increase in age as well as those recorded by WHO (Madani *et al.* 2022).

Even though a higher prevalence of anemia was recorded in children of 2–10 years, most of the recorded anemia cases were mild and moderate. Mild and moderate anemic children do not show any symptoms or clinical signs (Yueying, Yu and Jun 2020). This will become the mask for diagnosing other major anemia consequences. Early diagnosis and effective prevention will minimise further complications. However, the adolescents presented higher severe cases than the other age groups. Children above 2 years are at having higher risk of developing anemia (Villamor *et al.* 2000). The present study confirms the same with results of 54.3% of anemic respondents from 2–10 years group (p = 0.0008).

The influence of gender did not show much difference in severe and moderate anemia. Adolescent female respondents are more prone for prevalence of anemia with a frequency of 72.9% (N = 37). Female respondents were found to fall into the category of mild anemia more than male respondents with a p-value of 0.0015. Previous studies indicated a similar pattern and this can be attributed to the low food intake and physiological changes due to the onset of menarche (Vijayshree, Shobha and Nitin 2023).

Microcytic anemia occurs due to a deficiency in iron and also due to chronic disease conditions. Normocytic anemia can be caused by blood loss, hemolysis, infectious conditions, malignancy, marrow failure, thyroid dysfunction and renal failure (Clinton *et al.* 2022; Stouten *et al.* 2016). Macrocytic anemia can be caused by alcohol, liver diseases, autoimmune diseases, thyroid and deficiency of specific vitamins like folate and vitamin B12 (Turner, Parsi and Badireddy 2024; Bando *et al.* 2023). Among the respondents, microcytic anemia (61.9%) was the most common while normocytic anemia (35.7%) and macrocytic anemia cases (2.3%) were less common. Microcytic anemia is the most prevailing anemia below the age of 10 years. This is in accordance with previous studies (Green *et al.* 2011). In the age group from 11–18 years, there are more Normocytic anemia cases. More number of microcytic anemia cases indicate a deficiency of Iron in food and less awareness about the

nutritional food intake in growing children and parents. Normocytic anemia was found to be more common in the adolescent group. The reasons can be attributed to insufficient nutrition to match the increasing needs of body in adolescence and in female, the commencement of menstruation during the age of 11–18 years. Very less cases of macrocytic anemia were observed indicating the absence of severe disease conditions.

Male respondents are showing an increased Hb values along the progression of age. On a comparative note, female patients did not show the similar pattern. The results clearly indicate the prevalence of anemia among children and adolescents. More number of microcytic and normocytic anemia cases are prevalent in the selected respondents. High rates of anemia in the age group 2–10 years and severe anemia cases in adolescent age group are the alarming observations. This may be related with insufficiency in regard to nutrition, awareness and resources especially in developing African countries.

CONCLUSION

Infants and children mostly of school-going age in developing countries are at high risk of developing anemia. This is a public health problem that has been neglected and continues to limit the urge for the need to develop intervention strategies in this age group. The current study investigated the prevalence, severity and type of anemia among the children and adolescents who visited Gatundu Level 5 Hospital. From the findings, it's evident that among the study population, the prevalence is highest in children aged 2–10 years old. Anemia cases presented in children (0–1 years and 2–10 years) were only mild and moderate while the cases were severe in adolescents. The high severe cases of anemia at older age could be attributed to the high accelerated metabolic demand in the advent of puberty. Microcytic anemia prevalence is more than the other types indicating the urgency of creating awareness about nutrition. Most of the cases were mild and moderate which are difficult to identify. These cases may transform into complex medical conditions in the future, if not identified at the right time. Further studies are recommended to identify the causes of the prevalence of anemia to reduce the anemia burden.

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