ANAEMIA AND PARASITIC INFESTATIONS AMONG SCHOOL CHILDREN LIVING IN URBAN SLUMS OF ASOKORO DISTRICT, FCT, NIGERIA

BY

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ATTESTATION

I declare that the work in this thesis entitled Anaemia and Parasitic Infestations among School Children Living in Urban Slums of Asokoro District, FCT, Nigeria has been performed by me in the Department of Community Medicine, Faculty of Medicine, Ahmadu Bello University, Zaria, Nigeria.

The information derived from the literature has been duly acknowledged in the text and a list of other references provided. No part of this dissertation was previously presented for another diploma or degree at this or any other university.

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CERTIFICATION

This thesis, entitled Anaemia and Parasitic Infestations among School Children Living in Urban Slums of Asokoro District, FCT, Nigeria meets the regulations governing the award of the degree of Masters in public Health (MPH), Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to the Almighty God, the very present help in times of need for seeing me through the successful completion of this Programme.

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SUMMARY

Anaemia is a public health problem that affects about 2 billion people worldwide. It is highly prevalent in developing countries with its prevalence; three to four times higher than that of developed countries as 53% school-age children estimated to be suffering from anaemia. In Nigeria, the prevalence ranges from 38.6% in Edo State to 82.6% in Abia State. The consequences include cognitive and growth impairment, increased morbidity from infectious diseases and reduced work capacity. Parasitic infestations like malaria and helminthiasis are major contributors to the development of anaemia in children in developing countries, most especially in areas where basic infrastructural amenities are lacking and the standard of living of is poor. The objective of this study was to determine the association between anaemia and parasitic infestations and the effect of nutritional and socioeconomic status on them among primary school children living in urban slums of Asokoro District, FCT.

A cross-sectional study was conducted on 318 primary school children aged 5-15 years. A structured questionnaire was administered to obtain information on socio-demographics and history of drug use. Blood samples were collected for haemoglobin estimation and malaria parasite examination. Stool and urine samples were also examined for parasites. Anthropometric measurements were taken for the calculation of nutritional indices. Data were analyzed using Epi-info version 3.5.3 for descriptive statistics and to calculate prevalence odds ratio to identify independent variables that are statistically associated with anaemia at significance level of 5%.

Of the 318 school children, 171 (53.8%) were females, the mean age, weight and height were 10.4±2.3 yrs, 29.1±7.7 kg and 135.7±2.1 cm respectively. Ninety-one (28.6%) were anaemic, out of which mild anaemia was 64 (20.1%), 26 (8.2%) was moderate anaemia and only 1(0.3%) was severe anaemia. The malaria parasitaemia prevalence rate was 129 (40.6%). The overall stool parasite prevalence was 20 (6.3%) and 9 (2.8%) for helminthic parasites. Prevalence rates of underweight and stunting were 20.8% and 20.1% respectively as males were more likely to be

underweight (OR 2.5; 95% CI: 1.23-1.72). Father's occupation was significantly associated with anaemia (OR 1.89; 95% CI: 1.12-3.13) and presence of any stool parasite was significantly associated with anaemia (OR 0.12; 95% CI: 0.02-0.92).

Anaemia was significantly associated with parents' socioeconomic status and the presence of stool parasites in the stool. It is recommended that the school health programme should be upscaled to include provision of safe water, hygienic practices and environmental sanitation in a sustainable manner and active adoption of these practices by the children. Further studies on other causes of anaemia (such as nutritional deficiencies and haemoglobinopathies) are also recommended.

Key words: Anaemia, Parasitic infestations, Nutrition, Socioeconomic Status, FCT

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LIST OF ACRONYMS

AMAC	-	Abuja Municipal Area Council
CO_2	-	Carbon-dioxide
FCDA	-	Federal Capital Development Authority
HAZ	-	Height-for-Age-Z score
HB	-	Haemoglobin
HSC	-	High Socioeconomic Class
IDA	-	Iron Deficiency Anaemia
ITNs	-	Insecticide Treated Nets
K_2EDTA	-	Potassium Ethylene Diamine Tetra-acetic Acid
LEA	-	Local Education Authority
LGA	-	Local Government Area
LLITNs	-	Long Lasting Insecticide Treated Nets
LSC	-	Low Socioeconomic Class
MCH	-	Mean Cell Haemoglobin
MCHC	-	Mean Cell Haemoglobin Concentration
MCV	-	Mean Cell Volume
MSC	-	Middle Socioeconomic Class
NCHS	-	National Centre for Health and Statistics
NFELTP	-	Nigeria Field Epidemiology & Laboratory Training Programme
O_2	-	Oxygen
PHC	-	Primary Health Care
RBC	-	Red Blood Cell
SD	-	Standard Deviation

STH	-	Soil Transmitted Helminths
UNHABITAT	-	United Nations Human Settlements Programme
US-CDC	-	United States Centre for Disease Control and Prevention
WAZ	-	Weight-for-Age-Z score
WBC	-	White Blood Cells
WHO	-	World Health Organization
WHZ	-	Weight-for-Height-Z score

CHAPTER ONE: INTRODUCTION

1.1 Background

The establishment of Abuja as a new Federal Capital Territory (FCT) in the 1970s resulted in the emergence of slums co-existing with well planned residential and administrative areas. United Nations Human Settlement Programme (UN-HABITAT) defines a slum household as a group of individuals living under the same roof in an area who lack one or more of the following: durable housing of a permanent nature that protects against extreme climate conditions; sufficient living space, which means not more than three people sharing the same room; easy access to safe water in sufficient amounts at an affordable price; access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people and security of tenants that prevents forced evictions.[1] Nearly 327 million people were projected to live in slums in Commonwealth countries and almost one in every sixth citizens. In a quarter of Commonwealth countries (11 African, 2 Asian and 1 Pacific), more than two out of three urban dwellers live in slums.[2] It is projected that by 2030, close to 1.7 billion of the expected 3.93 billion urban dwellers in low-income and middle income countries will be living in slums.[2] The situation is not different in Nigeria, where a recent report by United Nations documented that about 96.6 million (69%) of Nigerians live in slums.[3]

Low skilled artisan workers needed for the construction work in FCT reside in urban slums that are bereft of basic infrastructure. These slums are as a result of inadequate town planning, budgetary allocation and legislation to cater for urban poor and are therefore bereft of infrastructural provisions. Poor sanitation, non-existent organized waste disposal and vector control are some factors enabling the spread of infectious diseases including parasitic infestations. Anaemia is a common complication of infestation by these parasites; which is as

a result of haemolysis in malaria, intestinal blood loss and competition for host child's nutrients in the case of *Hookworm*, *Ascaris, Trichuris* and others. Anaemia can also be as a result of suppression of appetite as found in all parasitic infestations especially malaria and secondary suppression of erythropoiesis due to fever and nutrient deficiency.

Anaemia is the reduction in the haemoglobin concentration of the peripheral blood below the normal range expected for age, sex of an individual and altitude.[4] It is a worldwide public health problem that is highly prevalent in developing countries. The World Health Organization (WHO) estimated the number of anaemic persons to be about 2 billion worlwide.[5] it is reported to account for three-quarter of 1 million deaths a year in Africa and South-East Asia[5] and is the world's second leading cause of disability.[4] The causes of anaemia include nutritional deficiencies like iron, vitamin B12, folate deficiencies, parasitic infestations and haemoglobinopathies. The health consequences of anaemia are cognitive and growth impairment which cause delayed psychomotor development, poor performance of language skills, motor skills, and coordination in children; increased morbidity from infectious diseases; reduced work capacity and productivity and increased maternal mortality in women.[6] Anaemia can be treated effectively with oral iron supplements as ferrous sulfate, ferrous fumaerate or ferrous gluconate given as 200 mg twice or three times daily.

The groups most affected by anaemia are pregnant women (48%), school children (46%) and preschool children (39%). In developing countries, the prevalence of anaemia is three to four times higher than that of developed countries. The most highly affected population groups in developing countries are pregnant women (56%), school-age children (53%) and preschool children (42%) while in developed countries, the most-affected groups are pregnant women (18%) and preschool children (17%).[5]

Asia and Africa have the highest prevalence of anaemia in all the vulnerable groups. The prevalence of anaemia among pre-school children which ranges from 42% to 53% is highest in South Central Asia and the mid-zone of African continent. Among pregnant women, the prevalence rates in South Central Asia, Western and Eastern Africa are 75%, 56% and 47% respectively. In the developed countries, the prevalence rates ranges from 14% in Oceania (Australia and New Zealand) to 20% in Eastern Europe. For school-age children, the prevalence of anaemia is highest in South-East Asia (63%) and Africa (52%), followed by the Eastern Mediterranean (45%), the Americas (23%) and the Western Pacific (21%). In developed countries however, regional prevalence rates range from 5% in North America to 22% in Europe.[5,7] In Nigeria, the prevalence of anaemia among pregnant women ranges from 35.3% in Lagos to 72.0% in Kano State[8]. Among school children, it ranges from 38.6% in Edo State to 82.6% in Abia.[9–11]

Studies have shown that parasitic infestations contribute maximally to the burden of anaemia in sub-Saharan Africa and these infestations present a major cause of disease and morbidity in Africa. Malaria is a protozoan infestations of erythrocytes caused in human beings by five species of the genus *Plasmodium* (*P. falciparum, P. vivax*, *P. ovale, P. malariae*, and *P. knowlesi*). This disease commonly found in the tropics, is a major public health problem with a consequent high morbidity and mortality and is the primary cause of severe malaria among children and pregnant women in African countries like Nigeria.[12]

In Nigeria, the most common species found is *Plasmodium falciparum* which is also the most dangerous.[13] It is estimated that 300,000 deaths occurring each year, 60% of outpatient visits and 30% hospitalizations are all attributable to malaria.[14,15] In addition, at least 50% of the population has at least one episode of malaria annually resulting in high productivity losses while children that are aged less than 5 years have 2 to 4 attacks annually.[16] The disease is

particularly virulent among pregnant women and children under 5 years of age, due to their low levels of immunity. Malaria causes anaemia basically by rupturing red blood cells and suppressing the production of red blood cells. In the treatment of malaria, artemisinin and its derivatives have shown to have the highest parasite killing rates and target asexual and sexual stages of parasite development in the blood with two important therapeutic consequences: prevention of clinical deterioration and interruption of transmission.[17] Combination of an artemisinin derivative with a long acting antimalarial drug reduces treatment duration from 7 days to 3 days. Artemisinins are generally well tolerated, and are recommended by WHO as first-line treatment for *P falciparum.*[18]

Helminths such as hookworm, flukes and whipworm infestations cause chronic blood loss, and consequently iron loss; resulting in the development of anaemia.[19] Hookworm, *Ascaris lumbricoides* and whipworm are common in school aged children and can be found in stool. These worms live in the human intestines and their numbers build up through repeated infestations and it is possible to be re-infected with more than one kind of worm. Though hookworm infects all age groups, ascariasis and trichuriasis are more common in school aged children. Hookworm is the leading cause of anaemia, afflicting an estimated 740 million people in the developing nations of the tropics. The largest numbers of cases occur in impoverished rural areas of sub-Saharan Africa, Latin America, South-East Asia and China. *Necator americanus* is the most common hookworm worldwide, while *Ancylostoma duodenale* is more geographically restricted. Blood loss in hookworm is caused primarily by coagulase released by the parasite and it is responsible for continuous blood loss in the stool. *Trichuris trichiura* (whipworm) causes anaemia if the worm burden is heavy[12] and colonic lesions are associated with bleeding. Trematodes like *Schistosoma haematobium* (fluke), predisposes to significant urinary blood loss in severe infestations and infected persons may

present with terminal haematuria, which continues for as long as it is not treated and then results in anaemia. *Schistosoma mansoni* eggs can rupture the intestinal lining and result in the leakage of blood, other fluids and nutrients into the lumen. The interaction of malaria and helminths infestations can increase the severity of anaemia and may potentially create a great challenge. Praziquantel is used to treat schistosomiasis and benzimidazole anthelmintics, albendazole, and mebendazole to treat these helminthic infestations.

Evidence from studies has also shown that anaemia and helminth infestations are intertwined and co-exist among low-income population. Other determinants are demographic factors such as age, gender and larger family size and low educational attainment of parents and have shown to have significant association with both anaemia and helminthiases, particularly among the rural and poor communities in developing countries.

In Nigeria, few studies have reported on anaemia among school age children living in different parts of the country; however, to our knowledge, there is paucity of information on the school age children living in FCT and in urban slums across the country. This study aims to carry out a study on anaemia and parasitic infestations among school children living in the urban slums of Asokoro District of FCT. It is hoped that this study will provide an insight into and provide baseline data on anaemia and parasitic infestations and the effect of nutritional and socio-economic status of children living in urban slums of Asokoro District, FCT. This will help stakeholders to develop appropriate interventions and also serve as baseline for further studies.

1.2 Statement of Problem

Anaemia is a widespread public health problem in school children with major consequences for health as well as social and economic development. Globally, anaemia affects about 46% of school age children[5] with prevalence ranging from 38.6% to 82.6% in Edo, Ogun and Abia

States, Nigeria.[9,11,20] From extensive literature search, there is paucity of information on anaemia in school children living in FCT and in urban slums. Anaemia affects populations in both rich and poor countries though it varies among population groups and in different areas according to the local conditions and the groups most affected are school age children, pre-school children and pregnant women.[5]

The major health consequences in school children are cognitive and growth impairment, increased morbidity from infectious diseases and reduced work capacity. Although the etiology of anaemia is complex and multifactorial, iron deficiency accounts for about 50% of all cases of anaemia which results in iron deficiency anaemia (IDA) and parasitic diseases, including *P. falciparum* and helminthic infestations have been recognized as other major contributors to anaemia. Some of the measures put in place to reduce the burden of anaemia in FCT are the prevention of malaria through the provision of long lasting insecticides treated nets (LLITNs) and provision of anti-helminthic drugs to children under 5 years during the Maternal and Child Health week. However, presently in FCT, there is no specific intervention in place for the prevention of anaemia among school age children and the paucity of data on the burden of anaemia on this age group has made it difficult to define appropriate interventions.

There is a need to know the burden of parasitic infections, especially malaria and helminthic infestations among this age group and to determine the association with anaemia and the contribution of nutritional and socioeconomic status.

This study will provide information on the burden of anaemia and the contribution of parasitic infestations among school children living in urban slums of Asokoro District and effect of malnutrition and socioeconomic status in FCT, Nigeria. This will help policy makers

to develop appropriate interventions to combat anaemia among school children living in FCT and urban slums of Asokoro in particular.

1.3 Justification

Although anaemia has been recognized as a public health problem for many years, little progress has been reported on it and the prevalence remains high especially in developing countries like Nigeria and in school age children[5]. Major health consequences are cognitive and growth impairment, increased morbidity from infectious diseases and reduced work capacity.[6] The etiology of anaemia is complex and multifactorial, but in Nigeria and most developing countries, parasitic diseases like *P. falciparum* infestations and helminthic infestations, have been recognized as major contributors to anaemia.[9,11] WHO recommended that chemotherapy be given for helminthic infestations as a strategy to prevent anaemia, but presently in FCT, Nigeria, this is only given to children under 5 and school age children are not included. Furthermore, available data shows that the coverage and usage of LLITNs given to households for the prevention malaria which causes anaemia is low.[15] Few studies have reported on anaemia among school age children living in the different parts of Nigeria and to our knowledge, there is paucity of information school age children living in FCT and urban slums across the country and this makes it difficult to formulate appropriate policies. Asokoro extension of Asokoro District of FCT was selected because is the most exclusive and developed urban area council in FCT and the findings from this study according to our knowledge will provide the first data on the health status of school children with regards to anaemia.

This study therefore aims to look at anaemia and parasitic infestations and the effects of nutritional and socio-economic status on anaemia among children living in the urban slums of Asokoro Districts of FCT. It is hoped that this study will provide baseline data for further

studies on anaemia among children living in urban slums of Asokoro Districts of FCT and provide stakeholders with evidence based information to develop appropriate interventions for this vulnerable group.

1.4 Research Questions

- What is the prevalence of anaemia among school children living in the slums of Asokoro District, FCT, Nigeria?
- What is the prevalence of parasitic infestations among school children living in the slums of Asokoro District, FCT, Nigeria?
- What is the nutritional status of school children living in the slums of Asokoro district, FCT, Nigeria?
- What is the relationship between anaemia, parasitic infestations, nutritional and socio-economic status among school children living in the slums of Asokoro District, FCT, Nigeria?

1.5 General Objective

To determine the association between anaemia and parasitic infestations and the effects of malnutrition and socioeconomic status on anaemia among school children living in urban slums in Asokoro District, FCT, Nigeria.

1.6 Specific Objectives

- To estimate the prevalence of anaemia among school children living in urban slums in Asokoro District, FCT, Nigeria.
- To determine the prevalence of parasitic infestations among school children living in urban slums in Asokoro District, FCT, Nigeria.
- To assess the nutritional status of school children living in urban slums in Asokoro District, FCT, Nigeria.

CHAPTER TWO: LITERATURE REVIEW

2.1 Anaemia

The World Health Organization (WHO) estimated that about 2 billion people, including adults and children are suffering from anaemia[6]. It is reported to account for three-quarter of 1 million deaths a year in Africa and South-East Asia and is the world's second leading cause of disability.[5] The prevalence of anaemia among school children ranges from 63% in South-East Asia to 21% in Western Pacific and 52% in Africa.[5] In Nigeria, it ranges from 38.6% in Edo State to 82.6% in Abia States.[9,11,20] In developing countries where the prevalence of anaemia is highest, the causes are multifactorial ranging from micronutrient deficiencies such as iron, folate, vitamin B_{12} to infectious diseases such as malaria, worm infestations, HIV/AIDS and hereditary haemoglobinopathies.[21,22]

Iron deficiency is the most common micronutrient cause of anaemia. Iron is an essential component of haemoglobin required for basic cellular function in all human tissues particularly the muscle, brain and red cells and if there is deficiency of this haemoglobin in the body, it can lead to anaemia. Mild to moderate forms of iron deficiency can occur in which the tissues are functionally impaired, although anaemia is yet to be present. Iron deficiency anaemia (IDA) occurs when iron deficiency is sufficiently severe to diminish red cell production thereby leading to a decrease in the number of red cells in the blood resulting in anaemia.[6] It is generally assumed that 50% of all cases of anaemia are due to iron deficiency but may vary within population groups and environments. The main risk factors for IDA include low intake of iron, poor absorption of iron from diets high in phytate, tannins or phenolic compounds and period of life when iron requirements are high like during child's growth, pregnancy, heavy blood loss as a result of menstruation and parasitic infestations.[6] Other micronutrient deficiencies like vitamin B12, folate and vitamin can also cause anaemia.

Anaemia is generally characterized by a decrease in the number of red blood cells, reduction in the haemoglobin concentration and packed cell volume (PCV). The main function of red blood cells is to carry O_2 to the tissues and to return carbon dioxide (CO_2) from the tissues to the lungs, and in order to achieve this gaseous exchange, they contain specialized protein called haemoglobin and each red cell contains 640 million haemoglobin molecules. The consequences of anaemia in children are inimical as it affects their cognitive performance and physical growth. Children who suffer from anaemia have delayed psychomotor development and impaired performance; in addition, they experience impaired coordination of language and motor skills, equivalent to a 5 to 10 points deficit in intelligent quotient.[6]

In a study on prevalence and correlate of anaemia among 76 elementary schools in two rural regions Ningxia and Qinghai of China by Luo et al in 2011, the overall prevalence of anaemia, 24.9% was reported with large regional variation due to the differences in income and existence of distinct minority groups in certain areas which are related to difference in diet and lifestyle that may affect the levels of anaemia. Despite the regional variation, none of the schools had an average anaemia prevalence below 5% indicating that, according to the WHO classification, the prevalence of anaemia in all the sample schools was high enough to be considered a public-health problem[23] and another study conducted in Southern China by Shang et al in 2010 among children aged 9-12 years reported prevalence of anaemia of 13.1%.[24] In different studies conducted in India, Gomber et al in 2003 reported anaemia prevalence of 41.8% among school children aged 6-12 years in urban Delhi slums, Srivastava et al in 2012 reported a prevalence of 37.5% among urban slums children aged 5-15 years, Singh et al in 2013 reported a prevalence of 31.4% among children aged 6-11 years in Hyderabad, Andhra Pradesh and Bhise et al in 2013 reported a prevalence of 77.1% among children 8-14 years in Ashram in Ahmednagar District of Maharashtra region; prevalence of

anaemia in girls was higher (87.8%) than the boys (65.1%), higher in normal weight children (44.5%) when compared to children with underweight (23.2%) while Le et al in 2007 among children aged 5-8 years in rural Vietnam documented anaemia prevalence of 25%.[25–29]

Studies conducted by Ngui et al in 2012 among rural and remote children aged 1-12 years in West Malaysia, reported overall anaemia prevalence of 26.2%, Hashizume et al in 2004 among children aged 8-17 years in rural Kazakhstan reported a prevalence of 27% and Abou-Zeid et al in 2006 reported a prevalence of 11.6% among children aged 6-14 years living at Saudi high altitude area, Aboussaleh et al reported a prevalence of 32.5% in 2009 among children aged 12-16 years in Morocco.[30–32] In another study conducted by Assefa et al in 2014 among children aged 6-14 years living in Southwest Ethiopia reported a prevalence of 37.6% and children age group 6-11 years were found to be more anaemic.[33]

The prevalence of anaemia reported from different studies conducted across African countries also suggests that anaemia is a public health problem. Egbi et al in 2014 reported anaemia prevalence of 30.8% among children aged 6-12 years in Volta region of Ghana and females were found to be more anaemic, Klnung'hi et al in 2014 reported a prevalence of 34.4% among children aged 3-13 years in North-western Tanzania and Makoge et al in 2012 reported a prevalence of 57.6% among children aged 3-16 years in villages in Cameroon.[34–36]

Similarly, studies conducted in Nigeria among school children have reported different prevalence; Onimawo et al in 2010 in Abia State among school children 7 to 12 years in rural communities reported an overall prevalence of 82.6% with rates of mild, moderate and severe anaemia being 9.6%, 71.6% and 1.4%, respectively. All the subjects that had severe anaemia (100%) were females but sex specific anaemia rates were not significantly different for boys and girls, Osazuwa et al in Edo State reported among 316 children aged 1-15 years, living in rural communities in 2011 reported a prevalence of 38.6% and Anumudu et al in Ogun State

among pre-school and school children aged 2-11 years, in two rural communities of Odogbolu LGA, reported overall prevalence of 87.1% and 62.5% respectively.[9,11,20]

2.2 Parasitic Infestations

Across the continent, *P. falciparum* and a number of helminth species share the same geographical distribution. The most ubiquitous of these are the soil-transmitted helminths (*Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms), which infect more than one third of the continent's population at any point in time.[37] The Schistosomes; S. *haematobium* and *S.mansoni*, are also endemic throughout the continent, but generally have a much more focal distribution than soil transmitted helminths species.[38] Malaria and helminth infestations have long been recognized as major contributors to anaemia in endemic countries and also contribute maximally to the burden of anaemia in Sub-Sahara Africa including Nigeria; and constitute a major cause of morbidity and mortality.

The prevalence of parasitic infestations is low in countries that rank high in Human development index (HDI) as a result of sustained environmental urban planning, provision of basic amenities, infrastructure and human capital development. Also, malaria infestations are not common in these countries due to appropriate public health interventions (vector control) and climatic factors.

Malaria is a protozoan infestations of erythrocytes caused in human beings by five species of the genus *Plasmodium* (*P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlesi*). This disease commonly found in the tropics, is a major public health problem with a consequent high morbidity and mortality and is the primary cause of severe malaria among children and pregnant women in African countries like Nigeria.[12] Malaria also poses an enormous public health burden, and greater than 75% of the global clinical episodes caused by *Plasmodium falciparum* each year are concentrated in Africa.[39]

Age-stratified epidemiologic studies indicate that the prevalence of asymptomatic *Plasmodium* infestations increases in early childhood, beginning to decline with the gradual acquisition of immunity. The precise rate and age at which immunity is acquired is exposure dependent, but in areas of stable transmission infestations in adulthood are generally low.[40]

Asymptomatic malaria infestations have been documented to be highest in school children[41] and helminth infestations are most prevalent and intense among school aged children.[42] Hookworm and schistosome infestations affect children generally and persist up to adulthood but *Trichuris trichiura and Ascaris lumbricoides* prevalence is high in children 5-15 years of age.

Studies in some African countries by Makoge et al in 2012 reported malaria prevalence of 50.7% among children aged 3-16 years in villages in Cameroon while Haliday et al in Kenya in 2012 reported a prevalence of 13% among children aged 5-18 years and Egbi et al in 2014 reported malaria prevalence of 67.8% among children aged 6-12 years in Volta region of Ghana.[34,36,43] In Nigeria, Ojurongbe et al in 2011, Jeremiah et al in 2007 and Osazuwa et al in 2010 reported malaria parasitaemia prevalence rates of 25.6% among school children aged 4-15 years, 27.5% among children aged 1- 8 years and 33.5% among children aged 1-15 years and that malaria was prevalent in the age group 1-5 years respectively.[10,44,45]

In Malaysia, Ngui et al in 2012 reported overall helminthic prevalence of 76.5% (presence of at least one helminth) among the school children, 71.5%, 41.6% and 13.5% for *Trichuris trichiuria, Ascaris lumbricoides* and hookworm infestations respectively, Le et al in 2007 in Vietnam, reported prevalence of 92%, 71% and 6 % for overall intestinal parasites, *Ascaris lumbricoides* and hookworm respectively, Shang et al in 2010 in China reported overall STH prevalence of 36.7%, *Ascaris lumbricoides* of 18.5% and hookworm of 14.7%, also,

Verhagen et al in 2013 among children aged 4-16 years in Venezuelan and Warao reported overall stool parasites prevalence of 68%.[24,29,46,47]

Lwanga et al in 2012 among children aged 6-14 years in Wakiso District; Central Uganda reported prevalence of 16%, 10.9%, 3.1%, 1.9% and 0.2% for overall helminths, hookworm, *T. trichiuria, S. mansoni* and *A. lumbricoides* respectively. But in Karachi Pakistan, the overall prevalence reported was 52.8%, 28.8% for *Giardia lamblia* and 16.5% *for Ascaris lumbricoides.*[48]

In Nigeria, some studies have documented that hookworm, ascariasis, trichuriasis and schistosomiasis are the most prevalent helminths observed among school children and high prevalence of asymptomatic malaria among the school children. *An* Edo study documented a p*revalence* rate of 75.6% for *Ascaris lumbricoides,* 16.2% for hookworm and 7.3% for *Trichuris trichiura*.[9]

In Ilobu Osun State, overall helminth prevalence was 78.3%; 55.1% *for Ascaris lumbricoides,* 22.7% for hookworm, 17.9% for *Trichuris trichiura*, 22.7% for *S. haematobium* and 10.3% for *S. mansoni.*[49] While an Osogbo study revealed an overall prevalence of 40.2%; with *Ascaris lumbricoides*, hookworm and *Trichuris trichiura* accounting for 34.2% , 5.1%, and 2.6% respectively.[44] From two separate studies reported in Osun State, an overall prevalence of 36.1% of helminths was documented by one and the other documented overall prevalence of 66.2%, *Ascaris lumbricoides* 53.4%, hookworm 17.8%, *Trichuris trichiuria* 10.4%, *Taenia spp*. 9.6%, *S. mansoni* 2.3%, *Strongyloides stercolaris* 0.7%, *S. haematobium* 0.6% and *Enterobius vermicularis* 0.3% by Oninla et al and Agbolade respectively.[50,51] In Bornu State, an overall prevalence of 80.9% of helminthic infestations was reported.[52]

2.3 Nutrition

Child growth is internationally recognized as an important indicator of nutritional status and health in populations. Globally, malnutrition among school-age children is becoming a major public health concern. More than 200 million school age children are stunted and if no action is taken, and at this rate, about 1 billion stunted school children will be growing up by 2020 with impaired physical and mental development.[53] The 4th World nutrition situation report documented that in West Africa, 34.9% of school age children were stunted while 36.5% were underweight.[54]Anthropometric examination is an almost mandatory tool in any research to assess health and nutritional condition in childhood. Physical measurements like body weight, height, circumference of arm and calf, triceps skin fold of children have been extensively used to define health and nutritional status of communities. Based on the age, body weight and height, a number of indices such as height-for-age and weight-for-height have been suggested.[55] The children are classified using three categories: underweight, stunting or wasting. Stunting measures the past (chronic) child under-nutrition which results from long-term nutritional deprivation, inadequate childcare and poor environmental and socio-cultural conditions. It is associated with higher morbidity and mortality, delayed mental development, poor educational achievement and reduced intellectual capacity. Wasting indicates acute or current under-nutrition, usually because of insufficient food intake or a high incidence of infectious diseases. Underweight reflects past (chronic) and present (acute) under-nutrition. Stunting is defined as a low height-for-age for children, underweight as low weight-for-age and wasting as low weight-for-height using z-scores < -2 SD from the CDC 2000 standards.

Studies have also revealed that children with nutritional deficiencies and parasitic infestations can develop malnutrition which can also lead to anaemia. Also, socioeconomic status of a household has been documented as a key determinant of anaemia. Studies have revealed

strong evidence that children living in low income household are at greater risk of anaemia compared to those with higher income. Limited access to food and poor sanitation, low mother's education and low income, explain the higher risk of anaemia among school children.

Nutritional studies conducted in China, India, Vietnam by Shang et al, Singh et al, Kaushik et al, Srivastava et al and Le et al documented prevalence rates between 9% and 42% for stunting, 42% and 57% for underweight and 15% - 33% for wasting.[24,26,27,29,56] Similarly, studies in Pakistan, Kazakhstan, Saudi, Morocco by Mushtaq et al, Hashizume et al, Abou-Zeid et al and Aboussaleh et al respectively reported prevalence rates between 8% and 25% for stunting, 10% and 14% for underweight and 8% - 33% for wasting.[31,32,57,58]

A study in an urban slum in Kenya by Chesire et al on determinants of under nutrition among school children aged 6-12 years revealed prevalence of 4.5%, 14.7% and 30.2% for wasting, underweight and stunting, respectively. The children who were over nine years of age were more underweight (72.4%) and stunted (77.2%) than those below eight years. The girls were more wasted (29.1%) than the boys (18.2%), whereas the boys were more stunted (65.7%) than the girls (50.7%).[59] In similar studies by Assefa et al in Ethiopia and Francis et al in Uganda, prevalence rates of 9-23% was documented for stunting.[33,60]

Different studies documented across Nigeria also showed high prevalence rates of undernutrition. Goon et al in Markurdi, Benue State in a study to anthropometrically determine the nutritional status of 2,015 primary school children aged 9-12 year in 2011, reported among the children with 52.7% stunted, 43.4% for underweight, boys were more underweight (48.8%) than girls (38.5%). Conversely, girls tend to be more stunted (56.8%) compared to boys (48.4%). Normal weight-for-age Z-score (WAZ) and height-for-age Z-score (HAZ) occurred in 54.6% and 44.2% of the children, respectively.[61]

Other studies by Osazuwa et al in Edo State in 2011, revealed that 37.0% were stunted, 19.3 wasted and 44.0% underweight, in addition, Futuga et al in Ogun State study in 2007 showed that 36% of the children were stunted, 18.3% wasted and 44.2% were underweight while Francis et al in Plateau State in 2010 study, reported 10.3% for underweight, 11.1% for stunting and 2.4% for wasting among the study participants and Onimawo et al in Abia State in 2010 study showed that 77% of the children were stunted and underweight while 56% were wasted.[10,11,60,62]

2.4 Conceptual Framework for the Analysis of Anaemia Risk

Figure 2.1 shows the interaction between exposure, vulnerability and health outcome leading to the development of anaemia in children. The basic causes in children are the parental socioeconomic factors which majorly are the mother's educational status, father's occupation and household income which will invariably affect the affect the type and quality of food available to the child care given by the parents to the child and the environment the child lives in. These will have a direct effect on the nutritional status of the child and the parasites the child is exposed to which are immediate causes of anaemia.

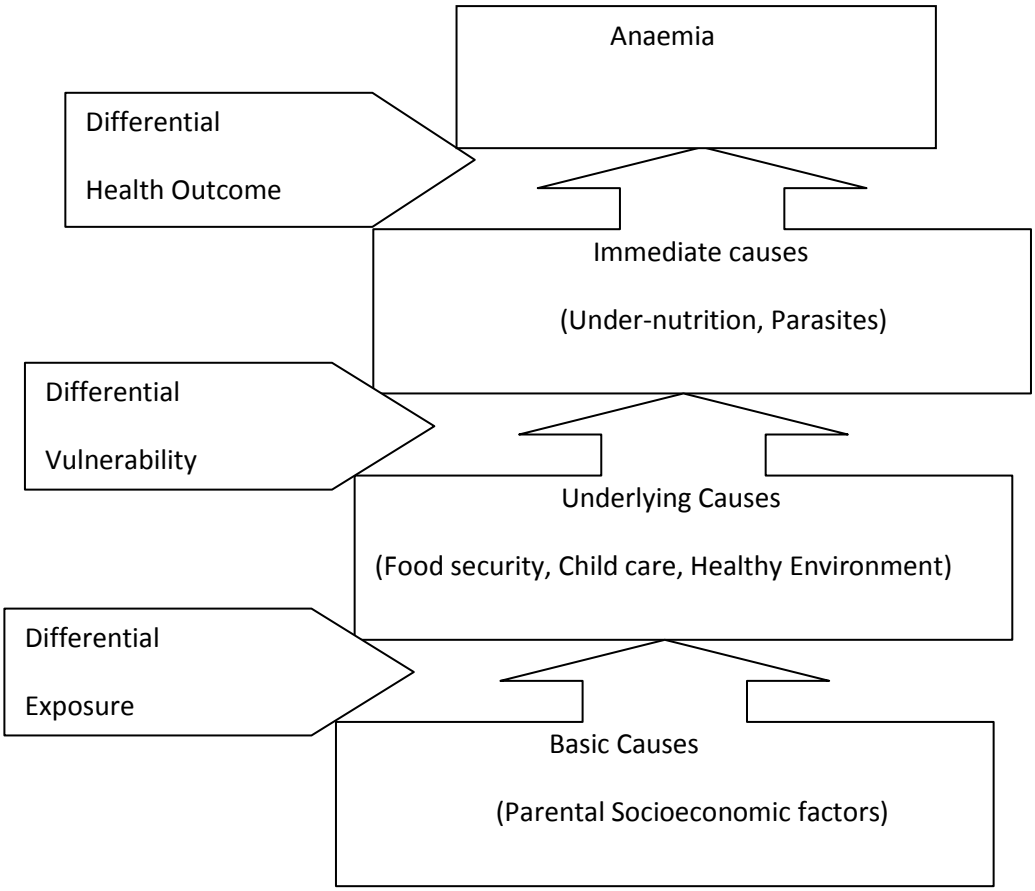


Figure 2.1: Conceptual framework for the analysis of anaemia risk

[Adapted from UNICEF. Strategy for improved nutrition of children in developing countries and Barros et al 2010[63,64]]

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The study area is Asokoro extension, a slum in Asokoro District. Asokoro District is one of the Districts under Abuja Municipal Area Council (AMAC) in the Federal Capital Territory (FCT), Nigeria. It is to the east of Garki District and south of central District. It is one of the urban Districts of Abuja and houses virtually all of the Federal cabinet ministers; in addition, the Presidential Palace, commonly referred to as the Aso Rock.

Asokoro extension consists of six settlements: Guzape, Kpaduma I, Kpaduma 2, Kpaduma 3, Kobi Madaki and Kobi Sarki. There is a total of 13 schools in the Asokoro extension, 2 are government (Local Education Authority) and 11 are private schools. The government schools are situated in Kpaduma 1 and Kobi Madaki and the 11 private schools are spread across four of the settlements. Two of the settlements (Kpaduma 3 and Kobi Sarki) didn't have any school.

3.2 Study Design

A descriptive cross sectional study.

3.2.1 Study Period

The period for study preparation and conclusion was from July, 2013-May, 2014. The pilot study and pretest of study materials were conducted in January, 2014 while the main data collection was conducted in February-March, 2014.

3.3 Study Population

Primary school children between age 5 years and 15 years who reside in any of the six settlements in Asokoro extension of Asokoro District, FCT.

3.3.1 The inclusion criteria:

- Primary school children aged 5years to 15years who have lived in any of the six settlements for at least 6 months and attended either LEA primary school Kpaduma 1 or Catholic primary school Kpaduma 2.

3.3.2 The exclusion criteria:

- Any child currently on haematinics or iron supplements in the last one month
- Any child currently on anti-malaria drugs
- Any child who took anti-helminth drugs in less than six months
- Any child who received blood transfusion in the last 3 months

3.4 Sample Size Determination

i) Prevalence of anaemia in school children from Anumudu et al[20] study was 87.1% i.e. p =0.871

(ii) Significance level of 0.05 (for 2-tail tests of significance); $Z_{\alpha/2} = 1.96$

(iii) Precision (d) of $\pm$4%

The minimum sample size required for the study was given as:

$$n = \frac{Z\alpha^2 * p * q}{d^2}$$ (Using Lwanga & Lemeshow 1991, for quantitative variable)

n = minimum sample size

p = prevalence of anaemia from a previous study = 87.1%=0.871

q = (1 – p) = 1-0.871= 0.129

d = precision = $\pm$4%

$$n = \frac{1.96^2 * 0.871 * 0.129}{0.04^2} = 270$$

Correcting for non-responses: =(1/1-f) X n

f = non-response =10% =0.1

$$= \frac{1}{1-0.1} \quad X \quad 270$$

= 300

3.5 Sampling Technique

A two-stage random sampling technique was used to select two schools (one LEA-government and one private) and the number of children needed for the study.

Stage 1

Step 1: one LEA school (LEA Kpaduma 1) was randomly selected from the two LEA schools in Kpaduma 1 and Kobi Madaki by tossing a coin and one private school was randomly selected from the list of private schools received from Private health care (PHC) facility in the settlement.

Step 2: proportionate allocation was used to determine the number of children to be selected in each of the two schools selected based on the number of children in each school using the calculated sample size. The registers of children in primary 1 to 6 were collected from the headmistress of each school and the sample size for each class in each school was calculated proportionately to the number of children in each class.

Stage 2

Simple random sampling was used to select children from primary 1 to 6 in each school by balloting.

3.6 Study Instrument

Questionnaire was developed, pre-tested and used to gather information on demographic characteristics and socioeconomic status of the children and their family, which includes marital status of parents, level of education of parents, occupation of parents, household size, type, medical treatment (history of blood transfusion, use of iron supplement, any anti-helminth, anti-malaria drugs and other medications) and nutritional indices. The

questionnaire was interviewer administered to children in upper classes and for children in lower classes, to their siblings in upper classes.

3.7 Data Collection Methods

Two Community Health Extension Workers (CHEWs), who routinely took anthropometric measurements in their health facilities, 2 Phlebotomists and 2 Laboratory Technicians were recruited and trained on the research protocol for data collection for two days. The CHEWs took the heights and weights of the children. The Phlebotomists collected blood specimen from the children and the Lab technicians educated the children on how to collect their stool and urine specimen and the period of collection.

The Laboratory analysis of the blood, urine and stool specimens were performed by the researcher and four qualified Medical Laboratory Scientists of which two were certified microscopists who read the malaria blood films.

i. Anthropometric measurements

The heights of the children were taken using a portable height gauge calibrated in centimeters (cm) and the weights taken using a balance scale calibrated in kilograms (kg).

ii. Blood specimen

5 ml of blood was drawn from each participant into K_2EDTA anticoagulant tube for full blood count (FBC) estimation and malaria parasite test.

iii. Stool specimen

Children were each given 20 ml wide mouthed screw capped container with an accompanied spatula for the collection of freshly passed stool samples for parasite examination after thorough explanation on how to collect the stool sample and avoid contamination by the Researcher, Laboratory Technicians and also local interpretation on the specimen collection was done by the class teachers.

iv. Urine specimen

Children were each given 20 ml wide mouthed screw capped container each for the collection of freshly passed urine samples while in the school for parasite examination after thorough explanation on how to collect the urine and avoid contamination by the Researcher, Laboratory Technicians and also local interpretation on the specimen collection was done by the class teachers.

3.8 Data Management

i. Nutritional status

The measured weights and heights were used to assess the nutritional status of the children using the NutStat programme on Epi-info version 3.5.1. The NCHS/WHO international reference value was adopted[65] to determine the height-for-age (stunting) and weight-for-age (underweight) for each child. The values were standardized by converting them to Z scores using age and sex specific values. The height-for-age Z score (HAZ), weight-for-age Z score (WAZ) and weight-for-height Z score (WHZ) were used to determine the nutritional status of the children and used to classify them as undernourished or normal. Those with Z score -2SD to +2SD from the mean were classified as normal and those with Z score less than -2SD were classified as undernourished.

ii. Socioeconomic Status

The socioeconomic status of the parents of the children was determined using the socioeconomic indices described by Olusanya et al[66]. Father's occupation was scored 1 for professional, top civil servant, politician or businessman, 2 for middle level bureaucrat, technicians, skilled artisans, well to do trader and 3 if unskilled worker or income below national minimum wage. Mother's educational status scored 0 if up to university level, 1 if up to secondary or tertiary below university e.g. colleges of education and 2 if no schooling. The

total score of both parents gives socioeconomic index of the child. Score of 1-2 is upper social class (USC), 3 is middle class (MC) and 4-5 for lower socioeconomic class (LSC).

3.9 Laboratory Analysis

i. Full Blood Count estimation(FBC)

FBC was measured using an automated hematology cell counter analyzer (Sysmex KX-21N, Sysmex America, Inc.)[67]

ii. Examination of blood for malaria parasites

Giemsa stained thick and thin film blood smears were microscopically examined for the presence or absence of any species of malaria parasites.

Malaria infestation was defined as any parasitaemia (any malaria species) detected in the blood film.[68]

iii. Examination of stool for parasites

Concentration method recommended by WHO was used.[69] The Mini Parasep SF Faecal Parasite Concentrator technique by Biotec was used. Each stool mixing chamber is pre-filled with 3.3ml of 10% formalin and a drop of surfactant. A level faecal sample using the spoon at the end of the Mini Parasep SF filter was introduced into the solution in the mixing chamber and mixed thoroughly. The mixing chamber was then screwed tightly with the filter/sedimentation cone unit, properly shaken to emulsify with the filter/sedimentation cone pointing upwards. This was then inverted and centrifuged at 1000 rpm for 2 minutes, cap unscrewed, discarding the mixing chamber and the filter, the supernatant was discarded and the sediment in the sedimentation cone was examined microscopically using 10X and 40X objectives for cysts and ova of parasites. The ova of parasites identified in some of the stool samples included: hookworm, *A. lumbricoides*, *E. histolytica*, *S. mansoni* and *H. nana*.

iv. Examination of urine for parasites

Sedimentation method as described by WHO was used. The urine sample was well shaken and poured into a conical tube and allowed to stand and sediment for 1hr, after which the supernatant was withdrawn and discarded. The sediment was poured into centrifuge tube and centrifuged at 2000rpm for 2 minutes. The centrifuged sediment was then examined microscopically using 10X and 40X objectives for the presence or absence of ova of *S. haematobium* or any other urine parasites.[69]

3.10 Variables

Outcome variable

- Anaemia

Independent variables

- Malaria Parasitaemia (absent, present)
- Ova/eggs of Helminths in stool and urine (absent, present)
- Nutritional status (stunting, underweight)
- Socioeconomic factors(mother's educational status, father's occupation)

3.11 Definitions of Variables

In participants aged 5 to 11 years

- Anaemia was defined as Hb level less than 11.5g/dl [70]
- Mild anaemia as Hb 11-11.4 g/dl
- Moderate anaemia as Hb 8.0-10.9 g/dl
- Severe anaemia as Hb< 8.0 g/dl

In participants aged 12years to 15years

- Anaemia was defined as Hb level less than 12.0g/dl [70]
- Mild anaemia as Hb 11-11.9 g/dl

- Moderate anaemia as Hb 8.0-10.9 g/dl
- Severe anaemia as Hb< 8.0 g/dl

3.12 Data Analysis

Entry of data, cleaning and analysis were done using Epi-info version 3.5.1. Frequencies and proportions were calculated for categorical variables while means and corresponding standard deviations were calculated for continuous variables. Student t test was used to compare the means of the continuous variables. Bivariate analysis was done by the calculation of Odds ratios to determine the association between anaemia and the independent variables; helminth infestations, malaria infestations, nutritional and socio-economic status.

3.13 Quality Assurance

The questionnaire designed for this research was pre-tested and necessary corrections made before the actual work started. Trained health care workers were used to administer the questionnaire, take the weights, heights and collect blood specimen from the study participants. The completed questionnaires were examined on the field by the supervisor for accuracy and completeness. Vaccine carriers containing ice-packs were used to preserve the collected blood, stool and urine specimen while on the field and for transportation to the laboratory for analysis and the urine samples were collected between 10 a.m and 12.00 noon.

3.14 Dissemination Plan

Copies of the report will be submitted to the Ahmadu Bello University, Zaria, the Federal Ministry of Health, Federal Capital Development Authority Department of Health (FCDA), Abuja Municipal Area Council (AMAC), Nigeria Field Epidemiology and Laboratory Training Programme (NFELTP), other identified stakeholders and presentations will be made at scientific conferences.

3.15 Ethical Considerations

Ethical approval was obtained from the FCT Health Research Ethics Committee before proceeding with the research. Permission was also obtained from Local Education Authority (LEA) secretariat of FCDA. Advocacy visits were paid to the Chief of Asokoro extension where the study was conducted and letter of introduction was collected from the community Chief to the parents informing them of his support for the research. Written or oral consent for the children to take part in the study was obtained from the parents or guardians in the presence of a witness. However children without parental or guardian consent were exempted from the study. Also children who were not willing to participate were exempted from the study. All information concerning the participants was kept confidential and children requiring medical attention were referred to Asokoro District hospital for proper evaluation and treatment.

3.16 Limitations of the Study

1. The questionnaires were administered to the school children and some of the responses provided by the children might be biased.
2. Parasite count was not done for stool and urine specimens that were examined, association between parasite density and anaemia could not be established.

CHAPTER FOUR: RESULTS

A total of 318 school children participated in the study. The mean age of the children was 10.4±2.3 years, the mean height was 135.7±12.1 cm and the mean weight was 29.1±7.7 kg.

Table 4.1: Socio-demographic characteristics of school children living in urban slums of Asokoro District, FCT, 2014

Variables	Frequency (n=318)	Percent (%)
Sex		
Male	147	46.2
Female	171	53.8
Age group		
<8	34	10.7
8-9	67	21.1
10-11	123	38.7
>11	94	29.6
Marriage of Parents		
Monogamy	266	83.6
Polygamy	52	16.4
Household size		
<5	50	15.7
5-8	227	71.4
9-12	36	11.3
≥13	5	1.6
Living with Parents		
Yes	257	80.8
No	61	19.2
Mother's educational level		
Tertiary	23	7.2
Secondary	162	50.9
Primary	106	33.3
None	27	8.5
Father's occupation		
Civil Servants	65	20.4
Trader	66	20.8
Artisan	85	26.7
Farmer	35	11.0
Others	67	21.1
Monthly Household Income		
≤ ₦18,000	96	30.2
₦19,000-below ₦35,000	141	44.3
₦36,000-below ₦70,000	58	18.2
Above ₦70,000	23	7.2
Parental SEC		
Lower Class	184	57.9
Middle Class	119	37.4
Upper Class	15	4.7

The socio-demographic characteristics of the school children are presented in (Table 4.1). Out of the 318, majority were females (53.8%), 123 (38.7%) were aged 10-11years and 257 (80.8%) of the children lived with their parents. Majority of the mothers of children studied had secondary education 162 (50.9%), 141 (44.3%) of the households earned between ₦19,000-₦35,000 monthly and 184 (57.9%) belonged to the lower social class (LSC).

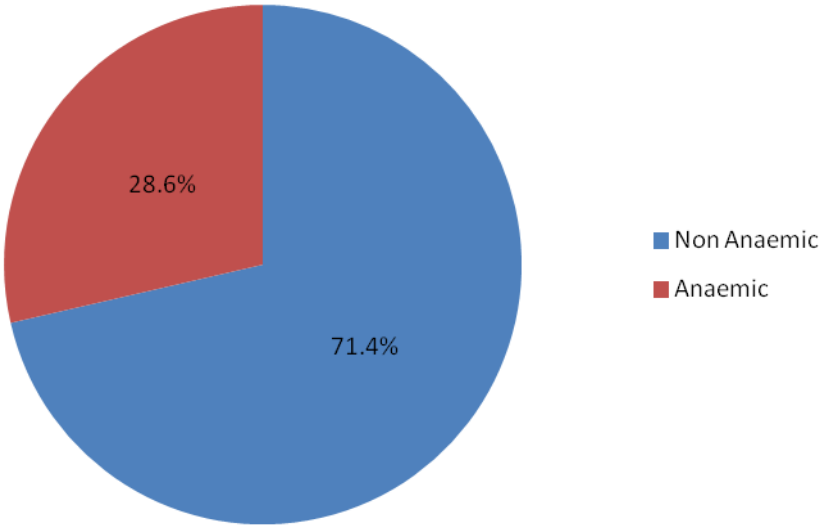


Figure 4.1: Prevalence of anaemia among school children living in urban slums of Asokoro District, FCT, 2014.

Out of the 318 children, 91 (28.6%) were anaemic. (Figure 4.1)

Table 4.2: Distribution of anaemia by sex and age group among the school children living in urban slums of Asokoro District, FCT, 2014.

	Anaemia		OR (95% CI)	P-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Female	50 (29.2)	121 (70.8)	1.07 (0.66-1.74)	0.89
Male	41 (27.9)	106 (72.1)		
Age group				
12-15	33 (35.1)	61 (64.9)	1.55 (0.92-2.60)	0.10
5-11	58 (25.9)	166 (74.1)		
Total	**91 (28.6)**	**227 (71.4)**		

The prevalence of anaemia among the females 50/171 (29.2%) was higher and females were 1.07 times more likely to be anaemic. Also, the prevalence of anaemia among age group 12-15 years, 33/94 (35.1%) was higher and 1.55 times more likely to be anaemic than age group 5-11 years, but the differences in these groups are not statistically significant. (Table 4.2)

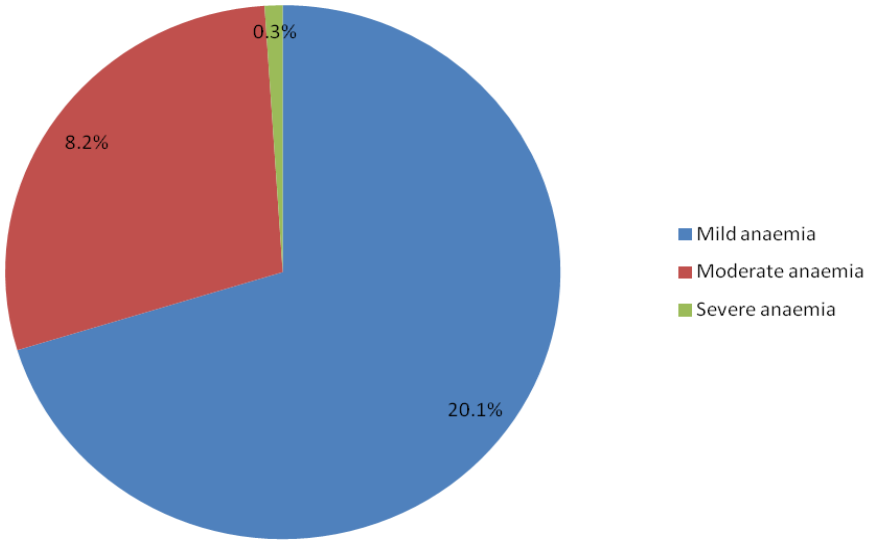


Figure 4.2: Distribution of severity of anaemia among school children living in urban slums of Asokoro District, FCT, 2014.

Out of the 91 (28.6%) school children who were anaemic, 64 (20.1%) had mild anaemia, 26 (8.2%) had moderate anaemia and only 1 (0.3%) had severe anaemia. The only child with severe anaemia was an 8 year old male pupil who attended the private (Catholic) school and lived with the parents who resided in Kpaduma 3 who were graduates, the father a clergyman and the mother, a housewife. (Figure 4.2)

Table 4.3: Distribution of mild anaemia by sex and age group among school children living in urban slums of Asokoro District, FCT, 2014.

	Mild Anaemia		OR (95% CI)	p-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Female	36 (21.1)	135 (78.9)	1.13 (0.65-1.97)	0.76
Male	28 (19.0)	119 (81.0)		
Age group				
12-15	25 (26.6)	6 9(73.4)	1.72 (0.97-3.05)	0.09
5-11	39 (17.4)	185 (82.6)		
Total	**64 (20.1)**	**254 (79.9)**		

Out of the 64 children who had mild anaemia, 36 (21.1%) were females and 25 (26.6%) were age group 12-15 years. Females were 1.1 times more likely to be anaemic and age group 12-15 years were 1.72 times more likely to have mild anaemia but not statistically significant. (Table 4.3)

Table 4.4: Distribution of moderate anaemia by sex and age group among school children living in urban slums of Asokoro District, FCT, 2014

	Moderate Anaemia (n=318)		OR (95% CI)	P-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Male	13 (8.8)	134 (91.2)	0.88 (0.51-1.53)	0.66
Female	13 (7.6)	158 (92.4)		
Age group				
12-15	8 (8.5)	86 (91.5)	1.07 (0.45-2.54)	0.93
5-11	18 (8.0)	206 (92.0)		
Total	**26 (8.2)**	**292 (91.8)**		

Out of the 26 school children with moderate anaemia, both sexes were equally affected but age group 5-11 years 8 (8.5%) was more affected but not statistically significant. (Table 4.4)

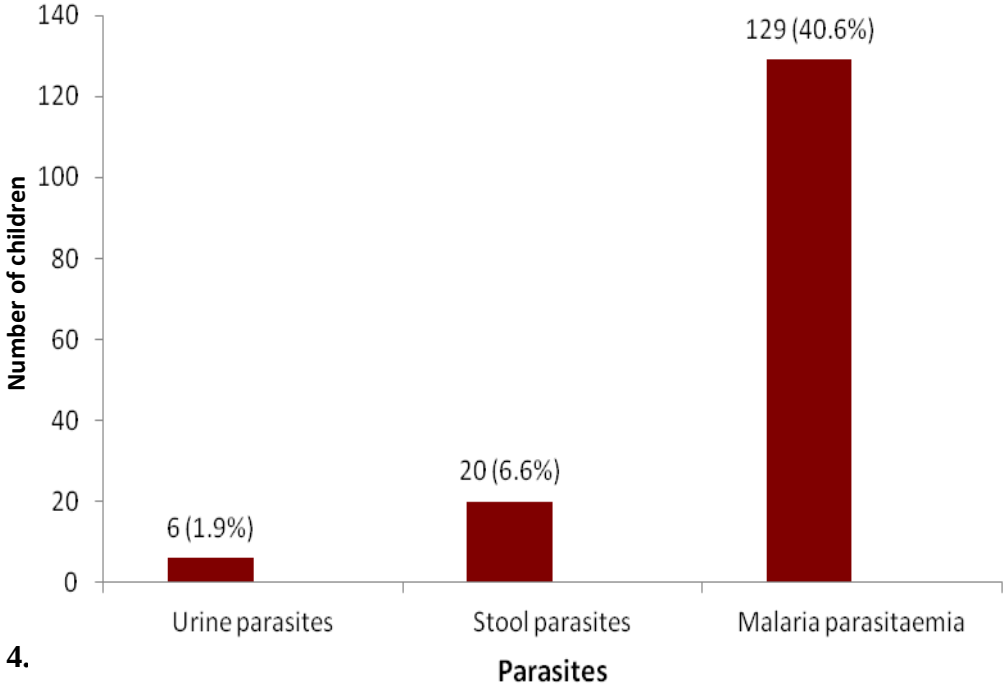


Figure 4. n slums of Asokoro District, FCT, 2014.

Among the 318 school children, the prevalence of malaria parasitaemia was 129 (40.6%), 21 (6.6%) for stool parasites, 6 (1.9%) for urine parasites (Figure 4.3)

Table 4.5: The distribution of malaria parasitaemia by sex and age group among the school children living in urban slums of Asokoro District, FCT, 2014.

	Malaria Parasitaemia (n=318)		OR (95% CI)	p-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Male	60 (40.8)	87 (59.2)	1.02 (0.65-1.60)	0.98
Female	69 (40.4)	102 (59.6)		
Age groups				
12-15	39 (41.5)	55 (58.5)	1.06 (0.65-1.72)	0.93
5-11	90 (40.2)	134 (59.8)		
Total	**129 (40.6)**	**189 (59.4)**		

The overall prevalence of malaria parasitaemia was 129 (40.6%). The prevalence of malaria parasitaemia was similar among sex and age groups. (Table 4.5)

Table 4.6: Prevalence of stool parasites among school children living in urban slums of Asokoro District, FCT, 2014.

Stool Parasites	Frequency (n=318)	Percent (%)
Helminthic Parasites	**9**	**2.8**
A. lumbricoides	2	0.6
H. nana	1	0.3
Hookworm	3	0.9
S. mansoni	3	0.9
Non helminthic Parasites		
E. histolytica	11	3.5
Total	**20**	**6.3**

Overall stool parasites was 20 (6.3%), helminthic was 9 (2.8%), non helminthic was 11 (3.5%), hookworm was 3 (0.9%) and *A. lumbricoides* was 2 (0.6%). (Table 4.6)

Table 4.7: Prevalence of urine parasites among school children living in urban slums of Asokoro District, FCT, 2014.

Urine Parasites	Frequency (n=318)	Percent (%)
S. haematobium	5	1.6
T. vaginalis	1	0.3
Total	**6**	**1.9**

The overall urine parasite was 6 (1.9%). The two types of parasites seen were *S. haematobium* and *T. vaginalis* with prevalence of 5 (1.6%) and 0.3% respectively. (Table 4.7)

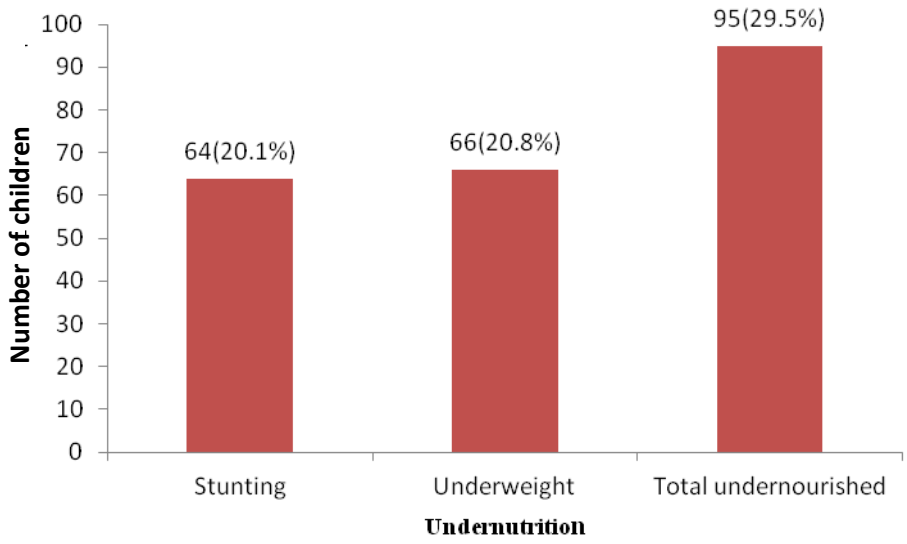


Figure 4.4: Prevalence of undernutrition among school children living in urban slums of Asokoro District, FCT, 2014.

The prevalence of stunting, underweight and total undernutrition were 64 (20.1%), 66 (20.8%) and 95 (29.5%) respectively. (Figure 4.4)

Table 4.8: Distribution of stunting by sex among school children living in urban slums of Asokoro District, FCT, 2014

	Stunted		OR (95% CI)	p-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Male	36 (24.5)	111 (75.5)	0.60 (0.35-1.05)	0.09
Female	28(16.4)	143(83.6)		
Total	**64 (20.1)**	**254 (79.9)**		

Males, 36 (24.5%) were more stunted but not statistically significant. (Table 4.8)

Table 4.9: Distribution of underweight by sex among school children living in urban slums of Asokoro District, FCT, 2014.

	Underweight		OR (95% CI)	P-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Male	42 (28.6)	105 (71.4)	2.5 (1.23-1.72)	0.002
Female	24 (14.0)	147(86.0)		
Total	**66 (20.8)**	**252 (79.2)**		

Males were 2.5 times more likely to be underweight (P=0.002). (Table 4.9)

Table 10a: Bivariate analysis of anaemia with the independent variables among school children living in urban slums of Asokoro District, FCT, 2014.

	Anaemia (n=318)		POR (95% CI)	p-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Sex				
Female	50 (29.2)	121 (70.8)	1.07 (0.66-1.74)	0.89
Male	41 (27.9)	106 (72.1)		
Age group				
12-15 years	33 (35.1)	61 (64.9)	1.55 (0.92-2.60)	0.13
5-11 years	58 (25.9)	166 (74.1)		
Residence				
Kpaduma 2	58 (32.6)	120 (67.4)	1.57 (0.95-2.59)	0.10
Others	33 (23.6)	107 (76.4)		
Living with parents				
Yes	76 (29.6)	181 (70.6)	1.29 (0.68-2.45)	0.54
No	15 (24.6)	46 (75.4)		
Family				
Polygamy	15 (16.5)	37 (16.3)	0.99 (0.51-1.90)	0.90
Monogamy	76 (83.5)	190 (83.7)		
Household size				
>8	31 (31.7)	28 (68.3)	1.19 (0.58-2.40)	0.78
2-8	78 (28.2)	199 (71.8)		
School type				
Government	58 (26.9)	158 (73.1)	0.77 (0.46-1.28)	0.38
Private	33 (32.4)	69 (67.6)		
Mal. parasites				
Yes	38 (29.5)	91(70.5)	1.07 (0.65-1.76)	0.88
No	53 (28.0)	136 (72.0)		
Stool parasites				
Yes	1 (5.0)	19 (95.0)	0.12 (0.02-0.92)	0.03
No	90 (30.2)	208 (69.8)		

Table 10b: Bivariate analysis of anaemia with the independent variables among school children living in urban slums of Asokoro District, FCT, 2014

	Anaemia		POR (95% CI)	p-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Urine parasites				
Yes	1 (16.7)	5 (83.3)	0.49 (0.06-4.28)	0.84
No	90 (28.8)	222 (71.2)		
S. haematobium				
Yes	1 (20.0)	4 (80.0)	0.62 (0.07-5.62)	0.95
No	90 (28.8)	223 (71.2)		
Stool helminths				
Yes	0 (0)	9 (100)		
No	91 (29.4)	218 (70.6)		
Other stool parasites				
Yes	1 (8.3)	11 (91.7)	0.22 (0.03-1.72)	0.1
No	90 (29.4)	216 (70.6)		
A. lumbricoides				
Yes	0 (0)	2 (100.0)		
No	91 (28.8)	225 (71.2)		
E. histolytica				
Yes	1 (9.1)	10 (90.9)	0.24 (0.03-1.91)	0.13
No	90 (29.3)	217 (70.7)		
Hookworm				
Yes	0 (0)	3 (100.0)		
No	91 (28.9)	224 (71.1)		
S. mansoni				
Yes	0 (0)	3 (100.0)		
No	91 (28.9)	224 (71.1)		
Parasitosis				
Yes	39 (26.5)	108 (73.5)	0.83 (0.51-1.35)	0.52
No	52 (30.4)	119 (69.6)		

Table 10c: Bivariate analysis of anaemia with the independent variables among school children living in urban slums of Asokoro District, FCT, 2014.

	Anaemia		POR (95% CI)	p-value
	Yes	No		
	Frequency (%)	Frequency (%)		
Anti-helminths use las 12months				
Yes	18 (34.0)	35 (66.0)	1.35 (0.72-2.53)	0.44
No	73 (27.5)	192 (72.5)		
Mother's educational level				
Pry & below	43 (32.3)	90 (67.7)	1.36 (0.84-2.23	0.26
Sec & above	48 (25.9)	137 (74.1)		
Father's occupa				
Irregular income	63 (33.7)	124 (66.3)	1.87 (1.12-3.13)	0.02
Regular income	28 (21.4)	103 (78.6)		
Household income				
< N18,000	29 (30.2)	67 (69.8)	1.12 (0.66-1.89)	0.78
≥N18,000	62 (27.9)	160 (72.1)		
Parent's SEC				
Low Class	60 (32.6)	124 (67.4)	1.6 1(0.97-2.67)	0.09
High &	31 (23.1)	103 (76.9)		
Middle Class				
Underweight				
Yes	18 (27.3)	48 (72.7)	0.92 (0.50-1.69)	0.91
No	73 (29.0)	179 (71.0)		
Stunted				
Yes	12 (18.8)	52 (81.3)	0.51 (0.26-1.1)	0.07
No	79 (31.1)	175 (68.9)		
Undernourished				
Yes	22 (23.2)	73 (76.8)	0.67 (0.39-1.17)	0.20
No	69 (30.9)	154 (69.1)		

Only two of the independent variables; fathers' occupation and presence of stool parasites were found to be statistically significantly associated with anemia. Children whose fathers' did not have regular means of income were found to be 1.89 times more likely to be anaemic than those whose fathers had regular means of income (P=0.02). Also, the presence of stool parasites was significantly associated with anaemia (P=0.03). (Table 10a,b&c).

CHAPTER FIVE: DISCUSSION

Anaemia is a worldwide public health problem that is most prevalent in developing countries. The prevalence of anaemia in this study was 28.6% and this showed that anaemia is according to the WHO classification a moderate public health problem among the school children. Malaria parasitaemia was 40.6% whereas the prevalence of stool and urine parasite was 6.6% and 1.6% respectively. Furthermore, the school children were affected by under-nutrition (20.1% stunted, 20.8% underweight) but males were more likely to be underweight. Fathers' occupation was found to be significantly associated with anaemia and the presence of any stool parasite was significantly but negatively associated with anaemia.

The anaemia prevalence in this study was similar to reports from China, Kazakhstan, Western Malaysia, Vietnam and India where prevalence rates between 24.9% and 31.4% were reported by Luo et al in 2011 among 4,100 mostly aged 9-12 years elementary school children , Hashizume et al in 2004 among 159 school children aged 8-17 years, Ngui et al in 2012 among 550 rural children aged 1-12 years, Le et al among 400 school children aged 5-8 years in rural Vietnam, in 2007 and Singh et al among 384 children aged 6-11 years in 2013.[23,27,29,31,46] However, other studies reported in India by Srivastava et al in 2012 among 384 school children aged 5-15 years and Bhawna et al in 2003 among 406 school children aged 5-11 reported about twice the prevalence documented in this study.[25,26] Bhise et al reported about three times the prevalence in 2013 among school children 8-16 years while prevalence rates from Saudi Arabia, China and Djokiv reported by Abou-Zeid et al in 2006 among 513 children aged 6-14 years, Shang et al in 2010 among 1031 school age pupils aged 9-12 years and Djokiv et al among 525 school children aged 7-14 years was about half of what was reported in this study.[24,28,32,71]

Studies from other African countries like Cameroon, Ethiopia and Ghana by Makoge et al in 2012 among 484 school children aged 3-16 years, Assefa et al among 404 children aged 6-14 years in 2014 and Egbi et al in 2014 among 143 school children aged 6-12 years reported higher prevalence rates of 30.8%-50.7% of anaemia, much higher than the one obtained in this study.[33,34,36]

Similarly, the prevalence rates of anaemia from other studies documented in Nigeria were about two to three times higher than one obtained in this study as reported by Osazuwa et al in 2011 among 316 children aged 1-15 years in Edo State, Onimawo et al in 2010 among 249 school children aged 7-12 years in Abia State and Anumudu et al in 2008 among 177 children aged 2-11 years in Ogun State.[9,11,20]

The differences in the prevalence of anaemia in the different studies reviewed might be due to the different methods of haemoglobin estimation and the haemoglobin cut- offs used for the categorization of anaemia. It might also be due to the differences in the age groups of the participants and the socioeconomic status of the parents. This implies that there is a need for nationwide multi-centre studies which adopts uniform methods and age characterization.

The overall prevalence of malaria parasitaemia in this study was 40.6%. Paradoxically, this study showed no association between malaria parasitaemia and anaemia. Malaria infestations have long been recognized as major contributors to anaemia in endemic countries and also contribute maximally to the burden of anaemia in sub-Saharan Africa including Nigeria; and constitute a major cause of morbidity and mortality. Previous studies which linked anaemia to malaria parasitaemia proffered haemolysis (intravascular and extra vascular); loss of appetite with consequent decrease in micronutrient intake and haemoglobinuria as possible mechanisms. Malaria also poses an enormous public health burden, as greater than 75% of

the global clinical episodes caused by *Plasmodium falciparum* each year are concentrated in Africa.[39] This calls for enhanced environmental, LLIN as vector control measures.

Studies from African countries like Cameroon and Ghana by Mokoge et al and Egbi et al reported malaria parasitaemia prevalence rates of about two times of what was obtained in this study, while the former did not find any association between anaemia, the latter found an association with anaemia.[34,36] Also, in contrast to another study by Haliday et al in 2012 among 2,400 participants aged 5-18 years in Kenya, malaria parasitaemia prevalence of about one quarter was obtained and a strong association with anaemia.[43]

However, in Nigeria, the report of our study on malaria parasitaemia was similar that of Osazuwa et al but differed from the prevalence rates reported by Jeremiah et al in 2007 among 240 asymptomatic children aged 1-8 years in Rivers State and Ojurongbe et al among 117 school children aged 4-15 years in Osun State but supported the non association with anaemia.[10,44,45] In addition, Onimawo et al reported a significantly higher prevalence of malaria parasitaemia, over times two of what was obtained in this study and a significant association with anaemia.[11]

The prevalence of malaria parasitaemia in this study, although lower than some studies might be due to the period of study; as most other studies were carried out during raining season while this study was done during dry season, just before the onset of raining season. The non-association in this present study compared to others may be attributed to low level of parasitaemia in the study participants, a condition that is usually associated with concomitant immunity with little or no adverse effects on haemoglobin concentration. This may also be due to the contributory roles of nutrition and genetics.

This study showed that overall prevalence of stool parasites was 6.3% and stool helminthic prevalence of 2.8%. The helminths identified were *Ascaris lumbricoides,* hookworm, *H. nana* and *S. mansoni* with very low prevalence. There was a statistically significant association between overall stool parasitic infestation (Protozoa and helminths) and anaemia which was not observed for individual helminths., Although the majority of stool parasites in children without anaemia were protozoa (11children children had *E. histolytica* infestation and only 9 children were helminthic infestations), the odds Ratio showed a reduced likely hood between anaemia and parasitic infestation which is contrary to established reports as parasites are recognized as cause of anaemia.[9,11,49–52] Since parasites are an established cause for anaemia; this study which showed a negative relationship calls for further studies using a larger population on an all year round basis.

In contrast to this study, significantly higher prevalence rates were documented from China, Vietnam and Malaysia by Shang et al, Le et al and Ngui et al. They reported overall helminthic prevalence of 36.7%, 18.5% for *Ascaris lumbricoides*, 14.7% for hookworm; overall helminth prevalence of 92.0%, 71% for *Ascaris lumbricoides* and only 6% for hookworm but no significant association with anaemia; and overall helminth prevalence of 76.5%, 13.5% for hookworm, 41.6% for *Ascaris lumbricoides* and a significant association was found between anaemia and ascariasis respectively.[24,29,46] Similarly, Makoge et al in Cameroon documented overall helminthic prevalence of about four times the one obtained in this study but that of Lwanga et al in Uganda is consistent with this study.[36,60]

In contrast to the prevalence of helminthic infestations obtained in this study, studies across Nigeria by Osazuwa et al, Onimawo et al, Ugbomoiko et al, Oninla et al, Agbolade et al and Damen et al documented overall helminth prevalence rates of 36.1% - 80.9%, 5.1% -22.7% for hookworm, 34.2% - 55.1% for *Ascaris lumbricoides* and 2.3% - 10.3% for *S. mansoni*.

However, only Osazuwa et al and Onimawo et al found statistically significant associations between helminthic infestations and anaemia.[9,11,49–52]

The low overall helminths and individual helminthic prevalence rates documented in this study varied largely from other studies in Nigeria and other parts of the world among school children. Hookworm, though very common elsewhere, the prevalence was very low in this study area, ascariasis infestations and *T. trichiuria* infestations were found to be low. Although the WHO recommended method for parasite examination and identification was adopted in this research, and quality control measures were put in place during the specimen collection and examination in the laboratory, the low helminthic prevalence rates documented in this study might be due to recall bias of anti-helminthic use in the last 6 months. Also, it might be that these parasites are truly rare in this study area as a result of adoption of key actions for health promotion, environmental sanitation, thus reducing the parasite burden in the area, and the proximity of the study area to Asokoro District which is one of the urban centers in Abuja, FCT.

The prevalence of both stunting and underweight were consistent with the trend in the 4th World nutrition situation report that documented that in West Africa, underweight affects more children (36.5%) than stunting (34.9%) but in contrast that globally stunting affects more children than underweight.[54] The prevalence of stunting in this study was about two to three times of what was reported by Mashtaq et al in Pakistan, Hashizume et al in Kazakhstan and Abou-zeid et al in Saudi with no significant association with anaemia.[31,32,72] This was consistent with reports from India, Morocco, Vietnam and China of prevalence rates 18.5% - 25.6% by Srivastava et al, Abousselah et al, Le et al and Shang et al with the last two studies reporting significant association with stunting [24,26,29,58] but about two times the prevalence of

stunting obtained in this study and underweight prevalence of about three times of what was obtained in this study was documented by Singh et al in India.[27]

The prevalence of stunting in this report was consistent with that of Francis et al in Uganda while it is higher than that of Assefa et al in Ethiopia. Males had a three fold risk of being underweight as the overall prevalence of underweight is higher than that of Francis et al.[33,60]

In Nigeria however, the prevalence rates of stunting and underweight in this study were consistent with reports by Fetuga et al in Ogun State and while higher prevalence rates was reported by Francis et al in Plateau State and that males were more underweight.[62,73] This was in sharp contrast with prevalence rates of 77% for both stunting and underweight documented by Onimawo et al in Abia State.[11] Other studies by Osazuwa et al, Anumudu et al, and Goon et al in Edo, Ogun and Benue States respectively documented prevalence rates of stunting of 36.0% to 52.7% and underweight of about 43.4% and Goon et al also reported that females were more stunted. [10,20,61]

The wide range of prevalence rates reported from different studies above might be due to epidemiological factors as well as differences in the diagnostic tools used in the various studies. Some used National Centre for Health Statistics references, which was used in this study while others used the new WHO reference values.

The only socio-economic factor that was significantly associated with anaemia in this study was fathers' occupation. Children whose fathers do not have regular means of income were found to be more anaemic compared to those whose fathers had regular means of income. This was consistent with findings by Abou-Zeid et al in Morocco who did not find significant association between education of both the father and mother of the school children and anaemia.[32] This study is however in disparity with other studies by Ngui et al in, Assefa et al

and Shang et al who all reported significant association between low mothers' educational level and anaemia.[24,33,46] Also, in disparity with this study, Onimawo et al in Nigeria documented significant association between mothers' level of education and anaemia in the children.[11] The association between fathers' occupation and anaemia found in this study may be due to the fact that children whose fathers had no good occupation with no regular means of income and low household income may not be able to provide the basic needs and would have poor living standards. On the other hand, the lack of association found in this present study between anaemia and low mother's educational level found to be significant in other studies, may be explained by the fact that both parents had basic knowledge on the prevention of anaemia in their children.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

This study was able to estimate the prevalence of anaemia and parasitic infestations and assess the nutritional status among school children living in urban slums in Asokoro District of FCT. It has also determined the association between anaemia, parasitic infestations and the effects of malnutrition and socioeconomic status on anaemia among school children living in urban slums in Asokoro District of FCT.

The prevalence of anaemia in the school age children was 28.6%. The distribution pattern of the parasitic infestations was 40.6%, 6.3% and 1.9% for malaria parasitaemia, intestinal and urinary parasites respectively. The intestinal parasites were *A. lumbricoides, Hookworm, S. mansoni, H. nana and E. histolytica.* The urinary parasites were *S. haematobium* and *T. vaginalis.* Malnutrition among the study participants was patent with prevalence rates of 20.1% and 20.8% reported for stunting and underweight respectively.

The fathers' occupation contributed significantly to the prevalence of anaemia. Also the presence of parasites in stool was found to be associated with anaemia in the school children.

6.2 RECOMMENDATIONS

In order to prevent anaemia, parasitic infestations and malnutrition among the school children living in urban slums of Asokoro District, FCT, the following recommendations were made:

1. The Federal Capital Authority Department of Health should institute school health programme consisting of nutritional support, anaemia prevention, quarterly deworming and health education especially to prevent spread of malaria.

2. The Local Government Department of Health should upscale all malaria prevention strategies and ensure compliance. E.g. use of LLINs, school children be mobilized towards identifying mosquitoes breeding spots.

3. The Local Government Department of Health services and the school authority should introduce school health nutritional programme and establish school garden or orchard for sustainable supply of micronutrients such as folic acid and vitamin C, adoption of child-child method of health education to engender good health habits, hygienic behavior, prevention of parasitic infestations and anaemia

4. Further research on other causes of anaemia (such as nutritional deficiencies and haemoglobinopathies) apart from the ones considered in this study.

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APPENDICES

Appendix 1: Study Questionnaire

Date:……..

General information

Questionnaire no _____

Name of School_____

Settlement where school is located _____

Name of Participant _____

Class _____

Settlement of Residence_____

Socio-demography

1. Sex: (a) Male (b) Female
2. Date of birth (dd/mm/yyyy): _____/_____/_____
3. Age in months _____ years ____
4. Principal occupation of Father:

   (a) Farming (b) Fishing (c) Trader (d) Labourer (e) Civil servant

   (f) Others (specify)_____
5. Level of education of Father :
   a. (a) None (b) Primary (c) Secondary (d) Tertiary
   b. (f) Other (specify) _____

6. Principal occupation of Mother:

(a) Farming (b) Fishing (c) Trader (d) Labourer (e) Civil servant

(f) Others (specify)_____

7. Level of education of Mother :

(a) None (b) Primary (c) Secondary (d) Tertiary

(f) Other (specify) _____

8. Type of family: (a) Monogamy (b) Polygamy

9. Household monthly income

(a) Below ₦18,000

(b) ₦18,000 – below ₦35,000

(c) ₦35,000 – below ₦70,000

(d) Above ₦70,000

10. Number of people in household _____

11. Do you live with your parents? (a) Yes (b) No

if no, what is your relationship with the person you live with?

Medical treatment

12. Have you received blood transfusion in the last 3 months?

Yes (b) No

If yes, when_____

13. Have you used any anti-helminthic drug in the last 12 months?

(a) Yes (b) No

if yes, when _____

14. Are you on any anti-helminths therapy? (a) Yes (b) No

if yes, please give details_____

15. Are you currently on any iron therapy? (a) Yes (b) No

if yes, please give details_____

16. Are you currently on any haematinics (blood tonic)? (a) Yes (b) No

if yes, please give details_____

17. Are you currently on any anti-malaria? (a) Yes (b) No

if yes, please give details_____

18. Are you currently on any other medication ? (a) Yes (b) No

if yes, please give details_____

Nutritional indices

i. Height(cm)----------

ii. Weight(km)----------

iii. Age(years)----------

Lab case report

Specimen collection

i. Blood collected for Full Blood Count

ii. Blood collected for Malaria parasites test

iii. Urine collected for parasite examination

iv. Stool collected for parasite examination

Laboratory results

i. FBC: Hb----------g/dl

MCV----------fl

MCH----------pg

ii. Trophozoites of MP----------Seen Not seen

iii. Parasite (ova/egg) seen in stool ----------

iv. Parasite (ova/egg) seen in urine----------

Appendix 2: Parent's Information Form

Study Title: Anaemia and Parasitic Infestations among School Children Living in Urban-Slums of Asokoro District, FCT, Nigeria.

Name of Researcher: this research is being conducted by Fagbemiro Olufunke (Mrs), a resident of the Nigeria Field Epidemiology and Laboratory Training Programme (NFELTP) which is sponsored by the Federal Ministry of Health (FMOH), Federal Ministry of Agriculture and Rural Development (FMARD) in collaboration with the United States Centre for Disease Control and Prevention (US CDC).

Background: anaemia or shortage of blood affects most people in the world including children. Shortage of blood can cause a child to feel weak and when the shortage is serious, it can make the child dull at school. This can also make the child to fail exams, and make us think that the child is lazy. In some cases, weakness and dullness make people think such children are stubborn or are possessed by witches or Ogbanje or are cultists. When children with shortage of blood are indentified and are treated correctly by identifying the cause, the children regain their strength and their brain becomes active. The commonest causes of blood shortage in children are germs like worms like malaria in blood, worms in faeces and urine.

Purpose of the research: to determine how many children have anaemia (shortage of blood) and to identify the causes of shortage of blood.

Procedure of the research: children whose parents give permission to do this study will give 3-5 ml (about one teaspoon full). Blood will be collected using a syringe and injection needle. The blood collection will cause a minor pain. All children who give one teaspoon of blood will also give samples of urine and stool or faeces to determine the cause of anaemia. Your child will be given 2 plastic containers so that each will be used to collect stool and urine

separately. The collection of stool and urine may not cause any harm to your child's body. The blood, urine and stool samples will be examined to find out if the germs that cause malaria and suck blood were present.

Risk: you may feel a slight pain when we are taking blood from you and there might be a tiny swelling. To avoid these, we will ensure that a trained health professional takes your blood with all due safety precautions. If you feel severe pain in the process, please call the attention of the health care professional**.** You may also contaminate your hand in the process of stool or urine collection. All samples will be kept in an air tight plastic containers and basin containing water and soap will be provided for you to wash your hands immediately.

Benefits: any child who is found to have malaria or any blood sucking germs and those requiring further medical attention will be referred to Asokoro District hospital for medical treatment. The children will also be taught on how hygiene and cleanliness prevent anaemia. Basins for water for hand washing will be given to the school for subsequent use by the children. Knowledge, attitude and practices (KAP) posters on hygiene and hand washing for role play on hygiene will also be supplied to the school.

Appendix 3: Parental Consent Form

Questionnaire no_____

I, ……... of ……...

Parent/guardian of …….has read this entire consent form, or had it read to me, and my questions have been answered to my satisfaction. I agree to allow my child to take part in the research to find out the causes of blood shortage in our neighborhood. I understand that blood, stool and urine samples will be taken and the pain from blood collection will be slight.

Signature or thumbprint of parent/guardian:

…….

Date:……..

Name of witness……

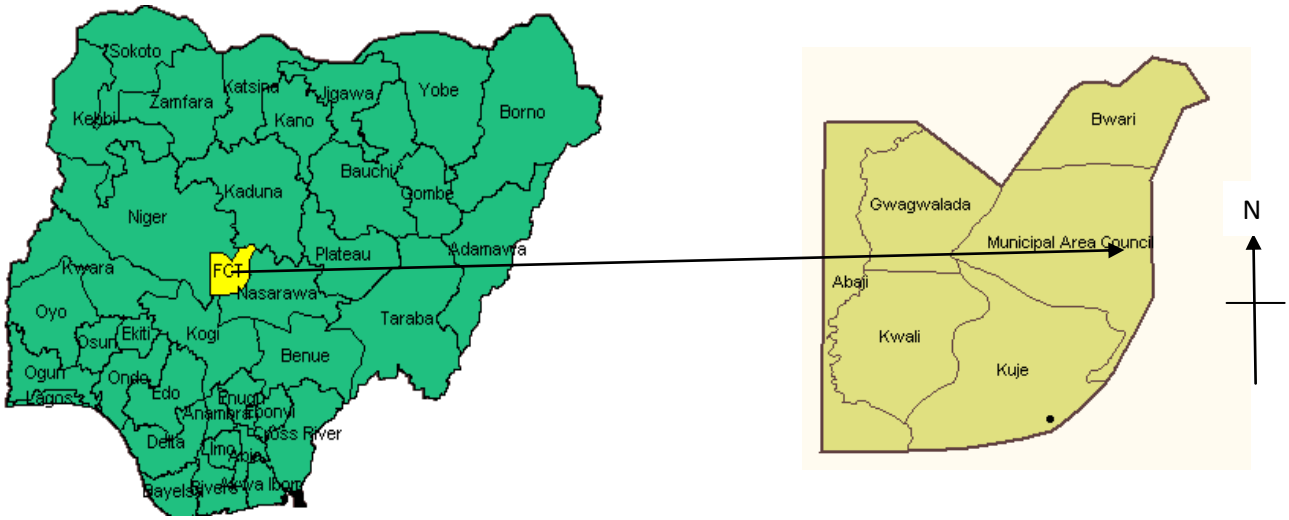
Signature or thumbprint of Witness…….

Date:……..

Name of Interviewer……

Signature of Interviewer:……..

Appendix 4: Map of the Study Area



Map of Nigeria showing the Federal Capital Territory and Abuja Municipal Area Council (AMAC) where Asokoro Extension of Asokoro District is situated.

Appendix 5: Ethical Clearance

FEDERAL CAPITAL TERRITORY
HEALTH RESEARCH ETHICS COMMITTEE
Research Unit, Room 10, Block A Annex, HHSS
FCT Secretarial No. 1 Kapital Street Area 11, Garki, Abuja - Nigeria

Name of Principal Investigator: FAGBEMIRO OLUFUNKE OLUBUMI
Address of Principal Investigator: Nigeria Field Epidemiology & Laboratory Training Programme 50 Haile Selassie Str. Asokoro, Abuja
Date of receipt of valid application: 30/10/2013

NOTICE OF APPROVAL AFTER COMMITTEE REVIEW
Protocol Approval Number: FHREC/2013/01/50/20-11-13

TITLE: **ASSOCIATON BETWEEN ANAEMIA AND PARASITIC INFECTIONS AMONG SCHOOL CHILDREN LIVING IN URBAN-SLUMS OF ASOKORO DISTRICT, FCT.**

The research described in the submitted protocol has been reviewed.

Documents Reviewed:
(i)Application form
(ii)Curriculum Vitae of the Investigator
(iii)Research Protocol;
* Questionnaire
* Participant Information Sheet
* Informed Consent Form

On the basis of the review, this research has been approved by the Committee (FHREC). Subsequent changes are not permitted in this research without prior approval by the FHREC.

This approval dates from 20/11/2013 to 21/11/2014. Note that no participant accrual or activity related to this research may be conducted outside of these dates. All informed consent forms used in this study must carry FHREC assigned protocol approval number and duration of FHREC approval of the study.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the code including ensuring that all adverse events are reported promptly. The FHREC reserves the right to conduct compliance visit to your research site without previous notification.

In multiyear research, endeavor to submit your annual report to the FHREC early in order to obtain renewal of your approval and avoid disruption of your research. At the end of the research, a copy of the final report of the research should be forwarded to FHREC for record purposes.

Ikwubiela S. Adem
Secretary, FHREC
November 20, 2013

Appendix 6: Budget

Category	Unit Cost (Naira)	Multiplying Factors	Costs (Naira)
I. Allowances			
(a) Researcher-supervisor (1)			
- Training research assistants	2,000 per day	2000 X 1	₦2,000
- Field work during pilot	2,000 per day	2000 X 1	₦2,000
- Field work during actual study	2,000 per day	2000 X 25	₦50,000
(b) Research assistants (2)			
- Training	2,000 per day	2000 X 1 X 2	₦4,000
- Field work during pilot study	2,000 per day	2000 X 1 X 2	₦4,000
- Field work during actual study	2,000 per day	2000 X 25 X2	₦100,000
(c) Med. Lab. Scientists (2)			
- Stool and urine microscopy	2,000 per day	2000 X 25 X2	₦100,000
(d) Secretariat (1)			
- Printing of questionnaire	50 per copy	50 X 318	₦15,900
- Finalizing report	2,000 per day	2000 X 10 X 4	₦80,000
Sub – Total (1)			**₦357,900**
II. Transportation			
a. Supervisor(for pilot study)	1,000 per day	1000 X 1	₦1,000
b. Research assistants (for pilot study)	1,000 per day	1000 X 1 X 2	₦2,000
c. Supervisor (for actual data collection)	1,000 per day	1000X 25 X 2	₦50,000
d. Research assistants for actual data collection)	1,000 per day	1000X 25 X 2	₦50,000
SUB – TOTAL (II)			**₦103,000**
III. SUPPLIES			
a. Sysmex analyser reagents	35,000 per Pack		
	3,000 per Pack (25 units)	35000 X 5	₦175,000
b. Lab consumables	Gloves, cotton-wool, EDTA bottles, markers vacutainer tubes, needles &holders, syringes, sterile bottles, glass slides, test tubes, Lab coats, transport boxes, biohazard bags, ice packs, tourniquets, height gauge, balance scale	50,000	₦50,000
c. Lab reagents	Formalin, ether, normal saline, iodine, Giemsa stain, alcohol	20,000	₦20,000
SUB – TOTAL (III)			**₦245,000**
TOTAL (I) + (II) + (III)			**₦705,900**
5% CONTINGENCY			**₦35,500**
GRAND TOTAL			**₦741,400**