Hookworm Infestations among Pregnant Teenagers in Bungoma County, Kenya

F. A. Mambo[1*], E. K. Mulunji[2], G. A. Sowayi[1], R. C. A. Omedo[1], G. A. Mukoya[1] and D. A. Kokonya[3]

[1]*Department of Medical Laboratory Sciences, Masinde Muliro University of Science and Technology (MMUST), Kenya.*
[2]*Department of Human Nutrition and Dietetics, Masinde Muliro University of Science and Technology (MMUST), Kenya.*
[3]*School of Medicine, Masinde Muliro University of Science and Technology (MMUST), Kenya.*

Authors' contributions

This work was carried out in collaboration between all authors. Authors FAM and EKM did the study design and wrote the protocol. Authors GAS and DAK did the statistical analysis and literature searches while analyses of study was done by authors RCAO, GAM and FAM. All authors read and approved the final manuscript.

Article Information

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ABSTRACT

Hookworm infection (Ancylostomiasis) and its association with hematopoietic micronutrient deficiency, contributes significantly to anaemia in poor countries. In these countries, teenage pregnancy is a major health problem characterized by high prevalence of anemia, exacerbating physiological distress due to increased oxygen demand. In spite of the high prevalence of this problem, no study has been undertaken in Kenya. This is resultant from the combined metabolic needs of a rapidly growing girl and her developing fetus. Anemia increases risks of feto-maternal and child mortality and morbidity, if preventive interventions are not part of antenatal care for prospective teenage mothers. Hookworm infection therefore significantly endangers the health of

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*Corresponding author: Email: fidelimambo88@yahoo.com;

the teenage antenatal mothers in Kenya. The literature revealed no previous study on the problem in the target population.

Objectives: The objective of this study was to explore the necessity for including treatment for worms in the antenatal care programme for the target population. The study, therefore, aimed at determining the prevalence of anemia, Hookworm infection and the possible etiological role of the latter among teenage antenatal mothers in Kenya.

Methods: A descriptive and cross-sectional survey conducted in 2009 at Bungoma County Hospital and Bumula Health Centre antenatal clinics in West Kenya whose sample population comprised 384 pregnant teenage girls. Diagnosis for anemia was made from hemoglobin concentration (estimated by cyanmethemoglobin spectrophotometry). Hookworm infection was diagnosed based on the presence of ova in stool using *Ritchie's Formol Concentration* and Direct stool microscopy. Statistical Package for Social Sciences (SPSS) version 12 was used to analyze data and inference was based on 5% significance level.

Results: The prevalence of Ancylostomiasis was 28% and that of anemia was 61% (Hb<100g/L). Severe anemia (Hb<60g/L) constituted 20%, moderate (Hb≤90g/L) 31.2% and mild (Hb>90<110g/L) constituted 48.3% of the teenage antenatal mothers. There was a significant association between Ancyclostomiasis and anaemia (Chi sq 32.238, p<0.001). Logistic regression (p<0.05) showed that Hookworm infection was a significant predictor of anemia. The teenage antenatal mothers infested with Hookworm were four (4) times more likely to be anemic (OR: 95% CI: 3.703; df 2.287-5.995).

Conclusions: Anemia in pregnancy in the rural Kenya settings is high and that hookworm infections have significant impact on the prevalence, health of teenage mothers and pregnancy outcomes. Based on this evidence and other studies, we suggest that during antenatal acre (ANC) period, there should be routine screening for Ancylostomiasis infections, followed by a single dose of Albendazole after the first trimester along with iron and folic acid supplements. This can cause significant elevation of hemoglobin and serum ferritin levels thereby reducing maternal and perinatal morbidity and mortalities, prematurity and low birth weights in our poor communities.

1. INTRODUCTION

In the year 1958, anaemia was prevalent and the impact on pregnancy was noted by a WHO study group when it was realized that anaemia had become a public health problem [1]. Anaemia, defined as hemoglobin (Hb) level of <11.0g/dl, is common in pregnancy due to feto-maternal competition for hematopoietic nutrients [2]. This is particularly pronounced in developing countries especially Sub-Saharan Africa, with a prevalence of 35-72%, where the prevalence of poverty and other determinants of poor nutrition and healthcare are high. Alongside obstetric hemorrhage, it contributes 17-46% of anaemia [3,4]. Anemia is a major factor in women's health, especially among women of reproductive age in developing countries and more specifically in resource limited settings. Severe anemia during pregnancy is an important contributor to maternal mortality [5] as well as low birth weight which is in turn an important risk factor for infant mortality [6,7]. Hookworms and some other helminthic infections [8,9] are bound to worsen the anemia. This can exacerbate the physiologic distress occasioned by the demands of the special state of the subjects (pregnant teenagers) for increased oxygen and carbon dioxide transport [3]. Hookworm infection (Ancylostomiasis), alongside hematopoietic micronutrient deficiency, contributes significantly to the etiology of anemia in poor countries and it is a common cause of iron deficiency anemia [10]. In these countries, teenage pregnancy is a major health problem characterized by high prevalence of anemia, exacerbating physiological distress due to increased oxygen demand, resulting from the combined metabolic needs of a rapidly growing girl and her developing fetus [11]. Anemia increases risks of feto-maternal and child mortality and morbidity, if preventive interventions are not part of antenatal care for prospective teenage mothers. Hookworm infections therefore significantly endanger the health of the teenage mothers [12].

In Kenya, teenage pregnancy is prevalent and it is conservatively estimated to account for school drop of about 13,000 girls per year. In view of these findings and accompanying health risks, including helminthiasis, malaria and anemia, the phenomenon of teenage pregnancy and these health problems requires attention by researchers and the government [13,14]. There

have been few studies on the role of hookworm induced anemia among expectant women in Kenya's rural communities where these parasites are endemic.

In fact, literature search reveals that no previous research on Ancylostomiasis and anemia among pregnant teenagers specifically in the setting of this study had ever been conducted yet in fact it is well established that hookworm increases foetal and maternal morbidity and mortality [15]. Bungoma District, the study site, is a resource limited part of Kenya whose poverty level was 56% [16] out of a population of 1.4 million [17]. Such high poverty level is a recipe for poor hygiene and sanitation standards, making Bungoma district a suitable site for Hookworm outbreaks. This study, therefore, aimed at determining the contribution of hookworm infestation to anaemia among the expectant teenage girls at the two rural community health facilities in West Kenya. The outcome of this study was to influence the policy on screening and treatment of hookworm in pregnancy in Kenya.

2. METHODS

This was a descriptive and cross sectional study, conducted over a three [3] month period from October to December, 2009 at Bungoma District Hospital and Bumula Health Centre antenatal clinics in West Kenya. The District hospital is a regional referral hospital with adequate obstetrical care and access to high level professionals. The two study sites facilitated the recruitment of 384 study participants into the study from among teenage antenatal patients aged 13-21 years (early, through mid and to late adolescence) who sought their first antenatal care, voluntarily signed the consent forms to participate in the study. The minimum sample size was determined using Fischer's formula. The study participants who met the inclusion criteria were recruited. Secondly, the primigravidae teenage antenatal patients had no previous practical experiences and knowledge about pregnancy, hence, a good selection for enhancement of data validity and reliability. The benefits of participation in the study included medical and nutritional advice, close follow up, iron and folate supplements and referral to specialist medical practitioners and nutritionists for effective care and support during pregnancy. The study participants were guided throughout the coded questionnaires and after answering the questions, venous blood samples were collected aseptically by swabbing the ante cubital fossae with 70% alcohol. About 3-5ml of blood was then drawn into an Ethylene Diamine Tetra Acetic acid (EDTA) vacutainer with a sterile hypodermic needle.

The blood was then mixed on a laboratory roller before being fed into the automated Coulter Act-5 machine to estimate the hemoglobin concentration. Anemia was also categorized microscopically on the basis of erythrocyte hemoglobinization patterns, size and morphology using Giemsa-stained (pH 7.2) thin peripheral blood film.

To assess the level of hookworm infection, study participants were provided with clean-labeled stool containers (screw-capped poly-pots) and instructed to bring small quantities of their stool specimen the next day within an hour of passing the stool. Wet mounts were prepared from the stool specimen using a direct smear with normal saline and iodine. A concentration method using Ritchie's formol/ether was also applied to help identify helminth eggs as well as protozoan cysts.

Data was collected using coded semi-structured questionnaires, which had been pre-tested, and corresponding laboratory forms and all data were treated confidentially. Care was taken to preserve data and specimens collected throughout the study period and questionnaires reviewed to ensure that they were complete in responses before participants were released from the data collection process and data entered into the Excel template on daily basis. At the end of data collection, the data was analyzed using the Statistical Package for Social Sciences (SPSS) version 12 with an inference based on 5% significance level. Frequency tables and means and proportions were produced. Fisher's formula for population sizes >10,000 was employed in deriving the sample size, using p=0.5 and α=0.05. Chi square (χ2) was done to compare the outcome of interest in this study, the relationships between categorical variables (hookworm infestation and anemia) among the pregnant teenagers.

3. RESULTS

3.1 Sociodemographic Characteristics

A total of 384 antenatal teenagers were recruited from Bungoma County Referral Hospital and Bumula Health Centre, of whom 18.5% were early teenage (13-15 years of age, 52.3% were

mid age teenage (16-18 years) and 29.2% in late teenage (19-21 years). Hence, about 71% (majority) of the antenatal teenagers were under-age (<18 years of age). The youngest antenatal teenager was aged 13 years, the oldest was 21 years and the range in age was 8 years while the mean age of the antenatal teenagers was 16 years. Almost three quarters (70%) of the antenatal teenagers had no education at all, 25.3% had primary school level of education, 4.7% had secondary school educational level and none (0%) had tertiary level of education. Primary school level of education and below constituted 95.3% of all the antenatal teenagers in Bungoma County. The same population had high potential of reverting to illiteracy. Almost three quarters (73.7%) of the antenatal teenagers were not engaged in any form of employment and 1.3% was formally employed (teachers), 23.7% in business and 1.3% engaged in farming. Over half (58.9%) of the antenatal teenagers were married while 41.1% were not married. Slightly over a quarter (28.4%) of the antenatal teenagers were infested with hookworm (Ancyclostomiasis) compared to the majority (71.6%) who were free of Ancyclostomiasis hence safe from the contribution of anaemia by Hookworm infestation. Almost a third (30.7%) of the antenatal mothers was in their first trimester, 43.5% were in the second trimester and 25.3% were in their third trimester of pregnancy Table 1.

3.2 Haematological Parameters

Out of a total of study participants (N=384) the prevalence of anaemia due to Hookworms among the pregnant teenagers (anaemic and non-anaemic) was 28.4%. Among all the anaemic 183 (47.7%), anaemia due to Hookworm accounted for 77 (42.1%). Slightly over half of the anaemic study participants were not anaemic, of whom 32 (15.9%) had hookworm (normal Hb level) infestation while 169 (84.1%) were free of anaemia (Table 2).

There was a significant association between anaemia and Hookworm infection (Chi sq 32.238, p<0.001) in which anaemia was proportionally related to hookworm infection. This was corroborated with statistical significance in logistic regression (p<0.05), which showed that hookworm infection is predictor of anaemia among pregnant teenager, with those affected being 4 times more likely to be anaemic (OR: 95% CI: 3.703; 2.287-5.995). Chi square test of association showed a statistically significant relationship, with an observed value of 32.238 against the critical value of 3.81 (df =1and α =0.05) or p=0.001). This is supported by the multiple logistic regressions below (Table 2).

Table 1. Results for Sociodemographic characteristics and anaemia (N=384)

Age (Years)	n	%
13-15	71	18.5
16-18	201	52.3
19-21	112	29.2
Education		
None	269	70.1
Primary	97	25.3
Secondary	18	4.6
Tertiary	0	0
Occupation		
Business	91	23.7
Farming	5	1.3
Unemployed	283	73.7
Teaching	5	1.3
Marital status		
Married	226	58.9
Single	158	41.1
Worm infestation		
Hookworm (+ve)	109	28.4
No hookworm (-ve)	275	71.6
Trimester		
First	118	30.7
Second	167	43.5
Third	99	25.8
Status of blood / haemoglobin		
Normal (>10g/dl)	150	39
Anaemia (<10g/dl)	234	61
• Mild (9-10g/dl)	113	48.3
• Moderate (<6-9g/dl)	72	31.2
• Severe (<6g/dl)	48	20.5
Peripheral blood film (PBF)		
Microcyctic hypochromic anaemia	121	51.8
Macrocytic hypochromic anaemia	113	48.2

Table 2. Correlation of hookworm and anaemia (N=384)

	Anemic	Non-anemic	Totals	χ^2 value	*p*-value	OR	95%CI	
							Lower	Upper
Hookworm +ve (n=109)	77(42.4%)	32(15.9%)	109	χ^2 =32.238;	p<0.001	OR=3.703	2.287	5.995
Hookworm –ve (n=275)	106(57.6%)	169(84.1%)	275	df=1; α=0.05				

The results show that the presence of hookworm among pregnant teenagers is associated with anaemia and vice versa (Fig. 1). Hence, hookworm is a causal factor for anaemia among pregnant teenagers in Kenya.

4. DISCUSSION

The study findings justify the need to improve the understanding of the effect of hookworm infestations on the frequency of anemia in pregnancy in the study population. This may help in the design of appropriate management strategies targeted at reducing adverse pregnancy outcomes often associated with hookworm parasites. The prevalence of 28.4% for hookworm found in this study was closely similar to the 30% reported in Nigeria [10] but higher than the 23% reported by Ndyomugyenyi in Masindi, Uganda [18]. The high prevalence rates of the Ancyclostomiasis (Hookworms) established in this study may be attributed to the common practice of defeacating in the farms (92.2%) and bushes where no pit latrines are found and the low socioeconomic status in the study population [19]. This is so because poverty and ancylostomiasis, it may be argued, are faithful bedfellows. Poverty implies primitive living conditions which promote the spread of the hookworms [20]. The chronic loss of blood caused by Ancylostomiasis tilts the scales against the bone marrow and disturbs the equilibrium maintained between blood formation and destruction. The large 42.4% prevalence of anaemia due to Ancylostomiasis among anaemic pregnant teenagers in this study is closely similar to the 40.4% reported in Nigeria [21] but higher again than 28% in Masindi, Uganda [19]. In practice, most hospitals use a hemoglobin level

of <10g/dl as the indicator for anaemia. This is justified on the basis of work done by Lawson [22] which showed that serious harm to mother and fetus did not occur until the hemoglobin value fell below 10g/dl. The significant relationship between hookworm infestations and anemia is obvious in the findings in this study; in that over 42% of the 109 with hookworm were anaemic. Hookworm infestations results in iron loss from the infested intestinal lumen where it is estimated that a load of 1,000 hookworm ova per gram of faeces is associated with loss of 1 mg of iron per day [23]. And although not evaluated in this study, there is an assumption that rural dwellers have poor nutritional intakes. This may also have contributed to the high prevalence of anemia in this study group. Anemia, even if it is the tolerated mild to moderate types, may adversely affect the sense of wellbeing of the affected and this may in turn decrease their work output due to physical exhaustion and fatigue. Other consequences of hookworm infestation associated with anemia in pregnancy are cardiovascular distress, reduced mental performance, reduced immunity, reduced peripheral blood reserves in mothers and intrauterine growth retardation, prematurity, and low birth weight in newborns [24]. These consequences suggest that hookworm infestation on maternal health merits all women of child bearing age living in endemic areas be subjected to periodic Ancylostomiasis screening and treatment. World Health Organization recommends that infested expectant women be treated after their first trimester [25]. Despite this suggestion, only Madagascar, Nepal and Sri Lanka have added antihelmintic treatment to their antenatal programs [26].
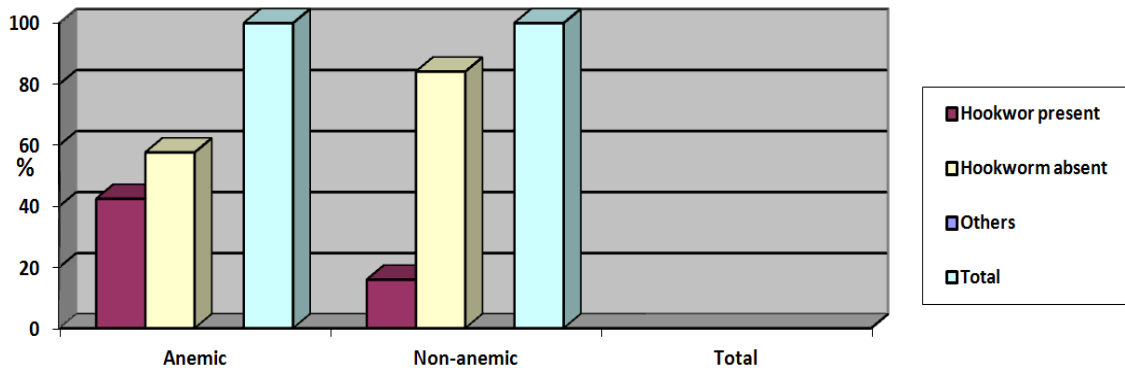

Fig. 1. Bar graph for correlation of hookworm infestation with anemia

5. CONCLUSION

We conclude that the prevalence of anemia in teenage pregnancy in the rural Kenya settings is high and that hookworm infestations have significant impact on the prevalence, health of teenage mothers and pregnancy outcomes. Based on this evidence and other studies, we suggest that during antenatal acre (ANC) period, there should be routine screening for Ancylostomiasis infestations, followed by a single dose of Albendazole after the first trimester along with iron and folic acid supplements. This can cause significant elevation of hemoglobin and serum ferritin levels thereby reducing maternal and perinatal morbidity and mortalies, prematurity and low birth weights in our poor communities.

ETHICAL APPROVAL

The research was approved and cleared by the Moi University/Moi Teaching and Referral Hospital Institutional Research and Ethics Committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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