SOIL TRANSMITTED HELMINTHES AND ANAEMIA AMONG PREGNANT WOMEN ATTENDING PRIMARY HEALTH CARE CENTERS IN IDO AND AKINYELE LOCAL GOVERNMENT AREAS OF IBADAN, OYO STATE.

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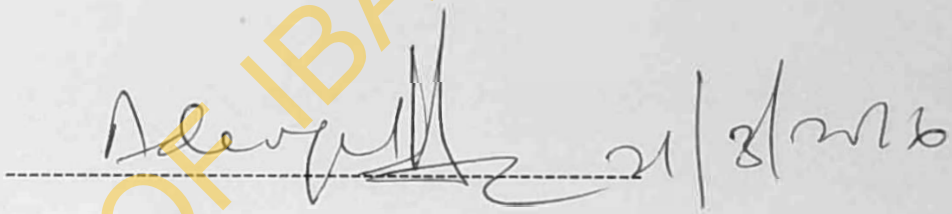
CERTIFICATION

I hereby certify that this research project titled "Soil Transmitted Helminthes and Anaemia among Pregnant Women attending Primary Health Care centers at Ido and Akinyele Local Government Areas of Ibadan" was carried out by Umezurike Chioma Emilia in the Department of Epidemiology and Medical statistics, Faculty of Public health, College of Medicine, University of Ibadan, Oyo state, Nigeria, under my supervision.



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DEDICATION

To God almighty who has been the source of my help and inspiration, also to my parents (Elder and Mrs. Umezurike) and my siblings.

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LIST OF ACRONMYS

AIDS	Acquired Immune Deficiency Syndrome
CDC	Center for Disease Control
CI	Confidence Interval
GBD	Global Burden of Diseases
HIV	Human Immunodeficiency Virus
IITA	International Institute of Tropical Agriculture
INACG	International Nutritional Anaemia Consultative Group
IPT	Intermittent Preventive Therapy
ITN	Insecticide Treated Nets
PCV	Packed Cell Volume
PT	Preventive Therapy
SP	SulfadoxinePyrimethamine
STH	Soil Transmitted Helminthes
UNICEF	United Nations International Children's Fund
UNU	United Nations University
WHO	World Health Organisation

ABSTRACT

Soil Transmitted Helminthes (STH) infection is an important but neglected tropical disease and a major cause of anaemia during pregnancy. STH infection has been well investigated among children while pregnant women have been given less attention. Investigating the association between STH and anaemia helps provide the needed evidence for providing interventions to reduce anaemia in pregnancy. This study was aimed to determine the prevalence and intensity of STH, factors associated with STH and also investigated the association between soil transmitted helminthes infection and anaemia among pregnant women attending Primary Health Care Centers (PHCC) at Ido and Akinyele Local Government Areas in Ibadan.

A cross sectional study was conducted using the multistage sampling technique, in which 326 pregnant women from six PHCC were studied, over a period of 12 weeks, a semi structured interviewer administered questionnaire was used to obtain information on the socio-demographic characteristics, reproductive and antenatal health, medical history, environmental factors and hygiene practices among the pregnant women. Stool samples were collected and kato-katz technique of quantification was used to determine the presence of STH, capillary blood samples were taken and used to determine the PCV and the presence of malaria in the study participants. Data analysis was done using frequency distributions, chi-square for bivariate and binary logistic regression multivariate analysis, at 5% level of significance.

Among participants mean age was 28.25 ± 5.6 years, 291 (89%) were married, 176 (54%) had at least secondary school education and 217 (66.8) were employed, Muslims were 168(51.5) and Christians 154 (47.2) with about two third of the women 217 (66.8) earning

below 10000 naira per annum. The prevalence of STH in this study was 13.8%, and common organisms were *Ascaris lumbricoides* 13.2%, *Trichuris trichiura* 0.3% and hookworms 0.6% with no case of multiple infection. There was a single case of moderate infection of *Ascaris lumbricoides* with others being of light intensity. At multivariate logistic regression women who wore shoes in the house (OR=3.94, 95%CI= 1.70-9.15) were four times more likely to be infected with STH than women who did not wear shoes in the house. Similarly women who washed their hands with soap before eating (OR=0.43, 95%CI=0.23-0.82) were 57% less likely to be infected with STH than the women who did not wash their hands before eating. There was a statistically significant association between STH infection and anaemia in the pregnant women in this study (OR= 2.13, 95%CI=1.13 – 4.01p=0.018), after adjusting for malaria.

Although the prevalence of this study was not up to the cutoff of 20% stipulated by WHO before it can be referred to as a disease of Public Health importance, anaemia was still significantly associated with STH infection. However, there is still a need for constant monitoring of STH infection in the semi-urban areas.

KEYWORDS: Soil Transmitted Helminthes, Anaemia, Pregnant women

Word count: 456

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Soil Transmitted Helminthes (STH) has affected about 2 billion people worldwide, and about 4 billion people are susceptible to this infection with 300 million people suffering severe morbidity that can lead to death.(Million et al., 2012). STH are intestinal worms infecting humans and are transmitted through contaminated soil, there are three major soil transmitted helminthes that are of public health importance which are; *Ascaris Lumbricoides, Trichuris Trichiura* and hookworm. Globally there are about 800-1000 million cases of *Ascaris lumbricoides* reported, 700-900 million cases of *Necator americanus* and *Ancylostoma duodenale* reported and 500 million cases of *Trichuris trichiura* also reported (Gyorkos et al., 2004).

The causes of helminthes infection is majorly lack of sanitation such as defecation in open places and lack of hand washing skills among residents of endemic areas (Strunz, 2014). STH affect humans worldwide and the largest occurrence of STH are in the impoverished rural areas of sub-Saharan Africa, Latin America, Southern Asia and China (WHO, 2014). It is estimated that STH is responsible for about 40%, of the health burden of neglected tropical diseases. (Million et al., 2012). The groups at risk are; preschool children, school-age children, pregnant women and adults with high risk jobs such as miners (WHO, 2015).

Anaemia is defined as a decrease in the amount of red blood cells, or haemoglobin in the blood. In pregnancy, it is defined as having a haemoglobin level that is less than 11.0g/dl

at booking (Blackwell, 2008). Malaria, hookworms and Vitamin A deficiency, contribute to anaemia during pregnancy in most under developed countries (Dreyfuss et al., 2000). However, in 2013, 183,000 women died worldwide as a result of iron deficiency anaemia (GBD, 2013). Some of the symptoms of anaemia in pregnant women are; weakness, fatigue, shortness of breath and pale skin, pregnancy induced anaemia can be treated by adding iron or vitamin supplement to daily, routine and in severe cases blood transfusion can be administered.

STH infection can affect both the mother and the foetus by causing low birth weight, impaired milk production and increased risk of mortality (Bethony et al, 2006). Studies done in Africa has shown a prevalence rate of 54% of STH infection among pregnant women (Million et al, 2012), which is above 20% the stipulated minimum level of helminthes infection before considered as a public health threat (WHO, 2012). A prevalence rate of 27% has been reported among pregnant women in Nigeria (Polycarp et al., 2013). STH, especially hookworm which is a major cause of anaemia in pregnant women, has been estimated to have infected about 44million pregnant women, out of 124 million pregnant women in endemic areas, while in the sub-Saharan Africa, hookworm has infected about 7.5 million pregnant women (Nelly et al., 2006).

Surveys have been done in different parts of Nigeria, mostly among school children but little attention has been paid on pregnant women, most of the studies have excluded pregnant women because of the deworming program, meanwhile they are becoming at high risk of STH infection. The purpose of this study is to determine the prevalence and intensity of STH infection among pregnant women, regardless of the deworming program

in other to provide more epidemiological data on the association between STH and anaemia, to aid reduction in the burden of mortality and morbidity caused by Anaemia.

1.2 PROBLEM STATEMENT FOR STUDY

Globally according to WHO fact sheet on Anaemia, about 1.62 billion people which corresponds to 24.8% of the population have Anaemia, also regional estimates done by WHO has shown that the highest proportion of individuals with Anaemia are found in Africa, with about 65.8% pregnant women being anaemic, indicating that one in four people is affected by Anaemia. (WHO, 2005). HIV is a major contributor to maternal Anaemia, and there is significant evidence that shows that Anaemia in pregnancy can be linked to HIV infection (Tolentino, 2007). Malaria is also a contributor to anaemia in pregnant women, with a very high rate being recorded in the sub-Saharan Africa (WHO, 2005).

STH infection in the sub-Saharan Africa has infected about 7.5 million pregnant women (Nelly et al, 2009). Helminthes infections such as hookworm, trichuriasis and schistosomiasis, have shown that they contribute to severe anaemia in patients through loss of blood and micronutrient deficiency (Mpairwe, 2014). Hookworm is a very important parasitic disease that affects the Disability Adjusted Life Years (DALYs), therefore, a high burden of hookworm eggs in an individual can lead to blood loss, to tackle hookworm infestation there will be a need to increase the haemoglobin level of the individual. The foetus requires a high amount of iron, when the iron intake of the woman is depleted, the woman becomes anaemic, the iron being transferred to the foetus through

the mother becomes limited and this can lead to deficiencies when the child is born especially cognitive impairment. (Mpairwe, 2014).

Attention has been focused more on how to determine the relationship between Anaemia and STH among school children in Nigeria. Showning mostly the association between Anaemia and Malaria, which has resulted in the routine administration of Intermittent Preventive Therapy (IPT) and also the use of Insecticide Treated Bed Nets (ITN). However, little evidence on Soil Transmitted Helminthes and Anaemia among Pregnant Women, and intensity of infection is available in Nigeria.

Therefore this study will help to determine the association between STH and Anaemia among pregnant women in the rural areas of Ido and Akinyele Local Government in Nigeria. WHO has recommended that anthelminthic therapy should be included in the antenatal process of pregnant women. Stating that it helps to reduce worm burden, thereby, reducing anaemia in pregnancy related to worm burden. Therefore this study wants to help provide more evidence on STH infection in Nigeria in other to enhance the anthelminthic therapy.

1.3 JUSTIFICATION FOR STUDY

In sub-Saharan Africa, up to 24 million women become pregnant each year and due to behavioural and immune changes, a majority of these women are susceptible to parasitic infections that results in poor pregnancy outcomes. Hookworm infection, an important aetiological agent of anaemia in pregnant women, has been shown to have prevalence and intensity rates which vary by geographic region (Dreyfuss et al., 2000). The distribution of STH in tropical regions particulrly in sub-Saharan Africa is high and hookworm infection

during pregnancy contribute significantly to the degree of Anaemia in mothers and their newborns. The prevalence and intensity of infection are especially high in developing countries among populations with poor environmental sanitation (Eijk et al., 2009). Helminthes infections contribute to severe Anaemia through blood loss and micronutrient deficiencies. (Stephenson et al., 2000)

International guidelines have put in place by WHO (Anthehelminthic therapy) in other to reduce the increase in maternal mortality and morbidity among pregnant women caused by STH infection. Despite the effectiveness of this intervention programs to address common infections such as hookworm, schistosomiasis, it has not yet been widely adopted by these endemic areas. (McClure et al., 2014).

However, there is a need for improvement in the health strategy for attainment of effective parasitic disease control programme, (Legesse,2008) particularly in pregnant women. Therefore this study wants to provide evidence required for the necessary policy developing regarding the STH in pregnancy and its implication on anaemia related to STH infection.

1.4 RESEARCH QUESTIONS

1. What is the Prevalence of Soil Transmitted Helminthes infection among pregnant women in Ido and Akinyele local government areas of Ibadan, Oyo state?
2. What are the Intensities of Soil Transmitted Helminthes Infection among pregnant women in Ido and Akinyele local government areas of Ibadan, Oyo state?
3. What are the Risk Factors that are associated with Soil Transmitted Helminthes among pregnant women living in Ido and Akinyele local government areas of Ibadan, Oyo state ?

4. Is there an Association between Soil Transmitted Helminthes and Anaemia among pregnant women at Ido and Akinyele local government areas?

5. What is the Prevalence of Anaemia among Pregnant women in Ido and Akinyele Local government areas of Ibadan, Oyo state?

1.5 OBJECTIVES OF THE STUDY

1.5.1 Broad objective

To determine the Prevalence, Intensity and the Risk Factors associated with Soil Transmitted Helminthes and Anaemia among pregnant women attending Primary Health Care Centers (PHCC) in Ido and Akinyele Local Government areas of Ibadan.

1.5.2 Specific objectives

1. To determine the Prevalence of Soil Transmitted Helminthes among pregnant women.
2. To determine the Intensity of the Soil Transmitted Helminthes among the pregnant women.
3. To determine those factors associated with Soil Transmitted Helminthes infection among pregnant women.
4. To determine the association between Soil Transmitted Helminthes and Anaemia among pregnant women.
5. To determine the Prevalence of Anaemia among Pregnant women.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Soil-transmitted helminthes infection (STH) is a condition caused by parasites called helminthes, also known as intestinal worms. Of the 100 species of helminthes reported from the human intestinal tract, the nematodes such as *Ascaris Lumbricoides*, Hookworm and *Trichuris Trichiura* are the most common species (Cheesbrough, 2005). It is estimated that at least one third of the world's population, is chronically affected by intestinal parasites and the prevalence of infection varies from one country to another and sometimes from one area to another in the same country (WHO, 2006).

The public health importance of intestinal helminthes infections continues due to their effects on both the nutritional and the immune status of infected individuals, particularly those living in the tropical and subtropical areas (WHO 2006). The prevention and control of these parasites are mainly by mass drug distribution. However, chemotherapy alone does not solve the problems, and the role of other measures such as sanitation and health education should also be considered, the success or failure of control measures may depend mainly on man's behavioral attitude and practices. Therefore, the participation of the community in active programme directed towards the improvement of their health and standard of living is of significantly importance (WHO, 2006).

2.2 Soil Transmitted Helminthes (STHs)

STHs infection varies based on geographical distribution, it has its highest prevalence in the tropical areas such as America, China, East Asia and sub Saharan Africa. There are four main types of STHs that are widely discussed about in most studies, these four helminthes include; Roundworm (*Ascaris lumbricoides*), Whipworm (*Trichuris trichiura*), and the Anthropophilic hookworms (*Necator americanus* and *Ancylostoma duodenale*). Recent estimates done suggests that *A. lumbricoides* infects 1.221 billion people, *T. trichiura* 795 million, and hookworms infects 740 million (de Silva et al., 2003). People at risk of STHs infection are Preschool children, school-age children, women of child bearing age (including pregnant and breast feeding women) and adults in certain high risk occupation.(WHO, 2015).

Types of Soil transmitted helminthes

Hookworm (*Ancylostoma duodenale* and *Necator americanus*): Hookworms are parasitic blood sucking roundworms, they cause infections called ancylostomiasis and necatoriasis. When it occurs in pregnancy it can cause retardation in growth of the feotus, premature birth and low birth weight. The species of hookworm that affects human are *Ancylostoma duodenale* and *Necator americanus*, the major morbidity that is caused by hookworm is as a result of heavy intensity of hookworm infection, which leads to intestinal blood loss, iron deficiency anaemia and protein malnutrition. (Bethony et al., 2006).

N.americanus and A.duodenale eggs can be found in areas that are warm and the soil is moist, about 576-747million individuals are infected with hookworm and out of these infected individuals 80million are severely infected (gasser et al., 2009). *N.americanus*is

found in America, sub Saharan Africa, and Asia, while *A.duodenale* is found in Europe and the Mediterranean, majority of the infected individuals are found is the sub Saharan Africa and East Asia, with each region having about 198 million and 149 million infected individuals respectively. (Hotez et al., 2005).

Whipworm (*Trichuris trichiura*): *Trichuris trichiura* is a human whipworm, which is one of the types of helminthiasis and also a neglected tropical diseases which infects the human's large intestine. The female T. trichiura produces 2000-10000 single celled eggs per day, these eggs are deposited from the feaces to the soil, then 2 or 3 weeks later it becomes infective, this infective larva penetrates the villi and develops in the small intestine, these worms can live up to 5years. This infection is more common in warmer areas, whipworm eggs are transmitted from feaces to infected persons and theses are caused when an infected person defecates outside, or if untreated human feaces is used as fertilizer, the eggs can be ingested when dirty fingers or hands are put in the mouth through the consumption of vegetables or fruits that are not well cooked, washed or peeled (CDC, 2013). The worldwide distribution of *Trichuris trichiura* is estimated as 1 billion human infection, Whipworm has a higher prevalence rate in Asia and a lesser rate in Africa and South America. (CDC, 2013).

Roundworm (*Ascaris lumbricoides*): *Ascaris lumbricoides* are giant round worms that infects human, they can be as long as 35cm (Aaron, 2008). It is the largest and the most common parasitic worm in humans, it causes Ascariasis, this infection has no symptom but when heavy infection occurs, it may include symptoms like bloody sputum, cough, fever, abdominal discomfort, intestinal ulcer, etc, ascariasis is the major cause of Loffler's

syndrome and part of the neglected tropical diseases, and about one-sixth of the human population is infected by *A.lumbricoides* (Harhay et al., 2010).

A.lumbricoides infect humans through the ingestion of fertilized eggs, these eggs penetrate the duodenum and enters the blood stream. When the eggs mature the female worm can produce about 200,000 eggs per day for a year. The eggs are resistant to acids and alkaline because of their lipid layers, this explains why this nematode is a referred to as ubiquitous parasite (Piper 2007), *Ascaris lumbricoides* affects more than 2 billion people (Murray et al., 2005).

2.3 Mode of transmission of Soil Transmitted Helminthes

Soil Transmitted Helminthes live in the intestine and their eggs are passed in the feces of infected persons. If an infected person defecates outside (near bushes, in a garden, or field) or if the feces of an infected person are used as fertilizer, eggs are deposited on the soil. *Ascaris* and hookworm eggs become infective as they mature in the soil. People are infected with *Ascaris* and whipworm when eggs are ingested. This can happen when hands or fingers that have contaminated dirt on them are put in the mouth or by consuming vegetables and fruits that have not been carefully cooked, washed or peeled. Hookworm eggs are not infective. They hatch in soil, releasing larvae (immature worms) that mature into a form that can penetrate the skin of humans. Hookworm infection is transmitted primarily by walking barefoot on contaminated soil. One kind of hookworm (*Ancylostoma duodenale*) can also be transmitted through the ingestion of larvae.

People with light STH infections usually have no symptoms. Heavy infections can cause a range of health problems, including abdominal pain, diarrhea, blood and protein loss,

rectal prolapse, and physical and cognitive growth retardation. STH infections are treatable with medication prescribed by your health care provider.

2.4 Diagnosis of Soil Transmitted Helminthes Infection

Helminthes can be easily identified from the feces, their eggs are usually examined both by using, the microscopic or fecal egg count method. Although there are limitations, such as, the inability to identify mixed infections (Krauth et al., 2012). An effective method for egg analysis is the Kato-Katz technique, It is a highly accurate and rapid method for *A. lumbricoides* and *T. trichiura*; except for hookworm, due to the fast rate of degeneration of the delicate hookworm eggs (Tarafder et al., 2010). Despite the intensity of infection with STHs (the number of helminthes infecting an individual) can be measured either directly, by counting the number of expelled worms after anthelminthic treatment, or indirectly, by counting the number of helminth eggs excreted in feces (WHO, 2014).

2.5 Soil Transmitted Helminthes Infection in Pregnant Women.

Prevalence and Intensity of Soil Transmitted Helminthes infection in pregnant women

In endemic settings, there is a high burden of helminthes infection among pregnant women (Woodburn et al., 2009). Recent studies done in the developing countries, to determine the differences in the prevalence rates of STH infection, have reported prevalence rates of 13.8% in Kenya (Wekesa et al., 2014) with intensity of STH among these pregnant women categorized into heavy (14.3%), moderate (42.9%), and low

(42.9%), respectively. Another study done in Bangalore reported a prevalence rate of 12.4% (Shrinivas et al., 2014). In Cameroon the prevalence of Soil Transmitted Helminthes was 47.1% (Ndamukong et al, 2011).

In Nigeria, Omorodion conducted a study in the South Southern part of Nigeria, which showed that the prevalence of intestinal parasitic infection of examined stool samples of 213 pregnant women was 23.74 %.(Omorodion et al, 2012). In the south eastern part of Nigeria a study carried out suggested a prevalence of 32.4% (Ikechukwu et al., 2014). Pregnant women attending antenatal care clinic at the University College Teaching Hospital Ibadan, recorded a prevalence rate of 43.4% (Alli et al., 2012)

Most of the studies done in Nigeria, have a prevalence rate that is above the 20%-30% range before Soil Transmitted Helminthes is viewed as a disease of public health importance by the World Health Organization (Omorodion et al., 2012, Ikechukwu et al., 2014 and Alli et al., 2012). Therefore there is a need to provide more information on prevalence rates of Soil Transmitted Helminthes in Nigeria, especially in the South western part of Nigeria where very few studies have been conducted, and especially in the rural areas where the risk of infection is high due to the poverty level and there have not yet been enough studies, that have explicitly showed results on the various categories of helminthes intensity (High, Low and Moderate), this needs hereby inform the Objectives of this study to determine the prevalence and intensity of soil transmitted helminthes infection.

I. Effects on the immune system and susceptibility to other infections: Parasitic infections may interfere with the host's immune system, and result in increased susceptibility to other infectious diseases (Boel et al., 2010).

II. Effect on Newborn: Exposure of the foetus to helminthes antigens and maternal antibodies may modulate the infant's immunity against these infections at a later stage. Moreover, compared to an infant born with normal birth weight, low birth weight may also predispose an infant to frequent parasitic infections (Petersen, 2007). Low birth weight babies run a much higher risk of intestinal and respiratory infections, a higher rate of hospitalisation, and most importantly, a higher mortality rate, than babies born with normal weight.(Larocque et al., 2006) Furthermore, babies born to anaemic mothers are at high risk of being low birth weight babies. Decreased immunity, increased susceptibility to other diseases and malnutrition (as observed in underprivileged countries), increased nutrient requirement for foetal development and for the expansion of the mother's blood volume, together with blood loss due to parasitic infections, may reduce quality of life, and contribute to causing the twin phenomena of high morbidity and mortality (Elhassan et al., 2010).

III. Effects on nutrition: Parasites interfere with nutrient uptake by inducing chronic blood loss, competing for nutrients, and causing hypersensitivity, thereby decreasing the time available for digestion and absorption. (Larocque et al, 2006) Therefore, parasitic infections intensify the problem of Anaemia in

pregnancy as they deplete or reduce nutrients that are essential for blood cell formation (erythropoiesis) (Larocque et al., 2006). As a result, infections contribute to malnutrition and iron deficiency anaemia, which are the major underlying causes of poor pregnancy. Anaemia can result in low pregnancy weight gain, and maternal and perinatal mortality (Fuseini et al., 2010)

2.6 Factors associated with Soil Transmitted Helminthes Infection in Pregnant Women

Several previous studies have identified numerous risk factors which are associated with the high prevalence and intensity of STH. These include some demographic, socioeconomic, environmental and behavioral factors which form a web of causation for STH infections, Hence, a better understanding of the relationship of risk factors to the dynamics of transmission of STH, is essential to implement effective control measures. The risk factors of STH infections may differ from one region to another and sometimes within the population or the country itself (de Silva *et al.*, 2003). The risk factors of STH infections are discussed briefly.

i. Environmental factors: The environmental conditions in the unplanned slums of developing countries are ideal for the persistence of STH infections, Both *Ascaris* and *Trichuris* commonly occur in semi urban environments and in rural areas In contrast, high prevalence of hookworm infection is restricted to areas where rural poverty prevails (Phiri *et al.*, 2000).

Adequate warmth and moisture are key features for each of the STH, *Ascaris* and *Trichuris* eggs have shells which are thicker than hookworm eggs, and therefore survive drier climates better. However, the rates of infection are low in dry climates for all STH species. It has been concluded that total rainfall and

its seasonal distribution may explain the observed patterns of infection; wetter areas are usually associated with increased transmission of all three major STH infections (Brooker and Michael, 2000). Previous studies from West Africa suggest that a minimum of 1400 mm annual rainfall is necessary for the prevalence of *A. lumbricoides* to exceed 10% (Brooker and Michael, 2000). Similarly, a study in Cameroon, Chad and Uganda suggests that *A. lumbricoides* and *T. trichiura* are not endemic in areas where land surface temperature exceeds 37°C (Brooker *et al.*, 2002a, 2002b).

ii. Demographic factors: The peak prevalence and intensities for hookworm occurs in individuals in middle age, or even over the age of 50 (Bethony *et al.*, 2002). In China, a variance components analysis revealed that age was the most important contributor to infection intensity (28-30%), with age alone being responsible for 27% of this variation, and the study showed that *Ascaris* and *Trichuris* infections decrease after the age of 20 (Hotez, 2002). the prevalence of hookworm infections has been reported to increase significantly with age, the nutritional and health status of the elderly in developing countries are often poor which makes them vulnerable to the morbidity associated with heavy hookworm infection (Tucker *et al.*, 2001). The age factor could be attributed to the different modes of transmission of these helminthes.

iii. Socioeconomic factors: Poverty is the root of almost all neglected tropical diseases including STH infections which are highly prevalent in poor and underprivileged communities. This may be attributed to the inadequate facilities that are essential in STH prevention and control. These include poor sanitation, unavailability of clean and treated drinking water and poor health

care facilities (Anantaphruti *et al.*, 2004; Tomono *et al.*, 2003). Many previous studies in Malaysia and other countries showed that low household monthly income was a significant predictor of STH infections (Nasr *et al.*, 2013a; Ngui *et al.*, 2011; Naish *et al.*, 2004). Moreover, these infections have negative impacts on the work capacity and future productivity of the infected individuals which may be reflected on the economy of the affected community which is trapped in a cycle of poverty, underdevelopment and disease (Bleakley, 2007).

Sanitation is considered a key factor for the transmission of intestinal parasitic infections. People in the rural areas and poor socioeconomic communities live with absence or inadequate sanitation including the absence of toilets and lack of provision of clean and treated water supply. Such situations cause STH infections to be easily transmitted vertically and horizontally as well (Suzy *et al.*, 2014).

iv. Behavioural factors: The association between STH infections and personal hygiene practices is well documented. Hygienic behavior has proven to be a significant contributor to a sustainable control of STH infections, schistosomiasis, diarrhoea, and other fecal-orally transmitted diseases (Schmidlin *et al.*, 2013). Unhygienic personal practices such as not washing hands before eating, walking barefooted, not washing vegetables/fruits before consumption and drinking untreated water, were identified as significant predictors of STH infections in Malaysia and other countries (Nasr *et al.*, 2013a; Schmidlin *et al.*, 2013; Ngui *et al.*, 2011).

2.7 Anaemia in Pregnant Women

Globally, Anaemia has been found to be the most common complication in pregnancy. The World Health Organization (WHO) estimates that more than 40% of non-pregnant and over 50% of pregnant women in developing countries are affected. The majority of the cases occur in sub Saharan Africa and South East Asia, World Health Organization (WHO) definitions for Anaemia differ by age, sex and pregnancy status as follows: children 6 months to 5 year Anaemia is defined as a Hb level<11g/dl, children 5–11 years Hb< 11.5 g/dl, adult males Hb< 13 g/dl; non pregnant women Hb<12g/dl and pregnant women Hb< 11g/dl4. Anaemia could be classified as mild, moderate and severe. The Hb level for each class of Anaemia in pregnancy are 10.0–10.9g/dl (mild), 7– 9.9g/dl (moderate) and <7g/ dl (severe) (WHO 2005). The knowledge of the prevalence of Anaemia in pregnant women is fundamental for the planning and execution of effective interventions by health authorities (Moss et al, 2008). The effect of Anaemia includes:

1. Maternal effects: Mild Anaemia may not have any effect on pregnancy and labour except that the mother will have low iron stores and may become moderately to severely anaemic in subsequent pregnancies. Moderate Anaemia may cause increased weakness, lack of energy, fatigue and poor work performance. Severe Anaemia, however, is associated with poor outcome, the woman may have palpitations, tachycardia, breathlessness, increased cardiac output, leading on to cardiac stress which can cause de-compensation and cardiac failure which may be fatal (Sharma, 2003).

II. Fetal effects: Irrespective of maternal iron stores, the fetus still obtains iron from maternal transferrin, which is trapped in the placenta and which, in turn, removes, and actively transports iron to the fetus. Gradually, however, such fetuses tend to have decreased iron stores due to depletion of maternal stores. Adverse perinatal outcome in the form of pre-term and small-for-gestational-age babies and increased perinatal mortality rates have been observed in the neonates of anaemic mothers. Iron supplementation to the mother during pregnancy improves perinatal outcome. Mean weight, Apgar score and haemoglobin level 3 months after birth were significantly greater in babies of the supplemented group than the placebo group. (Malhotra et al., 2002).

2.8 Prevalence of Anaemia in Pregnancy

Prevalence of anaemia among pregnant women in developing countries at average, is reported as 56% with a range of 35% to100% among various region of the world, It is more common in developing countries because of poor nutritional status and high prevalence of parasitic infestation and It has been reported that close to 500,000 maternal deaths occur every year, vast majority of them taking place in developing world (Haidar et al. 2009). Worldwide, anaemia contributes to 20% of all maternal deaths. Anaemia in pregnancy also leads to premature births, low birth weight, fetal impairment and infant deaths. The reduction in women's productivity places an economic burden on the families, communities and the societies. Recently, mental impairment in children who were anaemic in the very beginning of their life has been reported. All of those showed the necessity of special control program for anaemia in vulnerable population (Gibson et al., 2008).

The global prevalence of anaemia for the general population is 24.8% and it is estimated that 1,620 million people are affected by anaemia. For pregnant women the prevalence is slightly lower; however, its distribution by region follows the same trend as the one observed for preschool-age children. The highest prevalence is in Africa (57.1%) and in South-East Asia (48.2%), followed by the Eastern Mediterranean (44.2%), Western Pacific (30.7%), and the European Americas regions, 25% and 24.1% respectively. Overall, 56.4 million pregnant women are anemic (41.8% prevalence globally) (WHO/UNICEF/UNU, 2001).

2.9 Soil Transmitted Helminthes and Anaemia in Pregnancy

Hook worm infection is described to be one of the principal causes of iron deficiency anaemia in developing countries especially in children. It is prevalent throughout the tropics and subtropics wherever there is faecal contamination of the environment and is acquired mainly by skin contact with contaminated soil or vegetation. Adult hook worms live in duodenum and jejunum of humans attached to the intestinal mucosa and suck blood. Once they leave the attached site this causes chronic blood loss from the mucosa. In people whose dietary intake of iron is low and whose blood iron stores are already depleted, hookworm infection can presumably give rise to iron deficiency anaemia in just a few weeks, especially during pregnancy, when iron requirements are increased (Munasinghe and Broek, 2006).

Soil-transmitted helminthes (STHs), such as hookworms (*Necator americanus* and *Ancylostoma duodenale*) and whipworms (*Trichuris trichiura*), contribute to iron deficiency anaemia by ingesting blood and by damaging the intestinal mucosa during

feeding. An analysis of the baseline (second trimester) data for a randomized controlled trial investigating the effectiveness of de-worming and iron supplementation in a population of more than 1000 pregnant women living in and around Iquitos in the Peruvian Amazon reported that women with moderate-to-heavy intensities of both hookworm and *Trichuris* infection were more than twice as likely to concurrently have anaemia as those with no or light infection. An analysis of the trial proper documented the effect of mebendazole and iron supplementation on anaemia and on the presence and intensity of STH infections (Gyorkos, 2011).

A clinical study conducted in Venezuela shows that intestinal parasitic infections, especially due to helminthes, increase anaemia in pregnant women and the results of this are low pregnancy weight gain and intra uterine growth retardation, followed by low birth weight, with its associated causing greater risks of infection and higher perinatal mortality rates. In this clinical study, pregnant women (n= 1038) from nine states were included and evaluated and the prevalence of intestinal parasitosis was evidenced in 73.9%: *A. lumbricoides* 57.0%, *T. trichiura* 36.0%, *G. lamblia* 14.1%, *E. hystolitica* 12.0%, *N. americanus* 8.1%, *E. vermicularis* 6.3%, *S. stercoralis* 3.3%. Relative risk for anaemia in those women with intestinal parasitosis was 2.56 (P <0.01).

Hookworm infection rate was also associated with anaemia in which those pregnant women infected with hookworm had higher risk of developing anaemia, as 68.4% of the pregnant women infected with hookworm were anaemic.A similar study reported that there was a significant correlation between increasing hookworm parasite load, *A. lumbricoides* and *T.trichiura* and decreasing hematocrit values. This shows that as the helminth parasitic load increased the hematocrit level decreased; as a result the risk of developing anaemia increased (Getachew et al, 2012).

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A cross-sectional community-based study with analytic component was conducted among pregnant Ethiopian women (n=970) during June-July 2005 to assess the magnitude of anaemia and deficiencies of iron and folic acid and to compare the factors responsible for anaemia among anaemic and non-anaemic cases. The overall prevalence of anaemia, iron deficiency, iron deficiency anaemia, deficiency of folic acid, and parasitic infestations was 30.4%, 50.1%, 18.1%, 31.3%, and 13.7% respectively. In this study, the most frequently-encountered intestinal helminthes were *Ascaris lumbricoides* (35.3%), followed by *Trichuris trichiura* (28.6%), *Entamoeba histolytica* (22.6%), *Schistosoma mansoni* (19.5%), *Ancylostoma duodenale* (16.5%) (Teshome and Bijlsma, 2012).

2.10 Predisposing factors of Anaemia in Pregnant women

Malaria in pregnancy

Malaria infection during pregnancy is a major public health problem, with substantial risks for the mother, her fetus and the neonate. The World Health Organization (WHO) currently recommends a package of interventions for controlling malaria during pregnancy in areas with stable transmission of Plasmodium falciparum, which includes the use of insecticide treated nets (ITNs) and the administration during pregnancy of at least 2 doses of intermittent preventive treatment (IPTp) with sulfadoxine-pyrimethamine (SP) after quickening and effective case management of malaria.

A. Administration of intermittent preventive treatment during pregnancy (IPTP):

IPTp entails administration of a curative dose of an effective anti-malarial drug (currently sulfadoxine-pyrimethamine) to all pregnant women whether or not they are infected with the malaria parasite. IPTp should be given at each routine antenatal care visit, starting in the second trimester. Pregnant women are routinely given folic acid supplementation to prevent neural tube defects in their infants. However, high doses of folic acid counteract the effect of sulfadoxine-pyrimethamine. Therefore, it is preferred that women take only the recommended 0.4 mg daily dose of folic acid. In some countries, 5 mg of folic acid are used, and in those countries, it is recommended to withhold folic acid supplementation for two weeks after taking IPTp with sulfadoxine-pyrimethamine to ensure optimal efficacy.

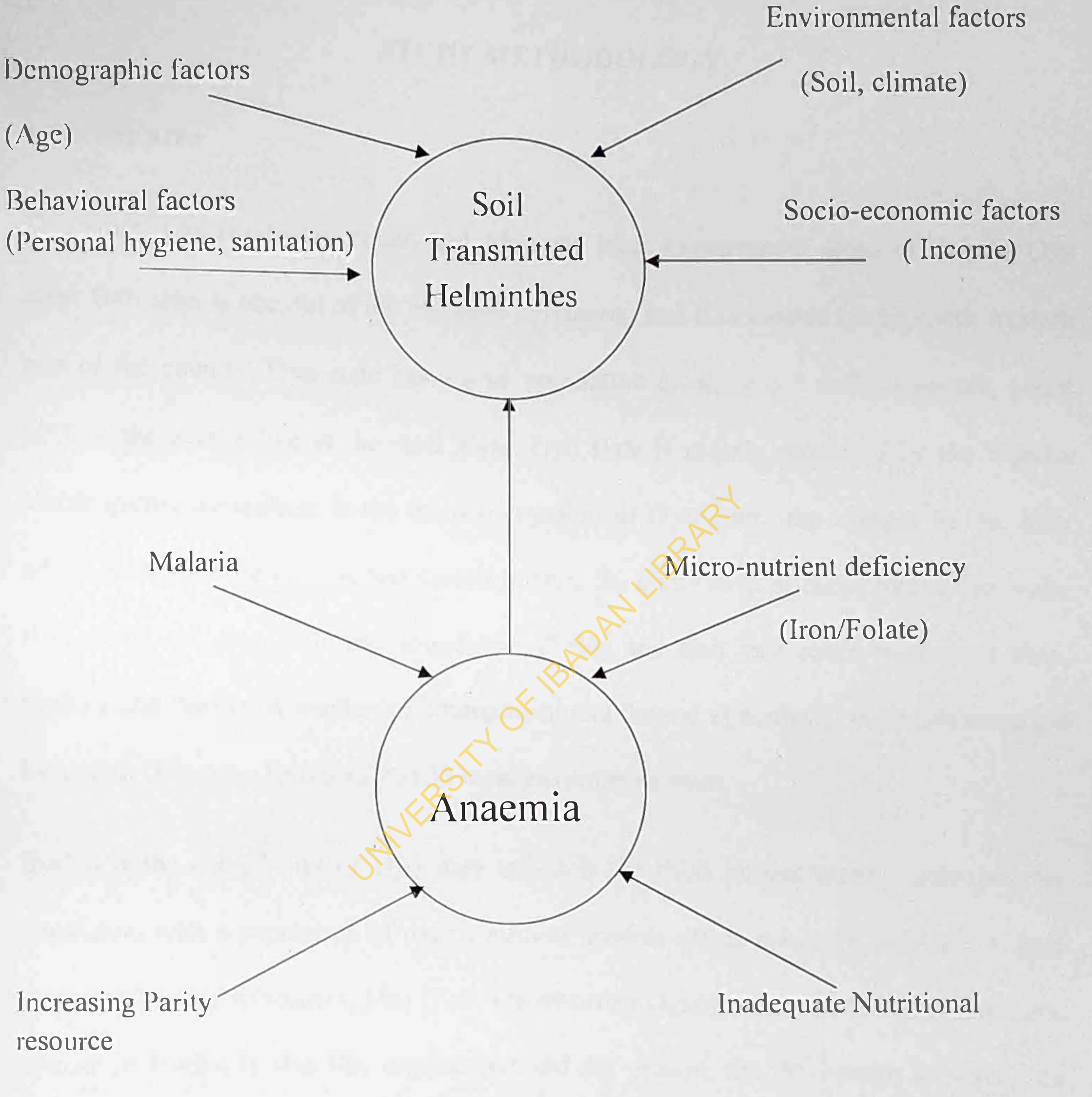
B. The use of insecticide treated nets (ITN):

Insecticide-treated bed nets (ITNs) are a form of personal protection that has been shown to reduce malaria illness, severe disease, and death due to malaria in endemic regions. In community-wide trials in several African settings, Over the past 5 years, there has been increasing evidence of an association between malaria in pregnancy and HIV infection (Ayisi, 2003). HIV increases the risk of malaria in women of all gravidities, although the mechanism of this association is unclear. The standard recommended intermittent therapy regimens of sulfadoxine–pyrimethamine may be insufficient to clear parasitaemia in these women and` may need to be reassessed (Ayisi, 2003)..

HIV in pregnancy

HIV prevalence in pregnancy is high (Mclytyre, 2005). Infection among pregnant women poses particular risk to their families, offspring, and health workers at time of delivery (Egesie and Mbooh 2005). HIV infection in pregnancy is associated with adverse maternal and foetal outcome (Mclytre, 2005). The effect of which includes among others, infectious morbidity vertical transmission and severe anaemia (Behets et al., 2008). The role of HIV/AIDS in maternal mortality in sub-Saharan Africa is difficult to evaluate as the HIV status of pregnant women in the region are largely unknown (Uneka et al., 2007).

Anaemia has been shown to be the most commonly encountered hematological abnormality in HIV positive patients with estimates climbing as high as 95% depending on clinical settings (Ramezani et al., 2008). Anaemia has a profound effect on the quality of life of people by inducing such symptoms as loss of stamina, rapid heart rate and shortness of breath (Castro and Goldani, 2009). It has also being identified as a risk factor for early death in patients with AIDS (Moyle, 2002). Ignorance, poverty and gender bias, significantly contribute to high prevalence of anaemia (Jaleel and Khan 2008). Poverty, malnutrition, and low educational status are known to be driving forces for acquiring HIV infection (Lerato, 2006). These factors are rife in rural communities in Nigeria (Imoh et al., 2009).



Conceptual framework of the determinants of Soil Transmitted Helminthes and Anaemia

CHAPTER THREE

STUDY METHODOLOGY

3.1 Study area

This study was conducted in Ido and Akinyele local Government areas of Ibadan, Oyo state. Oyo state is one out of the 36 states in Nigeria, and it is located in the south western part of the country. Oyo state has a total population of about 5.5 million people, about 60% of the people live in the rural areas. Oyo state is mainly inhabited by the Yoruba ethnic group, agriculture is the main occupation of Oyo state, the climate in the state which is majorly the dry and wet season favours the cultivation of crops like maize, yam, rice, cocoa etc. Oyo state has abundance of clay and also vast cattle ranches at Saki, Fashola and Ibadan. A number of international and federal agricultural establishments are located in Oyo state, Oyo state has 33 local government areas.

Ibadan is the capital city of Oyo state and it is the third largest metropolitan area by population with a population of over 3 million, Ibadan city is naturally supplied by four rivers with many tributaries, Ona river, Ogbere river,Ogunpa river and Kudeti river, the climate in Ibadan is also tthe tropical wet and dry season, the dry season runs through November to February, while the wet season runs between march and October. There are 11 local governments in Ibadan metropolitan area consisting of five Urban local governments which includes; Ibadan North, Ibadan North-East, Ibadan North-West, Ibadan South-East and Ibadan South-West and six semi-urban local governments which include; Akinyele, Egbeda, Ido, Lagelu, OnaAra and Oluyole. Ibadan has several cattle

ranches, a dairy farm and abattoir and the headquarters of the international institute of Tropical Agriculture (IITA)

Ido is one of the Semi-Urban local governments in Ibadan and it has an area of 986km^{2}and a total population of 103,261 based on 2006 national population census. Ido Local Government covers the area spanning Apata, Ijokodo, Omi-Adio, Akufo and Apete. It shares boundaries with Oluyole, Ibarapa East, Akinyele, Ibadan South-West and Ibadan North-West Local Governments in Oyo State and Odeda Local Government in Ogun State. The council formerly had six wards, which had been increased to ten for easy exercise of franchise. Among the major towns within the local Government Area are Ijokodo, Ido, Omi-Adio, Apata, Apete, Akufo and Bakatari, On the account of extensive fertile soil, which is suitable for agriculture, the basic occupation of the people is farming. There are large hectares of grassland which are suitable for animal rearing, vast forest reserves and rivers. There are about 15 primary health care centers in this area

Akinyele is also part of the semi-urban local governments in Oyo State. It is part of the eleven local governments that come together to make up Ibadan metropolis. . It has a land area of 464.892sqkm. Using 3.2% growth rate from 2006 census figures, the 2010 estimated population for the Local Government is 239,745. Its headquarter is located at Moniya. Akinyele local government area shares boundaries with Afijio Local Government to the north, Lagelu Local Government Area to the east, Ido Local Government Area to the west and Ibadan North Local Government Area to the south Akinyele local government area is subdivided into 12 wards: Ikereku, Olanla/Oboda/Labode, Arulogun/Eniosa/Aroro, Olode/Amosun/Onidundu, Ojo-Emo/Moniya, Akinyele/Isabiyi/Irepodun, Iwokoto/Talonta/Idi-oro, Ojoo/Ajibode/Laniba, Ijaye/Ojedeji,

Ajibade/Alabata/Elekuru, OlorisaOko/Okegbemi/Mele, and Iroko, Akinyele. The L.G.A. is endowed with fertile agricultural land suitable for the cultivation of fruits like orange, mango, banana, pineapple, etc. The area is also notable for palm oil production. There are about 10 Primary health care centers in Akinyele local government area.

3.2 Study Design

The study design used in this study is the descriptive cross-sectional study design.

3.3 Study Population

The selected study population were pregnant women attending antenatal care clinics in the chosen primary health care centers of Ido/Akinyele Local Government Area.

3.4 Sample Size Determination

The sample size required for this study was calculated using the prevalence rate of 23.74% of helminthes infection among pregnant women as reported by Omorodion, with 95% confidence interval and a 5% marginal error, sample size (n) was determined using this statistical formula

$$n = \frac{Z\alpha^2 (p\ q)}{d^2}$$

Where:

n = desired sample size

$Z\alpha$ = standard normal deviation of 1.96 which corresponds to 95% confidence level

p = proportion

$q = 1-p = 0.75$

d – degree of accuracy set at 5% = 0.05

Applying the formula: $n = \frac{1.96^2 (0.2374 \times 0.7653)}{0.05^2}$

n = 279

Making provision for a non-response rate of 10%

$$\frac{100 * 279}{100 - 10} = 310$$

n = 310 (calculated sample size for study)

3.5 Sampling Technique

A multi stage sampling technique was used

Stage 1: Out of the eleven local governments in Ibadan two were selected by purposive sampling technique. Ido and Akinyele local governments were selected based on being semi-urban areas and because of their primary occupation of livestock and crop farming.

Stage 2: Six most viable Primary Health Care Centers were also selected based on the number of pregnant women attending the antenatal care centers, three from Ido local government (Ido, Gbekuba, Apete) and three from Akinyele local government area (Ojoo, Sasa, Moniya) were selected.

Stage 3: Selection of women who participated in this study was by a serial recruitment of pregnant women who gave their consent and were willing to take part in the study, *[systematic random sampling was difficult to carry out due to the nature of the research which involved collection of stool samples which made many women unwilling to participate in the study.]*

3.5.1 Inclusion Criteria

1. Pregnant women attending the Primary Health Care Centers that were selected
2. Women who have not received anthelmintic therapy for a month prior to the study

3.5.2 Exclusion Criteria

Severely sick pregnant women.

3.6 Data Collection

A semi-structured interviewer administered questionnaire was used to obtain vital information on socio demographic characteristics, reproductive health and antenatal information, medical characteristics and environmental factors. Stool samples and blood samples were also collected from the pregnant women.

A pre-test was done in a Primary Health Care Center at Ibadan north west local government area of Ibadan, about 30 pregnant women, and the results of the pre-test helped to make a few adjustments, especially on the questionnaires.

3.6.1 Collection of Stool samples

The pregnant women were given a screw capped labeled leak proof stool containers (universal bottles) and applicator sticks. Before giving out the bottles, it was well explained to the pregnant women on how to get the samples, the bottles were coded with numbers, and therefore for each of the bottles given to a woman the questionnaire had on it the same code as the bottle. The stool samples were transported in ice pack in order to maintain the viability of the helminthes ova, the stool samples were collected in the morning between 9am and 11am and were transported immediately to the University

College Hospital laboratory in the department of Medical Microbiology and Parasitology on collection for examination by an experienced and qualified Parasitologist.

3.6.2 Collection of Blood Samples

The pregnant women were screened for malaria parasites by collecting capillary blood samples and taken to the laboratory for malaria parasite test, Giemsa stained blood film smears were done and observed under a light microscope of 1000x magnification to determine the presence or absence of malaria parasites, which are recognizable by their physical features and the appearance of the red blood cells that are infected. The collection and examination of the blood samples was done by a well skilled laboratory scientist in the University College Hospital.

After collection of stool samples

These stool samples were examined microscopically using the Kato-Katz technique of quantification and also the wet preparation method.

Direct wet preparation of fresh stools was used in this study because this technique helps certain protozoa and trophozoites maintain motility which may aid in their identification. This technique was done by placing a drop of 0.85% NaCl on the left side and a drop of iodine on the right side of the slide, then a small amount of fecal specimen was taken and properly emulsified in the saline and iodine solution with the aid of an applicator stick, the sample spread out thinly enough that newsprint can barely be read when the slide is placed on the text, a 22mm cover slip at an angle was slid into the edge of the emulsified fecal drop, then the coverslip was pushed across the drop before allowing it to fall into place, the sample was then systematically scanned, the entire 22mm coverslip with overlapping

fields with 10x objective lens was scanned, then switch to high dry 40x objective lens for a more detailed study of any suspected eggs or protozoa.

The Kato-Katz technique was chosen to be used in this study because it has been recommended to be the most reliable method of measuring the number of eggs of helminthes per gram of stool sample by WHO. The Kato Katz technique for helminthes eggs was done by preparing the layer by using glass tile or newspaper, place the template with the hole in the center of a microscope slide, wear gloves, place a small amount of faecal material on the glass tile or newspaper, press the screen on top so that some of the faeces filters through and scrape with the flat spatula across the upper surface to collect the filtered faeces, add the collected faeces in the hole of the template so that it is completely filled, remove the template carefully so that the cylinder of faeces is left on the slide, then cover the faecal material with pre-soaked cellophane strip, then invert the microscope slide and firmly press the faecal sample against the cellophane strip on a smooth hard surface such as a tile so that the material can spread evenly, carefully remove the slide by gently sliding it sideways to avoid separating the cellophane strip, place the slide with the cellophane upwards, Two Kato slides was prepared for each of the stool samples and was viewed under the microscope using the x10 and x40 lens to help visualize and identify the helminthes ova and the number in the two slides would be counted and the average number of eggs will be gotten and recorded.

Egg counts would be used to classify infection intensities into light, moderate, or heavy infections respectively as follows:

For Ascaris lumbricoides: 1 – 4,999 epg, 5,000 – 49,999 epg and > 50,000 epg;

For Trichuris trichiura: 1 – 999 epg, 1,000 – 9,999 epg and > 10,000 epg;

And for hookworms (Ancylostoma duodenale/Necator americanus): 1 – 1,999 epg, 2,000 – 3,999 epg and > 4,000 epg. (WHO, 2006).

3.6.3 Measurement of Anaemia

According to WHO guidelines, pregnant women are said to be anaemic, when their haemoglobin concentration is less than 10g/dl or 30% haemocrit value. Blood was collected into heparinized capillary tubes for haematocrit estimation to determine their PCV levels and was recorded, this blood sample was collected by a skilled laboratory scientist, and it was used to determine whether these pregnant women were anaemic or non-anaemic.

3.7 Study Variables

3.7.1 Dependent Variable:

Anaemia is the dependent variable and is measured by the haematocrit value.

3.7.2 Independent Variable:

Soil-transmitted Helminthes infection is the main independent variable. It is assessed by presence of at least one of the parasites *Ascaris lumbricoides, Trichuris trichiura* and Hookworm in stool. Covariates were age, type of toilet facility, dietary adequacy and other socio-demographic socio-economic.

3.8 Data Analysis

Data entry and analysis was done after the collection of the 326 samples, the questionnaires were manually accessed for any inconsistencies before it was entered into SPSS version 16.0, quantitative variables were analyzed using mean and standard deviation, while categorical variables was analyzed using frequencies and proportions. The association between anaemia and soil transmitted helminthes was examined using chi-square test analysis. Regression analysis was used to assess the association between various risk factors and soil transmitted helminthes infection.

3.9 Table: Data Management and Analysis

S/N	OBJECTIVE	VARIABLE	METHOF OF ANALYSIS
1	Prevalence of soil transmitted helminthes infection among pregnant women.	Soil transmitted helminthes (Present or Absent)	Proportions and frequencies
2.	Intensity of soil transmitted helminthes among pregnant women	Soil transmitted helminthes (Light infection, moderate infection and Heavy infection)	Frequencies and proportions
3	Risk factors associated with soil transmitted helminthes	Dependent variable- Anaemia Independent variable- Socio-demographic characteristics, environmental factors.	Logistic regression
4	The association between soil transmitted helminthes infection and anaemia	Anaemia Soil transmitted helminthes	Logistic regression

3.10 Ethical Considerations

Ethical permission to carry out the study was obtained from Oyo State Ministry of health, after which permission was gotten from the authorities in the primary health care centers, permission to carry out the study was also gotten from the Medical Officers of Health in Ido and Akinyele health LGAs, meetings were held with staffs of these primary health care centers to explain the study, the samples to be collected, the procedures for the collection of the samples and if there will be any discomfort. Informed consent was given to all the pregnant women and was collected and approved before any pregnant woman's sample was collected for participation in the study.

Confidentiality of Data

All forms and documents were coded using numbers and not names for the purpose of identification. Only the principal student investigator and the research assistants were authorized to handle the study documents that contain participant's information.

Beneficence to Participants

All pregnant women were assured that if the results came out and anyone of them is infected with Soil Transmitted Helminthes, the results will be sent to their consultant doctors for proper management such as the administration of 200mg of anthelmintic drug and there will be an immediate follow-up care on the individual to make sure the infection is treated to avoid potential harm that can arise from the infection, and the pregnant women will also be informed of their malaria status and their haemoglobin levels for proper care, the pregnant women that participated were also given incentives.

Non-Maleficence to Participants

The risk of harm to study participants is estimated to be minimal. Documents such as the questionnaires were placed under lock and keys while password protected computerized systems were used for data management to maintain the safety of the documents.

Voluntariness

To be a participant in this study was totally voluntary, no subject was forced to participate in the study. The pregnant women that met the inclusion criteria for the study were assured of their choice to either participate in the study or not to, as well as their right to quit the study at any time they decide to.

CHAPTER FOUR

RESULTS

4.1 Socio-Demographic Characteristics of the Study Participants

Table 4.1 shows the socio demographic characteristics of the study participants, the mean age was 28.25 ± 5.6 years, Of the 326 respondents, 221 (67.8%) were between 20-29 age bracket, 100 (30.7%) were between the ages of 30-39 years while 5 (1.5%) were ≥40 years of age. The participants had among them 291 (89.5%) married and 265 (81.3%) had at least secondary school education.

217 (66.8%) reported that they were fully employed, There were more Muslims 227(69.8%) than other religions. However, 218 (66.87%) of the respondents claimed they earned less than 10000 naira monthly, 61 (18.7%) earned between 10000 and 20000 naira monthly and 47 (14.42%) earned above 20000 monthly. 254 (77.91%) of the respondents were Yorubas while the others belonged to other ethnic groups.

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Table 4.1: Socio Demographic Characteristics of Study Participants

Variables	Frequency n=326	Percentage %
Age		
<20-29	221	67.8
30-39	100	30.7
≤ 40	5	1.5
Marital Status		
Single	31	9.5
Married	291	89.5
Separated	3	0.9
Educational Status		
No formal education	10	3.1
Primary education	51	15.6
Secondary education	176	50.3
Tertiary Education	89	25.4
Occupation		
Unemployed	81	24.9
Employed	217	66.8
Others	27	8.3
Religion		
Christianity	154	47.2
Islam	168	51.5
Others	4	1.2
Average income per month		
< 10000	217	66.8
10000-20000	61	18.8
>20000	47	14.5
Ethnicity		
Yoruba	254	77.9
Igbo	19	5.8
Hausa	36	11.0
Others	17	5.2

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Yoruba	254	77.9
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Hausa	36	11.0
Others	17	5.2

4.2 Reproductive Health Information and Antenatal Care Characteristics of Study Participants

Table 4.2 shows the reproductive health information and antenatal care characteristics of study participants, the mean gestational age in weeks 25.51±8.4 years, 178 (54.6%) were Primipare and 148 (45.4%) were Multipare. 54 (16.6%) were in their first trimester, 111 (34%) second trimester and 161 (49.4%) third trimester, 164 (50.3) had normal BMI,321(98.5) women were taking Haematinics and 303(86.6) had taken IPT and 151(46.3) used ITN.

Table 4.2: Reproductive Health Information and Antenatal care Characteristics of Study Participants

Variables	Frequency n=326	Percentage %
Parity		
Primipare	178	54.6
Multipare	148	45.4
Complications		
Yes	36	11.0
No	290	89.0
Trimester		
1st	54	16.6
2nd	111	34.0
3rd	161	49.4
Haematinics		
Yes	321	98.5
No	5	1.5
IPT		
Yes	303	86.6
No	23	6.6
Use of ITN		
Yes	151	46.3
No	175	53.7
BMI		
Underweight	15	4.6
Normal	164	50.3
Overweight	110	33.7
Obese	37	11.3

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Parity		
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Multipare	148	45.4
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Trimester		
1st	54	16.6
2nd	111	34.0
3rd	161	49.4
Haematinics		
Yes	321	98.5
No	5	1.5
IPT		
Yes	303	86.6
No	23	6.6
Use of ITN		
Yes	151	46.3
No	175	53.7
BMI		
Underweight	15	4.6
Normal	164	50.3
Overweight	110	33.7
Obese	37	11.3

4.3 Medical Characteristics of Study Participants

Table 4.3 shows the medical characteristics of the study participants, 144 (44.1%) of the study participants had AA blood genotype, while 163 (50%) were AS, 10 (3.1%) were SS and others were 9 (2.8%). Similarly, 87 (26.7%) were of blood group A, 77 (23.6%) blood group B, 38 (11.7%) blood group AB and 124 (38%) blood group O. The distribution by HIV status revealed that 15 (4.6%) had positive HIV status.

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Table 4.3: Medical Characteristics of Study Participants.

Variable	Frequency n = 324	Percentage %
Genotype		
AA	144	44.1
AS	163	50
SS	10	3.1
Others	9	2.8
Blood Group		
A	87	26.7
B	77	23.6
AB	38	11.7
O	124	38
HIV		
Positive	15	4.6
Negative	311	95.4

*Others in the Genotype were those with AC and SC genotype group.

4.4 Hygiene Practices and Environmental Characteristics of Study Participants

Table 4.4 shows the hygiene practices and environment characteristics of the study participants. Respondents who washed their hands with soap before eating regularly, Yes 228 (69.9%) and No 98 (30.1%).The type of toilet facility most commonly used by the study participants was the water closet 249 (76.7%), followed by pit latrine 53 (16.3%). Similarly, 296 (91.1%) of the respondents do not wear shoes at home and 278 (85.3%) wear shoes when playing n the house. 96(29.4%) lived in detached bungalow while 219(62.7%) lived in face to face apartments.

Concerning the type of roofing showed that 33 (10.1%) of the women lived in houses with thatched roofs. 16 (4.9%) reported that they were eating soil during pregnancy, majority 209 (64.1%) do not rear animals, also in the table are women who use human feaces for fertilizer Yes39 (12%) and No287 (88%).

Table 4.4: Hygiene Practices and Environmental Characteristics of Study Participants

Variable	Frequency n= 326	Percentage %
Toilet facility		
Pit latrine	53	16.3
Water closet	249	76.6
Open air Defeacation	23	7.1
Wash hands before eating		
Yes	311	95.4
No	15	4.6
Wash hands with soap		
Yes	228	69.9
No	98	30.1
How often do you wash hands		
Every time	171	52.5
Sometimes	155	47.5
Wearing of shoes at home		
Yes	29	8.9
No	296	91.1
Shoes outside the house		
Yes	278	85.3
No	48	14.7
House Type		
Detached bungalow	96	29.4
Apartment	219	62.7
Others	11	3.4
Roofing Type		
Thatched roof	33	10.1
Corrugated iron sheets	288	88.3
Others	5	1.5
Pica		
Yes	16	4.9
No	310	95.1
Rearing of animals at home		
Yes	117	35.9
No	209	64.1
Use of human faeces as fertilizers		
Yes	39	12
No	287	88

4.5 Prevalence of Soil Transmitted Helminthes Infection among Study Participants

Table 4.5 shows the prevalence of STH among the respondents. The prevalence of STH in this study was 13.8% as 45 out of 326 were infected with Soil Transmitted Helminthes, Specifically, the prevalence for *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm were 13.2%, 0.3% and 0.6% respectively.

Table 4.5: Prevalence of Soil Transmitted Helminthes infection among the Study Participants.

STH infection	Frequency n=326	Percentage %
Overall STH positivity		
Yes	45	13.8
No	281	86.2
Ascaris lumbricoides		
Yes	43	13.2
No	283	86.8
Trichuris trichiura		
Yes	1	0.3
No	325	99.7
Hookworm infection		
Yes	2	0.6
No	323	99.4

4.6: Intensity of Soil Transmitted Helminthes infection among Study Participants

Table 4.6 shows the intensity of Soil Transmitted Helminthes infection. Most of the STH infections were of light infection, 42 (12.8%) *Ascaris lumbricoides* infections were of light intensity while 1 (0.3) were of moderate intensity. 1 (0.3) *Trichuris trichiura* infection of light intensity and 2 (0.6) of hookworm infection of light intensity were also observed.

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Table 4.6: Intensity of Soil Transmitted Helminthes Infection (in eggs per gram) among the 45 infected Study Participants

Parasite intensity	Frequency n=326	percentage %
Ascaris lumbricoides		
Light (1 - 4,999)	42	12.8
Moderate (5,000 – 49,999)	1	0.3
Trichuris trichiura		
Light (1 - 999)	1	0.3
Hookworm		
Light (1 – 1,999)	2	0.6

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Trichuris trichiura		
Light (1 - 999)	1	0.3
Hookworm		
Light (1 – 1,999)	2	0.6

PREVALENCE OF ANAEMIA, MALARIA AND REPORTED WORM INFESTATION.

The prevalence of anaemia among the study participants and about a quarter of the participants 81(24.85%) had a PCV <30. The prevalence of Malaria among study participants, the prevalence of malaria was 17%. the women's self-reported experience with worm infestation, 54.9% of the women reported to have passed out worms from their mouth, noses or faeces prior to present pregnancy.

4.7 Association of the Socio-Demographic Characteristics of the Study Participants with Soil Transmitted Helminthes Infection

Table 4.7 summarizes the results of bivarate analysis of socio-demographic characteristics with STH infection. Age, Marital status, level of education, occupation, religion and income had no significant association with STH, however ethnicity was marginally significant p=0.065 with the proportion of Igbo with STH.

Table 4.7 Association of the Socio-Demographic Characteristics of the Study Participants with Soil Transmitted Helminthes Infection

Variables	STH				
	Absent	Present	Total	Chi-Square	P-value
Age					
<20-29	192(86.9)	29 (13.1)	221	0.368	0.832
30-39	85 (85)	15 (15)	100		
≥40	4 (80)	1(20)	5		
Marital status					
Single	29 (93.5)	2 (6.5)	31	2.460	0.292
Currently Married	249 (85.6)	42 (14.4)	291		
Not currently married	3 (75)	1 (25)	4		
Highest level of education					
No formal education	10 (100)	0 (0)	10	0.479	0.374
Primary school	45 (88.2)	6 (11.8)	51		
Secondary school	152 (86)	24(14)	176		
Tertiary School	74(83)	15(17)	89		
Occupation					
Employed	188 (86.2)	30 (13.8)	218	0.65	0.724
Unemployed	71 (87.7)	10 (12.3)	81		
Others	22 (81.5)	5 (18.5)	27		
Religion					
Christianity	86 (86.9)	13 (13.1)	99	0.054	0.816
Islam	195 (86)	32(14)	227		
Average income per month					
<10000	187 (85.7)	31 (14.22)	218	0.108	0.947
10000-20000	53(86.9)	8 (13.1)	61		
>20000	41 (87.2)	6 (12.8)	47		
Ethnicity					
Igbo	13 (68.4)	6 (31.6)	19	5.461	0.065
Yoruba	221 (87)	33 (13)	254		
Hausa	47 (88.7)	6 (11.3)	53		

*Statistically significant at $p < 0.05$

4.8 Association of Reproductive Health Information and Antenatal Care Characteristics with Soil Transmitted Helminthes Infection

Table 4.8 summarizes the results of bivariate analysis of Reproductive health information and antenatal care characteristics of Study Participants with STH infection. Parity, BMI, Taking of Haematinics, Use of IPT, use of ITN and Trimester had no significant association with STH

Table 4.8: Association of Reproductive Health Information and Antenatal Care Characteristics with Soil Transmitted Helminthes Infection

Variable	STH				
	Absent	Present	Total	Chi-Square	P-value
Parity					
Primipare	150 (81.2)	28 (18.8)	178	2.531	
Multipare	131 (88.5)	17 (11.5)	148		
Trimester					
1st trimester	48 (88.9)	6 (11.1)	54	0.502	0.778
2nd trimester	96 (86.5)	15 (13.5)	111		
3rd trimester	137 (85.1)	24 (14.9)	161		
Use of ITN					
Yes	130(86.1)	21(13.9)	151	0.003	0.960
No	151(86.3)	24(13.7)	175		
Haematinics					
Yes	278(86.6)	43(13.4)	321	3.209	0.201
No	3(60)	2(40)	5		
IPT					
Yes	263(86.8)	40(13.2)	303	2.213	0.697
No	18(78.3)	5(21.7)	23		
BMI					
Underweight	12(80)	3(20)	15	2.652	0.448
Normal	146(89.0)	18(11)	164		
Overweight	93(84.6)	17(15.4)	110		
Obese	30(81.1)	7(18.9)	37		

*Statistically significant at $p < 0.05$

4.9 Association of Medical Characteristics of Study Participants with Soil Transmitted Helminthes

Table 4.9 summarizes the results of bivariate analysis of medical characteristics of study participants with soil transmitted helminthes. Genotype, Blood group and HIV status had no significant association with STH.

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Table 4.9: Association of Medical Characteristics of Study Participants with Soil Transmitted Helminthes

Variable	STH		Chi-Square	P-value
	Absent	Present		
Genotype				
AA	131 (85.1)	23 (14.9)	1.71	0.789
AS	143 (87.7)	20 (12.3)		
SS	7 (77.8)	2 (22.2)		
Blood Group				
A	76 (87.4)	11 (12.6)	0.24	0.971
B	66 (85.7)	11 (14.3)		
AB	32 (84.2)	6 (15.8)		
O	107 (86.3)	17 (13.7)		
HIV				
Positive	14 (93.3)	1 (6.7)	0.673	0.412
Negative	267 (85.9)	44 (14.1)		

*Statistically significant at $p < 0.05$

4.10 Association of Environmental Characteristics and Hygiene practices of Study Participants with STH

Table 4.10 summarizes the results of bivariate analysis of environmental characteristics of Study Participants with STH infection. The toilet facility, wearing of shoes in the house, wearing shoes outside the house, house type, roofing type, rearing of animals at home, use of faeces as fertilizers, washing of hands before eating, washing of hands with soap before eating and how often do you wash your hands were analyzed for their association with STH. Women who wore shoes at home had a higher probability of being infected with STH than women who did not wear shoes in their homes (34.5% vs11.8%) p=0.001, likewise women who did not wash their hands with soap had a higher probability of having STH (22.2% vs10.1%) p=0.004.

Table 4.10: Association of environmental characteristics and Hygiene practices of study participants with Soil Transmitted Helminthes

Variable	STH		Chi-square	P-value
	Absent	Present		
Wash hands with soap				
Yes	204(89.9)	23(10.1)	8.469	0.004*
No	77(77.8)	22(22.2)		
Toilet facility				
Pit latrine	102(87.9)	14 (12.1)	1.908	0.385
Water closet	132 (83.5)	26 (16.5)		
Open air Defeacation	46 (90.2)	5 (9.8)		
Wearing of shoes at home				
Yes	19(65.5%)	10(34.5)	11.424	0.001*
No	262(89.2)	35(11.8)		
Wearing of shoes outside the house				
Yes	240(86.3)	38(13.7)	0.505	0.918
No	136 (82.4)	29(17.6)		
House Type				
Detached bungalow	84(87.5)	12 (12.5)	0.463	0.793
Apartment	187(85.4)	32 (14.6)		
Others	10(91)	1 (9)		
Roofing types				
Thatched roof	27(81.9)	6(18.1)	1.34	0.509
Corrugated iron Sheets	249(86.5)	39(13.5)		
Others	5(100)	0 (0)		
Rearing of animals at home				
Yes	99 (84.6)	18(15.4)	0.383	0.536
No	182(87.1)	27(12.9)		
Pets				
Yes	99(84.6)	18(15.4)	0.383	0.536
No	182(87.1)	27(12.9)		
Use of human faeces as fertilizer				
Yes	33 (84.6)	6 (15.4)	0.093	0.76
No	248 (86.4)	39(13.6)		
Wash hands before eating				
Yes	267(85.9)	44(14.1)	0.673	0.412
No	14(93.3)	1(6.7)		
How often do you wash hands				
Every time	151(88.3)	20(11.7)	1.343	0.247
Sometimes	130(83.9)	25(16.1)		

*Statistically significant at $p < 0.05$

4.11 Association of Soil Transmitted Helminthes with Anaemia in Study Participants

Table 4.11 shows the association between Soil Transmitted Helminthes Infection and Anaemia, respondents who had STH infection and anaemia were 23(51.15%), results indicate a statistically significant association between anaemia and the presence of STH infection (p=0.018).

Table 4.11: Association of Soil Transmitted Helminthes with Anaemia in Study Participants

Soil Transmitted Helminthes	Anaemia		Total	Chi-Square	p-value
	Present	Absent			
Present	23 (51.1)	22 (48.9)	45	5.567	0.018*
Absent	92 (32.9)	187 (67.0)	279		

*Statistically significant at $p < 0.05$

4.12 Regression analysis of factors associated with Soil Transmitted Helminthes Infection

Table 4.12 shows the results of the multivariate analysis of Soil Transmitted Helminthes and its determinants, study participants who wore shoes inside their homes were three times more likely to have Soil Transmitted Helminthes Infection (odds ratio= 3.940, 95% CI= 1.696-9.154) p=0.001 than those who did not wear shoes at home, similarly study participants who washed their hands with soap before eating were two times less likely to have STH infection (odds ratio=0.431, 95% CI= 0.227-0.819) p=0.010 than women who did not wash their hands before eating.

Table 4.12: Logistic Regression Coefficients of risk factors of Soil Transmitted Helminthes Infection

Variable	odds ratio	95% confidence interval	p-value
Shoes at home			
No (Ref)	1		
Yes	3.940	1.696-9.154	0.001*
Washing of hands with soap			
No (Ref)	1		
Yes	0.431	0.227-0.819	0.010*

*Statistically significant at $p<0.05$

Table 4.13: Regression analysis of factors associated with Anaemia

Table 4.13 shows the logistic regression of Anaemia and its determinants. Study participants who tested positive to helminthes infection were two times more likely to have anaemia (OR=2.125, 95% CI= 1.125-4.012) than those who tested negative to helminthes infection, likewise women who tested positive to malaria had a 60% higher chance of having Anaemia (OR=1.597, 95% confidence interval= 0.839-3.038) than women who tested negative.

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Table 4.13: Logistic Regression Coefficients of factors associated with Anaemia

Variable	odds ratio	95% confidence interval	p-value
Helminthes infection			
Absent (Ref)	1		
Present	2.125	1.125-4.012	0.020*
Malaria			
Absent (Ref)	1		
Present	1.597	0.839-3.038	0.015*

*Statistically significant at $p<0.05$

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 DISCUSSION

The aim of this study was to investigate the association between soil-transmitted helminthes infection (STH) and anaemia among pregnant women resident in Ido/Akinyele local government area of Ibadan, Oyo state, Nigeria.

5.1.1 Prevalence of Soil Transmitted Helminthes in Pregnant women

The prevalence of STH among the women was 13.8%, while the prevalence of Anaemia was 24.85%.The prevalence of STH among the women was lower than the range of between 20% - 30% stipulated by WHO for it to be considered a disease of public health importance requiring intervention. The prevalence in this study was lower than the WHO cutoff of probably because the study was carried out in a semi-urban area with better sanitary facilities than expected in the rural areas. This observed prevalence in this study was similar to recent findings observed in Bangladore and Kenya with reported prevalence of 12.4% and 13.8% respectively (Wekesa et al, 2014, Shrinivas et al., 2014). However, the prevalence of STH was much lower than 46.5% obtained from studies conducted in Imo state of Nigeria (Obiakor et al, 2014), 36.3% in Ghana (Yatich et al., 2009) 58.2% in Southern Ethiopia (Tadegbe, 2009) and 70% in Thailand (Boel et al, 2010).

The difference between the prevalence rates obtained from this study and those conducted in other locations, may be attributed to variation in geographic conditions, such as the type of soil (Texture and quality), as well as the climatic conditions (temperature, rainfall, humidity, poor sanitation) are associated with prevalence of heminthes in endemic areas.

The commonest STH observed from this study was *Ascaris lumbricoides* followed by hookworms and *Trichuris trichiura*. Similar findings have also been observed in Venezuela and Kenya where *A. lumbricoides* had the highest rate of infection with prevalence rates of 57% and 53.3% respectively (Alfonso et al, 2006; Tom et al., 2011)

The prevalence of *A. lumbricoides* may also be attributed to poor observance of personal hygiene. This is because *A. Lumbricoides* is commonly acquired by accidentally ingesting embryonated eggs in contaminated food, drink, or soil, the well-protected eggs can withstand drying and can survive for very lengthy periods in soil. Furthermore, pregnant women in many rural areas depend on pit latrines for waste disposal with no facilities for hand washing after defecation. Such scenario accompanied by seasonal flooding and possible latrine overflow of human waste into drinking water sources and gardens is likely to lead to the high prevalence of ascariasis reported.

The prevalence of hookworm infection was the second most common Soil Transmitted Helminthes infection with a prevalence rate of 0.6%. the prevalence of hookworm was however lower when compared to reports observed from studies conducted in Kenya (74.9%) (Brooker et al, 2008) and elsewhere in Africa Tanzania(56.6%), Uganda (44.5%). The sample size in this study may contribute to the possible variations in prevalence rates and the use of Kato-katz technique of quantification for identification of hookworm eggs, literature has it that this technique is not very suitable for hookworm identification because the eggs of hookworm collapse within 30-60 minutes of preparation using kato-katz (Tarafder et al, 2010)

The prevalence of Trichuris trichiura was also low at 0.3%. Trichuriasis is specifically prevalent in the warm humid tropics where faecal contamination of the soil and water sources is a major factor in the transmission of the infection in a community.

Transmission occurs through poor sanitary habits of indiscriminate defecation. Infections usually occur through ingestion of infective ova from contaminated hands, food, or drinks. Flooding and coprophagous animals play some part in the transportation of the ova to locations other than the defecation site. The low prevalence of trichuriasis reported in this study supports the claim that it is less common in the tropics, the differences in the prevalence may also be due to environmental factors and sample sizes used in various studies (Wekesa et al, 2014)

5.1.2 Intensity of Soil Transmitted Helminthes among pregnant women

The intensity of STH recorded , in this study was mostly light intensity. This finding is similar to studies conducted in Peru and Kenya where most of the STH reported were of light intensity (Renee et al., 2005; Wekesa 2014). The observed light intensity from this study may be influenced by climate and livestock density (Stock of animals per agricultural areas), in this study only 35.9% were rearing animals and the result showed that the relationship between rearing of animals and STH was not significant, therefore this could have affected the intensity levels of STH.*A. lumbricoides* had light intensity of 12.8% and moderate intensity of 0.3%, Hookworm cases in this study were also of light intensity, while *Trichuris trichiura* had the lowest prevalence of 0.3.

5.1.3 Factors associated with Soil Transmitted Helminthes infection among Pregnant Women

The factors associated with STH in this study were socio demographic factors, reproductive and antenatal care characteristics, medical characteristics and environmental and hygiene practices of the women in Ido and Akinyele local government areas. Among all these factors that were assessed for their association with STH, the results showed that only the environmental characteristics and hygiene practices of the study participants were not statistically significant with STH.

Sanitation is considered a key factor for the transmission of parasitic infections. People in the semi urban, rural areas and poor socioeconomic communities have inadequate sanitary facilities such as the absence of toilets and lack of provision of clean and treated water supply, which facilitates the transmission of STH infections (Campbell *et al.*, 2014). Findings also showed that women who used pit latrine had a higher proportion of STH compared to those who used water closet systems, although the association was statistically significant.

Poor hygienic personal practices such as not washing hands with soap before eating, was significantly associated with higher risk of STH. Study results showed that women who did not frequently wash their hands with soap before eating were at a higher risk of being with STH infection compared to those who washed their hands. This finding is supported by studies conducted in Rwanda which reported that hand washing was protective of STH infection among pregnant women (Emil et al, 2013); likewise in Kenya, hand washing was significantly associated with reduced likelihood of infection among pregnant women (Wekesa et al, 2014) while in a study conducted among pregnant women in Togo showed

that hand washing before eating and after defecation was associated with lower odds of STH infection (Strunz et al 2014). The significant association between hand washing and increase in STH infection observed in this study, can be attributed to lack of personal hygiene and inadequate water supply to aid constant hand washing. Hand washing is an important hygiene practice for prevention of parasitic diseases. it is also the most effective way of preventing the spread of infections, especially with the use of adequate amount of soap before eating. Several studies have also identified hand washing with soap before eating as a significant predictor of STH infections in Malaysia and other countries (Nasr *et al.*, 2013a; Schmidlin *et al.*, 2013; Nguie*t al.*, 2011; Acka*et al.*, 2010)..Furthermore, hand washing has been proven to be a significant contributor to a sustainable control of STH infections, schistosomiasis, diarrhoea, and other fecal-orally transmitted diseases (Schmidlin *et al.*, 2013).

In addition to hand washing, wearing of shoes inside the house was also significantly associated with STH infection from this study. Women who claim to wear shoes at home had a higher risk of infection than women who did not wear shoes in the home. This positive association between wearing of shoes inside the house among pregnant women and STH infection may be attributed to large family size causing clustering and further explanations may also be due to the fact wearing of foot wears inside the home will bring in dirt and possible helminthes eggs thus contaminating food items.

5.1.4 Association between Soil Transmitted Helminthes infection and Anaemia in Pregnancy

The association between STH and anaemia in this study was statistically significant. This finding is similar to a previous study conducted in Ethiopia by Getachew *et al.*,(2012) who also reported that as the helminth parasitic load increased the haematocrit values decreased.

Soil-transmitted helminthes (STHs), such as hookworms (*Necator americanus* and *Ancylostoma duodenale*) and whipworms (*Trichuris trichiura*), contribute to iron deficiency anemia by ingesting blood and by damaging the intestinal mucosa during feeding. *Ascaris lumbricoides* is the most common worm and largest intestinal nematode found in humans although they do not outrightly cause blood loss like hookworm but their larvae migrate from the intestine to the lungs and back to the intestine which causes blood loss from sites of intestinal attachment which may cause iron deficiency anaemia in pregnancy, of which in this study the prevalence of Ascaris among these women was high. Findings from this study showed that women who had hookworm infection also had anaemia, although the prevalence of hookworm among these pregnant women was very low 0.3%. Hookworm infection has been described as one of the principal causes of iron deficiency anemia in developing countries. It is prevalent throughout the tropics and subtropics wherever there is faecal contamination of the environment and is acquired mainly by skin contact with contaminated soil or vegetation. A study by Gyorkos et al (2014) reported that hookworm was the evidence linking soil transmitted helminthes and anaemia among pregnant women, this link between hookworm and anemia had also been reported by Million *et al* (2012). Micronutrient deficiency, parasitic infestation and stunting are significantly related problems, high prevalence of intestinal parasitic

infestation is associated with morbidities like anaemia and reduced resistance due to other nutritional disorder made the condition worse (WHO, 2006).

However, after controlling for malaria in the pregnant women in this current study, women with STH still had two times odds of having anaemia. This is supported by studies conducted in Ethiopia (Getachew et al., 2012). Malaria is a major cause of anaemia in pregnancy and has been under surveillance for years. The WHO, CDC and other health organizations have implemented the use of insecticide treated nets at home and taking of intermittent preventive therapy routinely during antental care sessions, all in the bid to reduce the prevalence of anaemia in pregnancy.

The probable reason for the lower prevalence of anaemia among women in this study may be due to the fact that study was conducted in PHCC setting, besides, the study area was largely urban with most women attending the PHCs being better informed with the determinants and prevention of anaemia.

The results of this study, has provided additional evidence in support of the recommendation of WHO, UNICEF and INACG to include anthelminthic treatment in prenatal programs, in areas where the prevalence of hookworm infection exceeds 20–30% (WHO, 2002).

5.2 STUDY LIMITATIONS

I. Early morning stool samples are preferable for STH tests, however, a few participants brought stool samples latter in the afternoon, this could have affected the viability of some of the eggs of the helminth making it difficult to identify the eggs of STH while doing the analysis.

II. Tarafder et al. (2010) suggested that Kato-katz method of stool analysis, which is used in this study, is reasonably accurate for the identification of *T trichiura* and *A lumbricioides* but not for hookworms.

III. Studies have concluded that wetter areas are usually associated with transmission of all the three major STH seen in this study. This study was carried out in the Dry season therefore this could be the reason for the low prevalence and intensity rates recorded in this study.

CONCLUSION

The prevalence of STH infection among pregnant women resident in Ido/Akinyele LGAs of Ibadan at the end of the study turned out to be 13.8% , of which the prevalence of *Ascaris lumbricoides* was the highest with 13.2% followed by hookworms 0.6% then *trichuris trichiura* 0.3% , the hookworm prevalence was below the cutoff point of 20-30% range as stipulated by WHO for implementing anthehelminthic therapy.

The intensities reported from this study showed that for the three major STH (*A. lumbricoides*, hookworms and *T. trichiura*), all recorded light intensity except for a single case of moderate intensity of *A. lumbricoides*. The factors that were associated with STH in this study were majorly environmental and hygiene practices which included improper washing of hands with soap and not wearing of shoes inside the house.

However, after controlling for Malaria in this study, because malaria is an important cause of anaemia, anaemia still had a high prevalence of 25%. However, there have been Public Health interventions have been put in place to help reduce Malaria, such as the use of ITNs and taking of IPTp. Therefore, the role of STH in pregnancy needs to be further considered and policies should be put in place to help reduce the prevalence of STH among pregnant women.

5.4 RECOMMENDATIONS

The rising prevalence rates of soil-transmitted helminthes infections as well as anaemia among pregnant women shows a pressing need for appropriate long term and short term preventive and corrective measures in order to prevent an increase in mortalities as well as morbidities related to parasitic infection. In view of these, my recommendations are as follow:

I. Regular screening of pregnant women for infection with soil-transmitted helminthes should be set up and monitored by appropriately instituted and regulated governmental organizations to help reduce the prevalence and intensity of the occurrence of STH

II. Health promotion to improve sanitation habits among these pregnant women should be emphasized during their antenatal care sessions this will help to prevent the factors associated with parasitic infections of soil-transmitted helminthes, educational programs should be done in primary health care centers and communities to promote healthy lifestyles.

III. Further studies should be done in the more rural settings of Ibadan because of the low prevalence level that was encountered in this study.

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APPENDIX 1: INFORMED CONSENT FORM

Title of the research:

Soil Transmitted Helminthes infection and Anaemia among Pregnant women at Ido/Akinyele local government area of Ibadan,

Oyo state, Nigeria

Name and affiliation of researcher of applicant:

This study is being conducted by Miss C.E Umezurike of the department of Epidemiology and Medical Statistics, College of Medicine, University of Ibadan, Oyo State.

Sponsor of research:

This study is sponsored by self

Purpose of research:

The purpose of this research is to determine the association between Soil Transmitted Helminthes and Anaemia of Pregnant Women at Ido/Akinyele local government area of Ibadan, Oyo state, Nigeria.

Procedure of the research, what shall be required of each respondent and approximate total number of respondents that would be involved in the research:

Pregnant women will be randomly selected from six primary health care centers in Ido/Akinyele local government of Oyo state, and 460 questionnaires will be proportionately distributed within these health care centers. 460 pregnant women ages 15 – 44 will be recruited as respondents for this research.

Expected duration of research and respondent(s)' involvement:

I expect to carry out this research in 12 weeks, and I expect each participant to answer the questionnaire for approximately 15 minutes.

Risk(s):

There is no anticipated risk(s) for participating in this study.

Costs to the respondents, if any, of joining the research:

Respondent's participation in this study will not cost them anything.

Benefit(s):

The goal of this study is to assess the association between Soil Transmitted Helminthes infection and Anaemia in pregnant women.. Findings from this study will give an insight on the relationship between soil-transmitted helminthes infections and Anaemia.

Confidentiality:

All information collected in this study will be given code numbers and no name will be recorded. This cannot be linked to you in anyway and your name and or any identifier will not be used in any publication or reports from this study.

Voluntariness:

Your participation in this study is completely voluntary.

Alternatives to participation:

If you choose not to consent to participating, this will not be used against you in any form.

Due inducement(s):

You will be compensated with a little incentive of detergent, but they will not be paid any fees for participation in this research.

Consequences of participant' decision to withdraw from research and procedure for orderly termination of participation:

You can also choose to withdraw from the research at any time. Please note that some of the information that has been obtained about you before you chose to withdraw them may have been modified or used in reports and publications. These cannot be removed

Consequences of participant' decision to withdraw from research and procedure for orderly termination of participation:

You can also choose to withdraw from the research at any time. Please note that some of the information that has been obtained about you before you chose to withdraw them may have been modified or used in reports and publications. These cannot be removed anymore. However the researchers promise to make effort in good faith to comply with your wishes concerning them as much as is practicable.

Any apparent or potential conflict of interest:

None

STATEMENT OF PERSON OBTAINING INFORMED CONSENT

I have fully explained this research to

.....

and I have given sufficient information, which also includes the benefits of participating in this study.

DATE: ..... SIGNATURE: .....

NAME:

.....

STATEMENT OF PERSON GIVING CONSENT

I have read the information given on the research, it has been well explained in the language I understand, and I am satisfied with the information. I understand that my participation in this study is voluntary, and have sufficient information on the purpose, methods, risks and benefits of this research, needed to determine if I want to participate in the study. I also understand that I can opt out whenever I want to during the research, and I have received a copy of this consent form and additional information sheet to keep for myself.

DATE: ..... SIGNATURE: .....

NAME: .....

WITNESS' SIGNATURE (if applicable): .....

WITNESS' NAME: .....

STATEMENT OF PERSON OBTAINING INFORMED CONSENT

I have fully explained this research to

.....,

and I have given sufficient information, which also includes the benefits of participating in this study.

DATE: ..... SIGNATURE: .....

NAME:

.....

STATEMENT OF PERSON GIVING CONSENT

I have read the information given on the research, it has been well explained in the language I understand, and I am satisfied with the information. I understand that my participation in this study is voluntary, and have sufficient information on the purpose, methods, risks and benefits of this research, needed to determine if I want to participate in the study. I also understand that I can opt out whenever I want to during the research, and I have received a copy of this consent form and additional information sheet to keep for myself.

DATE: ..... SIGNATURE: .....

NAME: .....

WITNESS' SIGNATURE (if applicable): .....

WITNESS' NAME: .....

Questionnaire number .....

Dear Respondent,

I am a Master's student of Public Health (Epidemiology) in the University of Ibadan, Oyo State. This questionnaire has been strictly designed for academic purpose. All information will be kept confidential and processed anonymously. Please make an **X** sign on the option most appropriate to you, or complete the statement in the spaces provided, information required is for the successful completion of a research work titled "Soil transmitted helminths and anaemia among pregnant women". Kindly please answer all questions with sincerity in other not to alter the accuracy of the data collected. Thank you for sparing your valuable time to complete this questionnaire.

This research has been approved by the Oyo State Ethical Review Committee of the State Ministry of Health. In addition, if you have any questions about your participation in this research, you can contact the principal investigator, UMEZURIKE CHIOMA EMILIA at the Department of Epidemiology and Medical Statistics, Faculty of Public Health, University College Hospital, Ibadan. 07051412999 or uemiliachioma@yahoo.com

Statement of person giving informed consent:

Now that the study has been well explained to me and I fully understand the content of the study, I hereby agree to participate in the study.

Name:

_____

_____

Date: ____/____/____ Signature: _____ Primary Health Care Center

_____

S/N	**SECTION A: Socio Demographic Characteristics** *(Kindly tick your answers to the following questions)*	
1.	Age (at last birthday): _____	
2.	Marital Status	☐ Never married ☐ Married ☐ Single parent ☐ Cohabiting ☐ Separated ☐ Divorced ☐ Widow ☐
3.	Highest Level of Education	☐ No Formal education ☐ Primary School ☐ Secondary School ☐ Tertiary Institution
4.	Occupation	☐ House wife ☐ Unemployed ☐ Trader ☐ Skilled worker

		☐ Professional ☐ ☐ Student Others specify:
5.	Religion	☐ Christianity☐ Islam others specify
6.	Average income per month	☐ < 5000☐ 5000-10000☐ 10000-15☐ 15000-20000 ☐ >20000
7.	Ethnicity	☐ Igbo☐ Yoru☐ Hausa others specify
	SECTION B: Obstetric Information	
8.	Previous pregnancies	Gravidity (number of pregnancies):____ Parity (number of live births):_____ Number of still births:_____ Number of induced abortion(s):_____ Number of living children: _____ Any complication(s) experienced in previous pregnan☐s? Yes☐ No If yes, what were the complications: ☐ Febrile Illness☐ Smelly vaginal discharge ☐ Painful urination☐ Vaginal bleeding☐ Yellowness of the e☐ Anaemia Other? Specify:_____
9.	Current pregnancy	Date of last menstrual period: ___/___/_____ (dd/mm/yyyy) Gestational age & date at first antenatal visit (current pregnancy):___(weeks) Date:__/__/____ Current gestational age (weeks):_____ Date: /___/_____ Was this pregnancy planned? ☐ Yes ☐ No Did you use any method to delay/avoid this pregn...cy? Yes☐ No If yes, state the method:_____ Expected date of delivery: ___/___/_____ (dd/mm/yyyy) What service(s) have you received during the antenatal period? ☐ Antimalarial(IPT) ☐ Tetanus toxoid ☐ Antiretroviral ☐ Haematinics ☐ Antibiotics Others? specify: _____ How many doses of IPT? ☐ None ☐ 1 dose ☐ 2 doses What medications have you received? ☐ Iron/Folic acid ☐ Anthelminthic drugs
	SECTION C: Medical history	

10.	Which of these diseases do you have?	☐ Hypertension ☐ Asthma ☐ Sickle cell anaemia ☐ Diabetes Others specify: _____
	What is your genotype?	☐ AA ☐ AS ☐ SS ☐ SC ☐ AC
	What is your blood group	☐ A ☐ B ☐ AB ☐ O
	Booking height and weight? Blood pressure Maternal packed cell volume HIV status Are you on any antiretroviral drug(ARV)	Height: _____ cm Weight: _____ kg _____ ☐ <20 ☐ 20-30 ☐ >30 ☐ Present ☐ Absent ☐ Yes ☐ No

SECTION D: RISK FACTORS OF SOIL TRANSMITTED HELMINTHS (kindly tick the correct option)		YES	NO
11.	What type of toilet facility do you use?	Pit Latrine		
		Water closet		
		Bush around the house		
		Nylon bags		
		Bucket		
12.	Do you wear shoes at home?			
13.	Do you wear shoes when playing in the house?			
14.	What structure of house do you live in? • Flat apartment • Detached bungalow • Face to face • Others specify_____			
	What type of house do you live in? • Thatched roof • Corrugated iron sheet • Others(specify)_____			

15.	Do you have the habit of eating soil?		
16.	Do you use human feaces as fertilizers in your farm?		
17.	Do you wash your hands before eating?		
18.	Do you wash your hand regularly with soap before eating? How often do you wash your hands? • Every time☐ • Sometimes☐ • Never ☐		
19.	Do you rear animals? Do you have a pet animal at home? • What type of animal? Dog ☐ Cat ☐ Others specify_____		
SECTION E: PAST HISTORY OF WORM INFECTION			
20.	Have you ever seen a worm before? Have you ever passed out worm from your nose, mouth or faeces? Have you ever been treated for worm in the last one year?		
SECTION F: RISK FACTORS OF MALARIA			
21.	Have you been using mosquito nets in this pregnancy for the last 3 months? Do you have net on the door or window of your house? Have you treated Malaria in the last 3 months? If yes, how was it treated? • Herbs • Antimalarial drugs Who treated you for malaria☐ Self medicatio☐ Health worker If Antimalarial drugs, which type?		

SECTION F: FOOD CONSUMPTION PATTERN & FREQUENCY

In the last 24 hours, list out the foods you ate:

22. Breakfast	
23. Lunch	
24. Supper	
25. Snacks and Drinks	

In the past 7 days how many times did you:	Never (0 Times)	Rarely (1-2 Times)	Occassionally (3-4 Times)	Frequently (5-7 Times)
26. Skip breakfast?				
27. Eat starchy foods e.g. Rice, Spaghetti, Garri/Eba, Fufu, yam				
28. Eat protein rich foods e.g. Meat, Fish, Eggs, Beans etc.				
29. Eat fruits and vegetables e.g. Oranges, Bananas, Watermelon				
30. Eat snacks/pasteries e.g. Chin-chin, Cake, Doughnuts etc.				
31. Take carbonated drinks e.g. Coca-cola, Fanta etc.				

SECTION G: PHYSICAL ACTIVITY

32. How would you assess your level of physical activity in this pregnancy?	☐ Not Active (e.g. watching TV, sleeping, sitting in most part of the day) ☐ Active (e.g. walk for about 30 minutes per day) ☐ Very Active (e.g. lifting heavy loads, pounding yam)

SECTION H: Parasitological Findings(Stool sample)

S/N		Eggs/slide	Eggs/gram(epg)	Heavy intensity threshold	Heavy intensity infection	
33.				≥ 50000epg	Yes	No
34.				≥10000epg		
35.				≥4000epg		
36.				≥ 4000epg		

BLOOD SAMPLE

PCV: _____

MALARIA PARASITE: Positive [__]

Negative[__]

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In the last 24 hours, list out the foods you ate:

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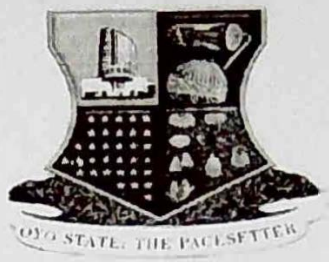
MALARIA PARASITE: Positive ☐

Negative ☐

TELEGRAMS..... TELEPHONE.....



MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. .....

All communications should be addressed to the Honorable Commissioner quoting

Our Ref. No. AD 13/ 479/989

January, 2016

The Principal Investigator,
Department of Epidemiology and Medical Statistics,
Faculty of Public Health,
College of Medicine,
Ibadan.

Attention: Umezurike Chioma

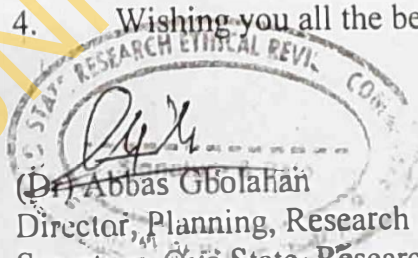
ETHICAL APPROVAL FOR THE IMPLEMENTATION OF YOUR RESEARCH PROPOSAL IN OYO STATE

This is to acknowledge that your Research Proposal titled: "Soil Transmitted Helminths and Anaemia among Pregnant Women at Ido/Akinyele Local Government of Ibadan, Nigeria." has been reviewed by the Oyo state Review Ethical Committees.

2. The committee has noted your compliance. In the light of this, I am pleased to convey to you the full approval by the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations, in line with this, the Committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of findings as this will help in policy making in the health sector.

4. Wishing you all the best.



(Dr.) Abbas Gbolahan
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethical Review Committee

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