CHAPTER ONE

Introduction

Malaria presents a public health paradox. Malaria is a preventable and curable disease and yet more than one million people die from it each year (Eke *et al.*, 2015). There were an estimated 438 000 malaria deaths around the world in 2015, of which approximately 69% were children under 5 years of age (WHO, 2015). Malaria killed 437,000 children before their fifth birthday in 2013, the majority in sub-Saharan Africa (WHO, 2014). The disease still took an estimated 627 000 lives in 2012, mostly those of children under five years of age in Africa. This means 1300 young lives lost to malaria every day-a strong reminder that victory over this ancient foe is still a long way off (WHO, 2013). It is transmitted from person to person through the bite of a female *Anopheles* mosquito that is infected with one of the five species of *Plasmodium*: *Plasmodium falciparum, P. malariae P. ovale, P. vivax, and P. knowlesi;* and in Nigeria by *Anopheles gambiae complex* (Okafor, 2013). These adult female Anopheles mosquitoes are, hence said to be carriers of malaria parasites. Children under five years and pregnant women are particularly vulnerable to the disease due to their weaker immune systems (WHO, 2000). The treatment of malaria is still problematic and this contributes to worsening burden of the disease in the developing country like Nigeria. Inspite of age-long efforts to control its devastating menace in Africa and other developing countries afflicted with the disease, the debilitating effects of malaria is still felt today across the globe. It is the widest spread parasitic disease in Sub-Saharan Africa with associated high morbidity and mortality especially among the predisposed population of pregnant women and children of age five years and below as a result of their low level of immunity (Opara *et al.*, 2011; WHO, 2010; Okogun and Amadi, 2005). Malaria is the cause of suffering and premature death in tropical and subtropical countries (Cheesbrough, 2008). This preventable disease has reached epidemic proportions in many regions of the world and continues to spread unchecked (WHO, 1998). Time is now right for rapid scale up to achieve impact toward malaria scourge with the best arsenal available. The incidence of malaria infection has been estimated to be about 500 million infections and 1-3 million infections-related deaths annually (WHO, 2008). It was on record by the (WHO, 2010) that there are 219 million malaria cases in 2010 with an estimated 666 000 deaths; and majority of these deaths occur among children living in Africa where a child dies every minute from malaria. World Health Organization (2008) estimated that about one out of every five Nigerian children dies before the

age of five years from malaria. Malaria predominantly affects rural and poor populations that have little or no access to current prevention and treatment tools.

The disease is one of the commonest causes of outpatient attendance across all age groups with about 60% of outpatient visits and 30% hospitalization (FMH, 2009). It is arguably the most prevalent infectious disease and one of the foremost impediments to social and economic development in the world (Oaks *et al.*, 1991). Malaria continues to represent a life threatening menace and an economic impediment for about 2 million people in the world. Much of this is due to weak health systems; large scale population movement; deteriorating environmental conditions; climatic change, spreading drug resistance; and in certain cases, uncontrolled development activities (WHO, 2008). According to Onwujekwe *et al.,* (2000) large number of children miss school and as such their educational development is being affected.

The pathology of severe disease is partly dependent on the age of the individual, independent of previous exposure (Baired *et al.*, 1998). The disease causes fever, shivering, joint pain, headache, muscle ache, vomiting, malaise and other flu-like symptoms, which can be very incapacitating.

In severe cases, patients can have jaundice, kidney failure and anaemia, and can result into a coma in some cases.

Most of the pre-school age children in endemic areas carry malaria parasites without symptoms due to the developing immunity following constant exposure (Barger, 2009 and Smith, 2007). Asymptomatic malaria infection serves as a rich source of malaria transmission in the community; indeed it contributes to the high rate of childhood anaemia and other health problems which have been associated with worse cognitive outcomes (Hay, 2004). Following the scale up of Artemsinin Combination Therapies (ACTs) and Insecticides Treated Nets (ITNs) use in Sub- Saharan Africa, there is growing evidence of decline in malaria transmission, and periodic study are required on malaria epidemiology in endemic settings, Aguata area being one of them. Transmission in the Southeast (Anambra State) part of the country occurs all year round (Eke *et al.,* 2015). In Tanzania, the available data on prevalence of malaria and anaemia among school children was 24.3% and 86.1% respectively. The public health and socio-economic consequences of malaria parasite infection, anaemia and incidence are of considerable global concerns more especially in the rural communities in developing countries where malnutrition, illiteracy, ignorance and other factors complicate the impact and control of the infection.

However, as a result of high prevalence of malaria in Nigeria (Kalu *et al.*, 2012; Opara *et al.*, 2011 and Okonkwo *et al.*, 2010) and subsequent consequences such as anaemia, death coupled with regular episodes of malaria parasite attack among the pre-school children 1-5 years; malaria was believed to be the root cause of more than 83% mortality and major cause of anaemia in this group of children. There was paucity of literature on association of malaria, incidence and anaemia in Aguata amongst the pre-school children. The study of associciation of malaria and anaemia amongst the children 1-5 years becomes a matter of urgency and also frequency of attack amongst this age group.

The main objective of the study was to determine the association between malaria Infection, incidence and anaemia amongst the pre-school children in Aguata L.G.A.

The specific objectives include:

1. To determine the prevalence of anaemia among the pre-school children
2. To determine malaria episodes over 12 months, seasonal variation and malaria parasite species amongst the pre- school children.
3. To determine the overall prevalence of malaria amongst the pre-school children in Aguata L.G.A.
4. To determine sex and age specific prevalence of malaria among the pre-school children.
5. To determine association between malaria and anaemia in the study population.

CHAPTER TWO
Literature Review

2.1 Malaria in Children

Malaria is a vector-borne disease caused by a protozoan parasite which is transmitted by the bite of female *Anopheles* mosquitoes. Malaria is a major public health problem in sub-Saharan Africa (SSA), with 90% of the burden occurring in African children (WHO, 2014). It is the most prevalent infectious disease in Sub- Saharan Africa (WHO, 2011). Children under 5 years of age are one of the most vulnerable groups affected by malaria. In 2015 an estimated 214 million cases of malaria occurred worldwide and 438,000 people died, mostly children in the African Region (CDC, 2015). In high transmission areas, partial immunity to the disease is acquired during childhood. In such settings, the majority of malarial disease, and particularly severe disease with rapid progression to death, occurs in young children without acquired immunity. Severe anaemia, hypoglycemia and cerebral malaria are features of severe malaria more commonly seen in children than in adults. In 2010, it was estimated that over 100 million school age children were at risk of malaria infection, 200 million in Sub-Saharan Africa (Gething *et al.*, 2011). It is estimated that more than one million children living in Africa die yearly from direct and indirect effects of malaria infection. The bulk of malaria morbidity and mortality is thus concentrated in pre- school children (Stanley, 1997). (In 2001, malaria was ranked the 8th highest contributor to the global Disability Adjusted Life Year (DALY) and 2nd in Africa (WHO, 2002). It has been reported that about 75% of the total number of deaths of children as a result of malaria is recorded in Africa (UNICEF, 2006; RBM, 2002 and WHO, 2000). Malaria is the most serious vector-borne disease known to man and it is highly intertwined with poverty. Over 80% of malaria infections are caused by *P. falciparum* while up to 15% are caused by *P malariae* and less than 5% are caused by *P. ovale* infections. Mixed infections with *P. falciparum* are common (Federal Ministry of Health, 1990; Orajaka, 1996). *P. falciparum* have been noted to be the parasite responsible for most cases of malaria worldwide (Mborea, 2004), it still remains unchallenged as the greatest killer of the human race especially children of under fives over most parts of Africa and elsewhere in the tropics. Malaria caused by *Plasmodium vivax, Plasmodium ovale curtisi, Plasmodium ovale wallikeri* and *Plasmodium malariae* are generally milder disease that is rarely fatal while the severe disease is largely caused by *Plasmodium falciparum* (Sutherland and Hallett, 2010).

In a cross sectional survey in Gambia, *Plasmodium falciparum* was the predominant species in children accounting for 96% of all infections. *P. falciparum* are found throughout tropical Africa, Asia and Latin America. It causes the malaria-associated children deaths mainly due to cerebral malaria and anaemia, constituting 25% of child mortality in Africa; and responsible for about 80% of malaria infection in man. In areas of intense transmission, children gradually acquire immunity that protects them from severe malaria attack and death (Snow and Marsh, 2002). Malaria parasite rate especially *P. falciprum* follows a well-established pattern as a function of age and transmission intensity, it rises during infancy and early childhood, settles to a plateau in older children and declines in adolescents and adults as malaria immunity develops (Smith, 2007). Studies across the country have shown a high parasite rates but actual rates in different localities are determined by a number of factors. These include whether the community is urban or rural; parasites rates of 33% among school children in Lagos urban while parasites rate of 80.5% was found in a semi rural suburb of Lagos in the same report. World Health Organization (WHO, 2010) showed that approximately 216 million cases of clinical malaria occur world-wide in 2010, with deaths of about 655 000 million occurring most among under fives of African children (WHO, 2011). In Nigeria, malaria is directly responsible for over 1,000,000 million deaths of children below school age and one quarter of an average family income is spent on the treatment of malaria (Etuk and Umoh, 2001).

Child mortality rates are known to be higher in poorer households and malaria is responsible for a substantial proportion of these deaths. In a demographic surveillance system in rural areas of the United Republic of Tanzania, under-5 mortality following acute fever (much of which would be expected to be due to malaria) was 39% higher in the poorest socio-economic group than in the richest (Mwageni *et al.*, 2002). A survey in Zambia also found a substantially higher prevalence of malaria infection among the poorest population from malaria infections affecting the brain (cerebral malaria) suffer from learning impairments and disabilities due to brain damage, including epilepsy and spasticity (Murphy *et al.*, 2001). Investigating the cause of deaths in the South bank of River Gambia, Alonso *et al.*, (2002) found out that 26% of all deaths in infants and 41% of deaths in children aged 1-4 years were attributable to malaria. In Upper River division of the Gambia; cause of death was

investigated using post- mortem questionnaire and 23% of the deaths in children less than five years of age were attributed to malaria. In Nigeria, malaria accounts for 30% of deaths in children less than 5 years, 11% of deaths among pregnant women and 1 of every ten maternal deaths (Uzochukwun and Onwujekwe, 2005).

The symptoms of uncomplicated malaria are non-specific and include fever. Some research results have been documented in Enugu State and Anambra State (Mbanugo and Ejims, 2000) in Awka for fever as a major symptom of malaria. The high proportion of headache and fever attributed to malaria reassure the policy of presumptive malaria treatment for rural communities of high transmission intensity (Nchinda, 2004). However, this is contrasted by arguments that fever and headache may also be attributed to other diseases or environmental and psychological factors; thus during erythrocytic schizogony, debris of destroyed cells release merozoites and other metabolic by-products. Chemoreceptors to the temperature regulating mechanism of the host to conserve heat are stimulated. This in turn results in chills, shivering and rigor, the body temperature begins to rise and continues during the hot stage when the subjective feeling of cold is replaced by warmth. In non immune children, the primary attack can vary widely. Jayant and Mani (2010) reported that the prodromal symptoms in Indian children includes non specific conditions like generalized weakness, headache, fatigue, abdominal discomfort and muscle ache, loss of appetite, nausea, vomiting followed by fever. Infants in endemic areas have some immunity to malaria, some symptoms of malaria are often more insidious and they include anaemia, restlessness, loss of appetite, easy fatigue, sweating and intermittent fever (Strickland, 1988).

The classical presentation of malaria consists of paroxysms of chills and rigor (15 min – 1hr) followed by hot state (1 – 8hr) and then there is sweating stage (fever comes down with profuse sweating) (Jayant and Mani, 2010). The typical consequences of malaria are: acute febrile (feverish) illness, chronic debilitation, complication of pregnancy, weakening of physical development and learning ability of children. These consequences cause a huge negative social impact in highly affected areas (Eke *et al.*, 2015). There could be lost and physical inability to engage in productive work and contribution to economic welfare which directly causes economic loss and impacts negatively in the quality of life of individuals, their dependence and caretakers in case of children. Hence, malaria as one of the most successful parasites ever known to

mankind and is responsible for much of the absenteeism, death, illness, loss education time as children are ill or caring for sick parents, and reduced social development in children because of illness. Malaria can therefore be regarded as both an urban and rural disease. The cost of daily labour coupled with cost of treatment and high mortality associated with the disease make malaria one of the main diseases retarding development in Africa (Ekpenyong and Eyo, 2008). Since many malaria endemic countries are already classified among the poor nations, the disease maintains a vicious cycle of disease and poverty.

From cross-sectional surveys, malaria parasite prevalence was found very similar in comparable epidemiological settings of some African countries. In Tanzania, 52.1% malaria parasite prevalence in infants was found (Kitua *et al.,* 2003). In Gambia, malaria parasitaemia was found in 64% of children aged 1-5 years. In Senegal, a study found an overall 60.3% malaria prevalence of which 92.6% in children and 7.4% in adults. In Nigeria, a parasite prevalence of 69% was found in children at the end of dry season. Mbanugo and Ejims (2000) in a study conducted in three hospitals and a Nursery School in Awka on prevalence of *Plasmodium* infections in children, discovered that out of 400 children, 233(58%) were positive. According to the latest estimates, malaria mortality rates were reduced by about 47% globally and by 54% in the WHO African Region between 2000 and 2013**.** Literature showed that malaria parasites are found in the blood circulation all the time in about 90%-100% of children less than 5 years old in parts of Africa and it declines as the child is getting old due to naturally acquired immunity which develop as a result of constant exposure (Parija, 2009). Bousema *et al.,* (2004) conducted a research on asymptomatic malaria and discovered that many asymptomatic children develop gametocytes, even in the absence of treatment. It has been demonstrated that *Plasmodium* carriers with sub microscopic densities of gametocytes are capable of infecting mosquitoes and they constitute a conservable proportion of the human infectious reservoir (Schnider *et al.*, 2007). In areas of high malaria transmission intensity, gametocyte carriage is most prevalent in younger age group who also has the highest prevalence densities of asexual malaria parasites (Tjitra *et al.*, 2002; Drakeley *et al.*, 2000). The fact that so many people are dying from mosquito bites is one of the greatest tragedies of the 21st century**.** In Nigeria, it has been well known that the bulk of the burden of disease due to malaria is borne by children under the age of five years (Sodeinde, 1997). Malaria contributes greatly to the increase in hospital attendance across the six geo political zones of Nigeria. World malaria report indicated that Nigeria accounted for a

quarter of all malaria cases in the 45 malaria endemic countries in Africa, showing clearly the challenges of malaria in Nigeria (WHO, 2008). Malaria does not only affect the health of the child but, it also causes great drain on the national economy. In malaria endemic areas, a significant proportion of children harbour parasites without presenting signs of clinical malaria and are considered asymptomatic cases (Landry-Erik *et al.,* 2003). Asymptomatic malaria can affect the individuals who carry the parasites and are cryptic carrier reservoirs for the community (Ashton *et al.,* 2011 and Osorio *et al.,* 2004).

By the time children reach school age, the risk of clinical attacks and death is reduced due to the immunity that they acquire in early childhood (Clarke *et al.,* 2008) however they often develop asymptomatic infection due to such immunity which then end up with anaemia and being reservoir is crucial for maintaining transmission. *Plasmodium falciparum* infection in school children is associated with reduced ability to learn which then affects the academic performance in the school (Ashton *et al.,* 2011). Patients with asymptomatic *P. falciparum* chronic infection especially children usually experience an increased morbidity due to anaemia, and reduced cognitive development. Since ancient of days, malaria has been a leading cause of morbidity and mortality in Sub- Saharan Africa that carries 90% of the global malaria burden, affecting mainly the under fives and pregnant mothers especially the primigravida (WHO, 2010). However; children who have malaria display some early symptoms of infection such as drowsiness, irritability, loss of appetite and difficulty in sleeping. These are generally considered to be the initial warning signs that a child has malaria. This is followed by chills which often develop into fever characterized by extremely fast breathing. When the fever subsides, the temperature of the body very rapidly returns to normal and the child experiences an extreme period of sweating (Davis, 2011).

2.2 Malaria and Anaemia

Anaemia is one of the complications seen in malaria infection and it contributes to its morbidity and mortality (Fowowe, 2011). It has been reported that over half of malaria related deaths are attributed to anaemia. Mortality rate for children admitted to hospital with severe malaria was considered to be 15-30% (Crawley *et a*l., 2010). The findings are consistent with results of studies conducted in school children of holoendemic areas of Ejisu-Juaben District, Ghana, Western Kenya; Cotonu in Benin and Onayadougou in Burkina Faso (Otupiri *et al.,* 2012; Siane

et al., 2004). In malaria endemic areas, asymptomatic cases result due to development of variant specific immunity and explain low-grade infection during extended periods without clinical symptoms. A study conducted on anaemia in young children in Asia and India reported that Anaemia prevalence in young children continues to remain over 70% in most parts of India and Asia despite a policy being in place and a programme that has been initiated for a long time. The irreparable damage that anaemia in childhood can cause particularly to the development of a young child on one hand and the knowledge and mechanism available for its control on the other, makes this silent morbidity completely unacceptable in modern times where we strive for millennium development goal. South East Asia has the largest number of anaemic persons, both as an absolute number and also in proportion to its population, including children. Sixty percent women, 36% men, and 66% of the children in this region are anaemic (Kotecha, 2011). This contributes to 324,000 deaths and 12,500,000 Disability Adjusted Life-Years (DALYs) in this region, which is the highest in the world (Stoltzfus *et al.*, 2005). In Asia, the prevalence of anaemia in children may exceed 90% for children less than two years of age (Hercberg *et al.*, 2010).

In a study conducted on prevalence of anaemia in fewer than five years old children in a children's hospital in Recife, Brazil, showed that anaemia is associated with socioeconomic, biological, environmental and nutritional factors. In Brazil, population-based information is available on anaemia in under 5 year old children. Globally, the World Health Organization (WHO) estimates that two billon people are anaemic. In Ibadan, Nigeria, anaemia ranks among the top ten causes of childhood mortality in a hospital based study and a high prevalence (62%) has been reported among rural primary school children. Population based data on the burden of anaemia amongst school children in rural communities of Abia State indicated a higher prevalence (82.5%) (Onimawo *et al.,* 2010). In the neighbouring Anambra State, there is paucity of literature on the prevalence of anaemia among school children (Onimawo *et al,* 2010). Anaemia is a global public health problem but most prevalent in developing regions especially Asia (50%) and Sub Saharan Africa (40%) (Haas and Brownilie, 2001). Anaemia was defined as Packed Cell Volume <30%**.** More than 2 million people around the world are estimated to be anaemic due to malaria as it impacts its effect on physical growth, cognitive functions and emotional development and reduced work capacity in adults (Grantham-McGregor and Ani, 2001). It has adverse consequences on child growth, development, and survival. This deficiency has affected approximately a quarter of the world population (El Kishawi *et al.,* 2015). Anaemia is caused by low haemoglobin concentration in the blood (Hurell

et al., 2000). This condition is brought about by parasitic infections such as malaria, inadequate iron intake in pre-school children (Stoltzfus *et al.*, 2000). It is an inevitable consequence of malaria infections in children and pregnant women, accounting for 30% of preventable low birth weights among new born infants, undermining their growth and development (UNICEF, 1999). The commonest complication of malaria and most important cause of the repeated haemolysis of infected red blood cells. Malaria is associated with anaemia (Ashton *et al.*, 2011) and Ezzati *et al.*, 2002). Anaemia among African children is a haematological state determined by combinations of nutritional deficiencies (iron, folic acid, other micronutrients and protein-calorie malnutrition), iron loss through helminth infection, red cell destruction, decreased red cell production by infectious diseases and the genetic constitution of red cell haemoglobin (Stolfus *et al*., 2000). Malaria has long been recognized as a major contributor to paediatric anaemia. Some of the mechanisms of anaemia during malaria are associated more with the acute clinical states (e.g. haemolysis or cytokine disturbances) whereas chronic or repeated infections are more likely to involve dyserythropoiesis (Menendez *et al.*, 2000). The World Health Organization defines mild anaemia as a haemoglobin of <11.0g/dl. Furthermore, this is the criteria used to define anaemia burden during the 1995 estimations of the DALY. What remains unclear is the extent to which children or adults with haemoglobin of 9-10g/dl experience any significant physiological or morbid disability. More appropriate morbid distinctions include haemoglobin concentrations less than 7-8g/dl (moderate) and less than 5g/dl (severe). In many African settings a reduced haemoglobin concentration and malaria infection are both common occurrences and defining precise attributable risks of malaria for anaemia is problematic. For childhood populations located in areas with a low prevalence of *P. falciparum* infection (less than 25%) the median prevalence of mild anaemia was 31.7% (n = 26; IQR 26.5, 42.3%). Children residing in areas where the prevalence of infection was in excess of 25% the median prevalence of anaemia was 75.3% (n=32; IQR 62.6, 83.0%). By modeling the relationship between mild anaemia and parasite prevalence, mild anaemia could rise on average of 6% with every 10% increase in the prevalence of infection; explained 71% of the variation in anaemia prevalence between studies. This contrasts the DALY estimations for Sub Saharan Africa for 1990, where malaria-anaemia (Hb <11.0g/dl) accounted for only 18% of all anaemia DALY descriptions for children aged 0-4 years. The ecological analysis is supported by evidence from community or individually randomized controlled trials of malaria-specific interventions aimed at reducing the incidence of new infections through insecticide-treated nets (ITNs).

Anaemia is prevalent among school-age children in the tropics and is worthy to note that the etiology of anaemia is multifactorial, and thus several underlying morbid and co- morbid conditions could cause wide variations in prevalence of anaemia among children in different clinical setting. The strongest evidence that malaria is an important cause of anaemia in children comes from intervention studies, but these have focused largely on those under 5 years of age (Korenromp *et al.*, 2004). Anaemia depends on the parasite load, duration of acute illness and number of febrile paroxysm. Malaria anaemia is an enormous public health problem in endemic areas and occurs predominantly in children in the first 3 years of life (Kai and Roberts, 2008). It was of particular importance in African children because of a high prevalence of chronic malnutrition and worm infestation, which often aggravate the anaemia. Report from study in Simanjiro Distrct, Tanzania on prevalence of anaemia and parasitic infections among the under five children by Nyaruhucha *et al.*, (2005) indicated that 47.6% of children were anaemic of which 20.8% mildly anaemic, 21.6% moderately anaemic and 5.2% severely anaemic. Anaemia can develop rapidly during malarial illness, especially if there is initial hyperparasitaemia. Although nutritional deficiencies, hookworm infection, HIV and haemoglobinopathies all predispose to the development of malaria in children, evidence suggests that, in endemic countries, malaria is one of the most important factors (Murphy and Breman, 2001). The disease contributes greatly to anaemia and accounts for about one-in-five of all childhood deaths. Malaria can affect a person's health in various ways: people who have developed protective immunity (through past infections, as is the case with most adults in high transmission areas) may be infected but not made ill by the parasite they carry. Some persons infected with particularly virulent strain suffer from severe anaemia and kidney failure. These severe forms occur more frequently in children with little protective immunity, and can result in death or life-long neurologic impairment. People subjected to frequent malaria infections (such as young children and pregnant women in high transmission areas) can develop anaemia due to frequent destruction of the red blood cells by the malaria parasites). Anaemia is estimated to be present in 33% of the population worldwide (UNICEF, 1999); and an inevitable consequence of malaria infection, its degree relates to the level of parasitaemia and other severe manifestations. Anaemia occurs by haemolysis, inadequate marrow response, malnutrition and others. Children and pregnant women are the ones commonly affected and present with general weakness, severe palmar pallor or pallor of mucous membranes and conjunctiva. It 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). Ignorance, poverty and gender bias significantly contribute to high prevalence of anaemia (Jaleel and khan, 2008).

In a study conducted on malaria and anaemia among children in a low resource setting in Nigeria, Olamdeinde *et al.,* (2012) showed a prevalence of anaemia among children as 47.3%. This was lower than a finding in Benin City by Akinbo *et al*., (2009) on prevalence of malaria and anaemia among young children in a Tertiary Hospital in Benin City. In a study conducted on malaria and anaemia among children in two communities of Kumasi, Ghana indicated that stunting was significantly associated with malaria Ronald *et al.,* (2006). However; studies have shown that in Africa, more than half of the school children are stunted in height and are anaemic (WHO, 1997). Anaemia was significantly higher in the rainy season than dry season. School children are often thought of as naturally healthy as long as they turn up at school. Malaria-induced anaemia (MIA), characterized by low haemoglobin levels has been identified as one of the life-threatening complications of childhood malaria. The possible long-term implications of childhood anaemia; which are thought to include permanent or irreversible psychomotor and mental retardation (Graham-Mcgregor, 2001 and Lozoff *et al.,* 2000) add to the health consequences of MIA in the long-term. Malaria is associated with anaemia (Ashton *et al.,* 2011 and Ezzati *et al.,* 2002) and it's insidious nature of presentation means that mild-to-moderate degrees of anaemia frequently remain undetected and untreated by health care workers and in the community (Schellenberg *et al.,* 2003). Studies have shown that long-term asymptomatic malaria could lead to anaemia (Gendrel *et al.,* 1992). Malaria is generally known to be a febrile illness characterized by fever and related symptoms. Fever due to malaria tends to be paroxysmal by anaemia and splenomegally and often by symptoms resulting from lesions of particular organs (Jellife, 2000). Therefore, according to WHO (2001), malaria must be suspected in all cases of fever in endemic areas until proven otherwise. This is particularly applicable in children in whom the early symptoms of the disease are vague and can stimulate other conditions. Children are particularly vulnerable since they have little or no immunity to the parasite (WHO, 2000). There has been wide variation in symptoms and presentation of cases of malaria, depending on immune status and age group (Jayant and Mani, 2010). Deaths from malaria in Africa are higher among children of under 5 years of age from the severe and complicated form of the disease. However, children under 6 months of age are believed to be relatively immune to the disease. Packed cell volume is the property of whole blood occupied by red cells. In anaemic condition

PCV values are reduced. Normal range of PCV was between 35-54% and makes use of Haematocrit centrifuge.

2.3 Incidence of Malaria in Children

Incidence is the measure of rate of occurrence of new cases of a disease in a population divided by the total number of population expressed as a percentage. In malaria endemic areas children suffer an average of six bouts of the disease yearly making school children in endemic rural area miss a week of school time due to the disease (UNICEF, 1999). Malaria episodes among African children are estimated to be between 1.6-5.4 million each year. This varies according to geographical and epidemiological circumstances (Murphy *et al.,* 2001). The impact of repeated malaria episodes on the development of the child, particularly as they relate to mental and cognitive functions, could be relevant to the later potential and prosperity of the individual and the community (Siane *et al.,* 2004). This fact was well demonstrated in the Garki project (Molineaux and Gramiccia, 1980) which reported a vectorial capacity of about 1000 times the threshold for maintaining endemicity and also reported a cumulative incidence of patient parasitaemia of 100% over an 18 months period for virulent *Plasmodum falciparum* in children between 1-8 years of age. Incidence of malaria varies with weather, which affects the ability of the main carrier of malaria parasites, Anopheles mosquitoes, to survive. Many adults when they have attack instead of seeking medical health help from hospital, they prefer to buy drugs directly from pharmacists' or dispensary shops thus increasing drug resistance to parasites. In most cases it is as a result of cost of treatment that discourages them from seeking help from the right source.. In parts of Africa, where malaria is highly endemic, people are infected and re-infected so frequently that they develop a degree of acquired immunity. But the immunity is never complete but limits the severity of the disease. The incidence rates declined by 30% around the world and by 34% in the African regions; these substantial reductions occurred as a result of a major scale-up of vector control interventions, diagnostic testing and treatment with artemisinin-based combination therapies, (ACTs). The absolute numbers of malaria cases and deaths are not going down as fast as they could.

Persons vulnerable to malaria parasite infections are those with no or little protective immunity against the disease in areas with high transmission (such as Africa, south of Sahara), travelers, visitors or migrants from non endemic areas who lack immunity; those with sickle cell anaemia

as well as those with HIV/AIDS. This is because they are immune compromised (Okafor, 2013). Young children have the most frequent and severe attacks of malaria. In older children, attacks become less frequent and less severe as immunity builds up. Children exposed to repeated infection in hyper endemic areas develop a high degree of immunity. In a study by Siane *et al.*, (2004) on malaria morbidity among school children living in two areas of contrasting transmission in Western Kenya he reported that one fourth of the school children under surveillance in highland schools experience one or more clinical attacks with 2.1% experiencing two attacks within the 11-week surveillance period. Lengeler *et al., (*1996) have reviewed the operational challenges of extensive use of Insecticides Ttreated Materials (ITMs) to achieve a measurable level of protection against malaria episodes, a minimum level of (ITMs) coverage must be reached greater than 30% (Kroger *et al.*, 1999) especially in Africa with predorminant *P. falciparum* infection. Monitoring of vector behaviour and insecticide resistance must also follow insitu and not on WHO test papers because they are expansive and difficult to obtain. The cost of nets retreat coverage and other operational costs including the required man power when put into consideration require putting into practice the WHO global malaria control strategy (WHO, 2000), with appropriate donor support and operational research and field studies for strengthening decision-making and increased community involvement in local activities as bednet impregnation, case finding and treatment (Kroeger *et al.*, 1999). The vast majority of malaria infections cause uncomplicated malaria, with only approximately 1-2% of these episodes becoming severe (Greenwood *et al.*, 1997). The human behaviour pattern is a major epidemiological factor that impacts on disease transmission and progress in Africa and there is a growing evidence that with appropriate awareness, education, attitude, attention to the key symptoms of malaria and chemotherapy, the incidence of severe malaria can be reduced drastically especially in the rural/semi- urban areas where most of the death occur.

In Nigeria, higher malaria prevalence are reported in Benin in children of five years of age in rural areas even after controlling with bednets; and equally showed that rural children had significantly more malaria episodes than the urban children. Available records show that approximately 50% of the Nigeria population experiences at least one malaria episode per year; however, official estimate suggests as much as four bouts per person per year on the average (WHO, 2000). The trend is rapidly increasing due to the current malaria resistance to first line anti malaria drugs (WHO, 2000). School-age children have attracted relatively little attention as

a group in need of special measures to protect them against malaria. However, increasing success in lowering the level of malaria transmission in many previously highly endemic areas will result in children acquiring immunity to malaria later in life than has been the case in the past. Thus, it can be anticipated that in the coming years there will be an increase in the incidence of both uncomplicated and severe malaria in school age children in many previously highly endemic areas. Recent data on the prevalence of malaria parasitaemia and on the incidence of clinical malaria in African school-age children are evidence that malaria adversely effects school performance. Cerebral malaria, a relatively uncommon outcome of malaria infection, is not a pre-requisite for cognitive impairment which may occur during the course of an uncomplicated clinical episode of malaria (Fernando *et al.,* 2003) and repeated episodes of uncomplicated malaria may have long-term effects (Fernando *et al,.* 2003). In a survey of seasonal variation in malaria episodes among residents in a semi- urban community of Udi in South-Eastern Nigeria, Eneanya (1998) recorded higher malaria episodes in the wet than in dry season. Study on seasonal variation of malaria parasitaemia in urban Tropical City of Benin indicated that the peak of malaria parasitaemia coincided with the height of rainy season (Endolease and Awodu, 2003). Reports in Ibadan and Abuja have shown parasites rates of 35-75% while rural environment may have parasites rates of up to 100% (Salako, 1997). There is even some evidence that asymptomatic parasitaemia can impair cognitive function. In the Yemen, Al Serouri *et al.,* (2000) showed that children with parasitaemia performed less effectively on formal cognitive testing than children without parasitaemia, even after adjusting for confounding factors. This was also the case in Uganda Nankabirwa *et al.,* (2013) and in Mali; although in Mali the effect was not as marked as in children with clinical malaria Thuilliez *et al.,* (2010). In Zambia, a strong association was found between exposure to malaria and cognitive skills and socio-emotional development in young children (Fink *et al.,* 2013).

In areas with lower transmission (such as Latin America and Asia), residents are less frequently infected. Many persons may reach adult age without having built protective immunity and are thus susceptible to the disease (WHO, 2010). There are generally more parasites rates in rural than urban communities, time of the year whether wet or dry season; and the age group involved; as well as the presence, nature and persistence of water bodies.

2.4 Malaria and Seasonality

Malaria is prevalent throughout Nigeria and Cameroon with transmission being affected by climate and geography (WHO, 1998; Fontenille *et al.*, 1997). In Nigeria, there are seasonal variations in different parts of the country determining the rate and intensity of parasite transmission within the population. Malaria transmission intensity fluctuate between dry and rainy seasons depending on the specific locality, dry seasons may last from one month to several months, during which *Anopheles gambiae* density is very low. Nigeria has two distinct seasons of wet season extending from April-October and a dry season extending from November-February. The initial large scale survey of malaria in Nigeria after the Second World War and subsequent survey have shown that malaria is holoendemic in all parts of Nigeria (Salako, 1997). There is transmission all year round with high intensity. The rate is however higher in wet season. However, mosquito populations and the rate of transmission increase rapidly following the onset of the rainy season and malaria cases peak a few weeks after the rainy season begins. However, the major vector responsible for transmission in Nigeria includes *Anopheles gambiae* although *Anopheles arabiensis and funestus* are also available (WHO, 2011). In Nigeria, malaria is holoendemic in the rural areas and mesoendemic in the urban areas. In the Southern part of the country the transmission rate is approximately uniform throughout the year. In the far North there is a marked difference between the high transmission rate in the short wet season and low transmission rate in the long dry season (Lucas and Gilles, 1998). In areas of high transmission, the main burden of malaria, including nearly all malaria deaths, is in young children.

Parasites rates vary according to time of the year and age group involved in the study. There are also variations between different parts of the country with differences between Southern and Northern Nigeria. The seasonal variations in parasites rate is more marked in the North than in the Southern Nigeria (Brinkman and Brinkman, 2004; Salako, 1997). Nigeria has two distinct seasons of wet season extending from April-October and a dry season extending from November-February. Malaria transmission season generally coincides with the planting and/or harvesting season and brief periods of illness exact a high cost on the world's poorest region.

In Nigeria, *P. faciparum* is found throughout the year but in greater abundance during rains because of the prensnce of adequate breeding sites, favourable climatic conditions and other prevailing environmental factors. It is the main species found in tropical and sub-tropical Africa,

parts of Central America, Bangladesh, Pakistian, Afghanistan, Nepal, Sri- Lanka, South East Asia, Solomon Islands, New Guinea, Philippine, Indonesia and Haiti including many islands Melanesia. *P. vivax* is capable of developing in mosquito at lower temperatures than *P. falciparum* and therefore has a wider distribution in temperate and sub-tropical areas. It is mainly found in South America, Mexico, Middle East, Northern Africa, India, Madagascar, tropical and Sub-tropical Africa, Korea and China. *P. malariae* has a much lower prevalence than *P. falciparum* and *P. vivax*. It is found in tropical and Sub-tropical regions. It accounts for up to 25% of *Plasmodium* infections. It is present in Guyana, India, and Malaysia. It accounts for less than 10% of *Plasmodium* infection in these countries. *P. ovale* has a restricted distribution and low prevalence. It is found mainly in West Africa, China, Indonesia and parts of the Far East, South America and South East Asia (Hughes, 1993). Malaria causes 0.5 – 3.0 million deaths each year. 75% of these deaths occur in African children under the age of five (RBM, 2010). The human behaviour pattern is a major epidemiological factor that impacts on disease transmission and progress in Africa and there is a growing evidence that with appropriate awareness, education, attitude, attention to the key symptoms of malaria and chemotherapy, the incidence of severe malaria can be reduced drastically especially in the rural/semi- urban areas where most of the death occur.

During the rainy season, the climate, environmental appearance, topography and the human behaviiour seem to favour the breeding of malaria vectors. The most important climatic factors that directly affect malaria transmission are temperature, rainfall and humidity.

It would seem that malaria prevalence is related to *Anopheles* vector abundance. More abundance of malaria mosquitoes could lead to high mosquito-man contact leading to high transmission of malaria especially in the presence of efficient malaria vectors. Most of the communities especially in the Southeastern part of the country are litered indiscriminately with refuse dumps, cans, damaged tyres, vehicles, filty gutters and drains and these may contain water all year round. Erosion plays its own part by creating horrible gullies that contain stream of clean water for a very long time after the rains thus encouraging vector breeding and subsequent transmission of the parasite. It is possible that mosquitoes breed in this stream all year round without disturbance since *Anopheles gambiae*, can breed in undisturbed pools resulting from overflow of river but never in polluted or alkaline water (Aniedu, 1992; Onyido *et al*., 2009). So the villagers are at risk of being bitten by these mosquitoes. Children are considered the high risk group in malaria transmission and the consequence of this could be enormous. On the otherhand,

majority of houses are clustered with over grown grasses giving the whole community a bushy appearance quiet excellent for malaria vector habitation thus high transmission of the disease among the populace especially the pre-disposed groups- the children less than five years of age and the pregnant women. Malaria mosquito breeding grounds include fresh water or salt-water, vegetative or non-vegetative, shady or sunlit. Ground pools, small streams, irrigated lands, freshwater marshes, forest pools, and any other place with clean, slow-moving water are all considered prime malaria mosquito breeding grounds for egg-laying (Onyido *et al*., 2009).

2.5 Malaria control among children

Child malaria remains a vital concern in sub-Saharan Africa in spite of major efforts to control it. The widely advertised best curative and preventive measures are not always accessible (Houeto, 2007). Malaria is a difficult disease to control largely due to the highly adaptable nature of the vector and parasites involved. Recent data on the prevalence of malaria parasitaemia and on the incidence of clinical malaria in African school-age children showed that malaria adversely effects school performance. Long-lasting insecticide treated bednets (LLIN) are an effective method of malaria control but several studies have shown that school-age children use LLINs less frequently than other population groups. Antimalarial drugs are being used in different ways to control malaria in school-age children including screening and treatment and intermittent preventive treatment (Nankabirwa *et al.*, 2014). While effective tools have been and will continue to be developed to combat malaria, inevitably, over time the parasites and mosquitoes will evolve means to circumvent those tools if used in isolation or used ineffectively. To achieve sustainable control over malaria, healthcare professionals will need a combination of new approaches and tools, and research will play a critical role in development of those next-generation strategies. Despite all the control and preventive measures in place for reduction of malaria infection, the disease still thrives in Sub- Saharan Africa killing millions of predisposed and compromised people especially children less than 5 years of age and pregnant women. Four reasons were listed by Philip (1994) for such continuous persistence as wide spread resistance of *Plasmodium falciparum*; impoverished economy; increase urbanization and development of epidemics following natural disasters and social unrest.Various countries and WHO regions have implemented vector control measures to a varying degree. The development of resistance to insecticides in vectors, concern about environmental contamination and human safety and increased costs of alternative insecticides are some of the challenges in malaria control especially in children. Malaria

chemoprophylaxis given to African school children is associated with lower rates of malaria parasitaemia and severe anaemia, fewer clinical attacks and malaria deaths and reduced school absenteeism due to malaria (Clarke *et al.*, 2008), however the intervention is not effectively established in several areas of Africa. In the study done by Stolzfus *et al.,* (2000) in Zanzibar on epidemiology of iron deficiency anaemia, she found that school children with circulating asymptomatic malaria parasitaemia had worst anaemia status as compared to those without asymptomatic malaria parasitaemia. The detection and treatment of asymptomatic carriers of *Plasmodium falciparum* as an innovative strategy for malaria control in children. Malaria transmission in most malaria endemic areas of Sub-Saharan Africa was moderate or high and control measures consequently focused on the protection of young children and pregnant women. However, enhanced control efforts have recently reduced the level of malaria transmission in many parts of sub-Saharan Africa (O'Meara *et al.,* 2010; Noor *et al.,* 2014) and in many areas where transmission was previously hyper or holoendemic has become mesoendemic. As a consequence children are acquiring immunity to malaria more gradually than in the past and clinical attacks, sometimes severe, are occurring in school-age children more frequently.

Development and implementation of interventions for malaria prevention and control have been mainly directed towards well-known risk groups, such as pregnant women and children younger than 5 years old (Clarke *et al.*, 2004). Scaling-up effective malaria interventions reduced malaria-related burden at health facilities by over 75% within 5 years. In high-malaria settings, intensified malaria control can substantially contribute to reaching the Millennium Development Goal for target of reducing under-five mortality by two-thirds between 1990 and 2015.

Large scale intervention studies with impregnated bed nets suggested that malaria contributes to as much as half of all mortality in children aged between 1 month and 5 years living in endemic areas (Alonso *et al.,* 2002). Long lasting insecticide impregnated nets (LLINs) are the preferred form of ITNs for public health distribution programme. WHO recommends coverage for all at risk person, especially children 0-5 years and pregnant women (Zahar, 1984). An insecticide-treated net (ITN) is a factory-treated net that does not require any further treatment, or a net soaked with insecticide within the past 12 months (NBS, 2010). Insecticide-treated nets (ITNs) and long-lasting insecticidal nets (LLINs) are the primary interventions for preventing malaria in sub-Saharan Africa (*Lengeler,* 2004). ITNs are providing barrier between human and mosquito especially during sleeping and in doing so it prevent mosquito bites which reduce chances of

malaria transmission. On the other hand it has a significant role of reducing mosquito longevity whereby the life span of the mosquito is reduced to the extent that *Plasmodium* species cannot develop enough before transmission to human. Insecticide- treated nets (ITNs) are estimated to be as twice as effective as untreated nets and offer greater than 70% protection compared with no net (WHO, 2006). The number of deaths among the children of under five attributable to malaria has significantly decreased in some parts of Africa, owing to combined strategies of mass distribution and an increased use of long lasting insecticide-treated nets (LLITN). The percentage of households owning at least one ITN in sub-Saharan Africa is estimated to have risen from 3% in 2000 to 50% in 2011 and 96% of them actually use it (WHO, 2011). Also ITNs have been shown to reduce child mortality by about 20%, saving six lives for every 1000 children under five years of age protected per year in Sub-Saharan Africa (SSA) and the cost-effectiveness of ITNs has also been demonstrated by Wiseman *et al.*, (2003). Between 2008 to 2010 Tanzania conducted national campaign on distribution of ITNs among under-fives whereby Coastal regions implemented it in late 2009 to 2010 (NBS, 2010), however by 2010 the ITNs available in Tanzania were sufficient to protect more than 50% of the population at risk although until this time there was no policy or strategies of free distribution of ITNs for the whole population (WHO, 2011). The coverage of mosquito nets in Tanzania has greatly improved in all regions since 2004 but rural households are less likely than urban households to own a mosquito net although the gap between rural and urban is narrowing (NBS, 2010). However there are some challenges toward effective use of ITN in the community, misconceptions towards ITNs distribution and use as well as negative attitudes among community members leading to misuse and misallocation of ITNs have been observed in Tanzania and Nigeria (Widmar *et al.*, 2009).

Long-lasting insecticide treated bednets (LLIN) are an effective method of malaria control but several studies have shown that school-age children use LLINs less frequently than other population groups. Antimalarial Insecticide-treated nets; there is strong evidence that, at the individual level, regular use of an ITN or long lasting insecticide treated net (LLIN) substantially lowers the risks of malaria (Lengeler, 2004) and that an additional, indirect 'herd' effect is achieved when a high level of ITN coverage is obtained. Thus, most LLIN distribution programmes now aim at achieving universal coverage. As children become older and more independent, parents have less control over the time when they go to bed, where they sleep, and whether they use a net, frequently resulting in low net coverage in children in this age group. A 2009 analysis of household surveys, undertaken between 2005 and 2009 in 18 African countries,

found that school-aged children were the group least likely to sleep under an ITN the previous night, with between 38% and 42% of school-aged children being unprotected (Noor *et al.*, 2009). Similar low ITN usage rates have been observed among school-age children in Cameroon (Tchinda *et al.*, 2012); Kenya (Atieli *et al.*, 2011) and Uganda (Pullan *et al*., 2010; Nankabirwa *et al.*, 2013). Recent cross-sectional surveys undertaken among children 1-5 years in Somalia (Noor *et al.*, 2008) and in Uganda (Pullan *et al*., 2010) suggested that net use was associated with a 71% and 43% lower risk of *P. falciparum* infection. An analysis of countrywide data from school surveys in Kenya (Gitonga *et al.*, 2012) showed that ITN use was associated with a reduction in the odds of malaria infection and anaemia in coastal areas, where malaria transmission is low to moderate and among boys in western lakeshore Kenya where transmission is high.

Indoor residual spraying is a technique which involves the spraying of interior walls of houses in malaria endemic areas. The insecticide will kill off the mosquito that perches to rest before it gets to the next victim. Indoor residual spraying, the application of long acting insecticides to the walls and roofs of houses and, in some cases, public buildings and domestic animal shelters, is an effective method of malaria control not only in children but for everyone. This is the most powerful way to rapidly reduce malaria transmission. It is effective for 3-6 months depending on the insecticide used and the type of surface on which it is sprayed. D.D.T can be effective for 9-12 months (WHO, 2010). When IRS is implemented as a community-wide campaign it can achieve marked reductions in the incidence and prevalence of malaria infection in all age groups (Pluess *et al.*, 2010). Repeated IRS campaigns conducted in the Pare Taveta region of Tanzania reduced malaria parasitaemia from 73% to 7%, and from 62% to 4% in children aged1-9 years and 10-14 years, respectively (Draper, 1999). More recently, targeted IRS conducted over 12 months in the epidemic-prone Kenyan highlands halved the monthly prevalence of asymptomatic infection in school children and reduced the incidence of clinical malaria (Zhou *et al.*, 2010). In some countries in America and Asia, indoor residual spraying continues to be the main vector control measure implemented (WHO, 2000). There is however a tendency to reduce reliance on spraying and a marked decrease in the use of conventional residual insecticides such as DDT which is being replaced by new generation insecticides such as pyrethroids, permethrin and deltamethrin at considerable financial costs (WHO,2006). Jambou *et al.*, (2001) reported a five-year indoor house spraying of DDT on highland of Madagascar that proved effective against *A.*

funestus the main malaria vector in the area. However re-infection of sprayed areas was suspected by Anopheles malaria vectors such as *A. gambiae* which is known to develop resistance, further points to solution to malaria control in another direction at best the development of a malaria vaccine is pre-eminent.

This rapid impact evaluation shows that scale-up of ACT as first-line treatment of malaria, widespread adoption of Artemisinin-based Combination Therapy (ACT) (Kern *et al.*, 2011). This have been successfully and safely used to control malaria morbidity and mortality in a range of environment in the Africa and Western Pacific regions combined with vector control using ITNs/LLINs and IRS resulted in a dramatic decline in the malaria burden. Within four years of intervention scale-up, malaria deaths, hospitalizations, laboratory-confirmed outpatient cases and slide positivity rates fell by 76% or more, both in children under-5 years and older age groups. However, national and international malaria control programmes have been implemented, inclucing: integrated management of childhood illness (IMCI); Roll back malaria initiative; and the global fund, major progress in the prevention and treatment of malaria has been reported through the adoption of artemisinin combination therapy (ACT) from several countries; the use of insecticide treated bed nets and intermittent preventive treatment (IPT) for pregnant women and children. However, despite the existence of effective treatment and protective measures, malaria continues to be of concern to mankind because of its persistence devastating menace to the existence and wellbeing of its citizens especially the under five children. The control of malaria for children of this age group 1-5 years should also involve parents and nonmedical community sectors. This is to checkmate the early appearance of the symptoms such as fever, weakness, loss of appetite and so on.

Antimalarial drugs, in combination with mosquito control programmes, have historically played a key role in controlling malaria in endemic areas, resulting in significant reduction of the geographic range of malarial disease worldwide. Over the years, however, the emergence and spread of drug-resistant parasites have contributed to a reemergence of malaria, turning back the clock on control efforts. The need for new, effective drugs for malaria has become a critical priority on the global malaria research agenda. Chemoprophylaxis has been used effectively for decades, but the increasing resistance of *Plasmodium* to medications has limited the effectiveness of chemoprophylactic regimens used in the past (Fischer and Bialek, 2015)

Vector management tools such as insecticides, environmental modification, and bed nets have contributed greatly to successful malaria control efforts historically in children, but have faced setbacks in recent years due to factors such as the emergence of insecticide resistance in mosquitoes.

The majority of cases of malaria are acquired via a bite from an infected mosquito, although some cases are acquired transplacentally or via transfusion of blood products. Generally, to avoid malaria infection, a child must avoid being bitten by an infected mosquito. This can be accomplished by choosing appropriate times and places for activities, controlling the physical environment, blocking mosquitoes' access to the skin, repelling mosquitoes from the skin, and killing mosquitoes near the child.

WHO (2015) recommends the following package of interventions for the prevention and treatment of malaria in children:

- use of long-lasting insecticidal nets (LLINs); in areas with highly seasonal transmission of the Sahel sub-region of Africa, seasonal malaria chemoprevention (SMC) for children aged between 3 and 59 months;
- in areas of moderate-to-high transmission in sub-Saharan Africa, intermittent preventive therapy for infants (IPTi) except in areas where WHO recommends administration of seasonal malaria chemoprevention (Kain *et al.,* 2001)
- prompt diagnosis and effective treatment of malaria infections.

2.6 Roll Back Malaria (RBM)

The launch of Roll Back Malaria (RBM) in 1998 was a catalyst for renewed global commitment to tackle a disease that affects 3.2 billion people and has devastating effects on health and development. Malaria exacts its greatest toll on the world’s poorest and most marginalized. The ambitious RBM goal of halving the global burden of malaria by 2010 remains an imperative for the global community. UNDP, WORLD BANK and WHO jointly funded this programme in 1998 with the aim of:

1. Reducing malaria burdens by 50% worldwide by the year 2010.
2. Ensuring that all persons with malaria have access to treatment within 24 hours.
3. To develop effective drug procurement/delivery.
4. Develop quality laboratory diagnostic capabilities of referral health centre (WHO, 2000).

The Roll Back malaria campaign is meant to focus first on Africa. It's aimed at:

- Upgrading health delivery system at both the local and national levels in malarious carrying countries.
- Intensify use of insecticide treated bed netting to prevent night time bitting by malaria mosquitoes.
- Mapping of malaria region and of medical facilities to better direct health resources. Develop new drugs for victims already infected with malaria. Co-ordinating the development and testing of new malaria drugs and vaccines.
- Developing of method to address malaria in emergencies as in refugees and post war situations.

Roll Back malaria is meant to set up resource network through out Africa to forecast malaria epidemics and their prevention. This is aimed at linking surveillance information from countries and regional surveillance systems so as to establish the means of routine and rapid analysis of this information for forcasting and early detection of epidemics. Strategies for epidermics preparedness and readiness for emergency action will be formulated and the resources network used to track malaria drugs quality and supply.

However it is a new approach to malaria prevention and control. RBM is a new social movement established on 31st July 1998 and aims at developing endemic countries health systems and building new means of tackling health concerns (WHO, 1998). The goals of the roll back malaria programme led by World Health Organization are to reduce death due to malaria progressively by 50% by 2010, by another 30% by 2015 and by another 20% by 2015 (WHO, 2000).

Other objectives of the Roll back malaria include:

- To support endemic countries in developing their national health system as a strategy for controlling malaria.
- To develop a broader health sector including the community. Public and private health providers; drug vendors and traditional healers.
- Encouraging the needed human and financial investments both national and international for health systems development (WHO, 1998). World Health Organization provides technical leadership; UNDP and World Bank will provide resources and expertise. UNICEF will help in programme implementation and work closely with governments and NGOs. They will promote the use of the insecticide treated bed nets and take lead responsiblility for developing impregnated bed net resource network.

African leaders met at the African summit on Roll back malaria hosted by Nigeria at Abuja on April 25th, 2000 and signed the Abuja Declaration on Roll Back malaria in Africa. In the Declaration, the leaders committed themselves to halving the malaria mortality for African people by 2010 (WHO, 2006). Heads of state and country delegations at the Abuja summit pledged to:

- Implement the summits plan of action
- Ensure that vital malaria information is available at household, community district and national levels.
- Reduce or waive taxes and tariffs for mosquito nets and materials, insecticides, anti-malaria drugs and other recommended goods and services that are needed for malaria control strategies.
- Allocate resources for sustainable RBM activity.
- Increase support for research to develop a malaria vaccine.
- Declare each April 25th African malaria Day and have United Nations announce 2001-2010 a decade for malaria.
- Explore and develop traditional medicine in the area of malaria control (WHO, 2000).

Nigeria is one of the countries in Africa where malaria is still a big health and development problem. The Nigerian government has accepted to adopt the Roll Back Malaria (R.B.M) initiative and has the following as the main objectives

- To significantly reduce the malaria burden through interventions adopted to local needs by strengthening the health sector;
- To review national goals based on situation analysis and feasibility assessment and
- To review targets from aggregated district and community goals at the end of the Roll Back malaria.

To achieve these objectives, the programme in Nigeria would build on all current malaria control activities based on existing global malaria control strategies (early diagnosis and treatment, sustainable preventive measures and operational research) to achieve targeted level of coverage in the affected population (WHO, 1999). Roll Back Malaria (RBM) targets were updated in June 2011 focusing on reduction of global malaria deaths to near zero and cases by 75% from 2000 levels by the end of 2015. These targets will be met by achieving and sustaining universal access to case management in the public and private sectors including accelerating the development of

surveillance systems (WHO, 2011). Roll Back Malaria does not propose any novel intervention and technique, but will utilize existing strategies and build on current efforts through local, national, regional and global partnership and maximize the impact of contributions from major stakeholders, including affected countries, G8 nations, WHO, World Bank, UNDP, UNICEF, and the private sector. The roll back malaria envisaged a situation in which malarial burden is reduced through development of health sectors and supporting intersectional action (WHO, 2001).

2.7 Malaria parasitological diagnosis

The changing epidemiology of malaria and the introduction of ACTs have increased the urgency of improving the specificity of malaria diagnosis. Parasitological diagnosis has the following advantages:

- Improve care in parasite-positive patient
- Identification of parasite-negative patient
- Prevention of unnecessary use of anti-malaria
- Improve malaria case detection and reporting
- Confirmation of treatment failures

The two methods in routine use are light microscopy and rapid diagnostic tests (RTDs).

Light microscopic test: this is the direct microscopic visualization of the parasite on the thick and thin blood smear of patients. However, the risk of false negative microscopy is higher if the patient has received a recent dose of an artemisinin derivative. Microscopy can be used for speciation and quantification of parasites and can be used to identify other causes of fever. A major drawback of microscopy is that it requires well-trained, skilled staff and usually an energy source to power the microscope (WHO, 2010).

Rapid diagnostic test (RDTs): this type of test detects parasite specific antigens or enzymes and some have a certain ability to differentiate species. Some of the RDTs developed are nucleic acid probes and immunoflorescence for the detection of *Plasmodium* within the erythrocytes; gel diffusion, polymerase chain reaction etc. Although RDTs for detection of parasite antigen are generally more expensive, their deployment may be considerably cost effective in many of the rural settings (WHO, 2010). There have been progresses in diagnostic testing and malaria treatment. The numbers of procured rapid diagnostic tests (RDTs) and ACTs are increasing, as well as the reported rate of diagnostic testing in the public sector in the African region, which

increased from 37% in 2010 to 61% in 2012. As a result, there has been a decrease in the number of suspected malaria cases treated presumptively with antimalarial drugs. However, millions of people with suspected malaria still do not receive a diagnostic test, and many people with confirmed infections do not receive appropriate treatment with a quality assured antimalarial (WHO, 2013).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The study was carried out in Aguata Local Government Area of Anambra State, Nigeria. The study area consists of the 13 communities (towns) namely Achina, Aguluezechukwu, Akpo, Amesi, Ekwulobia, Ezinifite, Igbo-Ukwu, Ikenga, Isuofia, Nkpologwu, Oraeri, Uga, and Umuchu. Aguata lies within the equatorial tropical rainforest belt of South Eastern Nigeria. The vegetation is typed with localized clustered growth of grasses and shrubs scattered all over the place; around the banks of natural water bodies and further inland are the guinea savannah. The study area has a tropical climate with mean daily maximum air temperature range of 28^0C – 36^0C; and mean daily minimum air temperature range from 18^0C – 23^0C. The highest temperature occurs between March and April; and lowest in January. The area has a distinct wet and dry season; wet season spans from March to October giving an annual rainfall of between 1,800mm – 23,000 mm. It has a relatively high humidity of about 76-84% for the most period of the year. The wet months are usually cool with characteristic heavy rainfall most of the time. Dry season period sets in between October to March and the dry season is characterized with very high temperature and low humidity. Harmattan period sets in from December to January. Some areas are erosion prone (Ekwulobia) rocky and hilly (Aguluezechukwu) with spring water scattered all over. Most of the towns in this area are semi-urban; and as such a lot of open drains, bushes, puddles and insufficient waste disposal system with huge refuse litters found in strategic areas of the towns.

The study area is located within latitude 6.038518 N^0 North of Equator and longitude 7.084706^{0}E East of Greenwich meridian (Google map). The people of the area are of Igbo ethnic stock and are predominantly Christians and few traditional religionists. The major occupation of the people was subsistence farming of diverse nature (palm oil milling, yam production, cassava, melon, maize, vegetable farming etc). The people live in scattered compounds surrounded by farmland with economic trees (palm trees, banana, mango, pear, bread fruit tree, e.t.c.); though some compounds were adorned with flowers. The villagers were engaged in trading while others civil servants. The land area is about 19,906.25sq/km (Aguata L.G.A). The study area has an estimated population of 370,172 thousand peopled (National population Census, 2006).

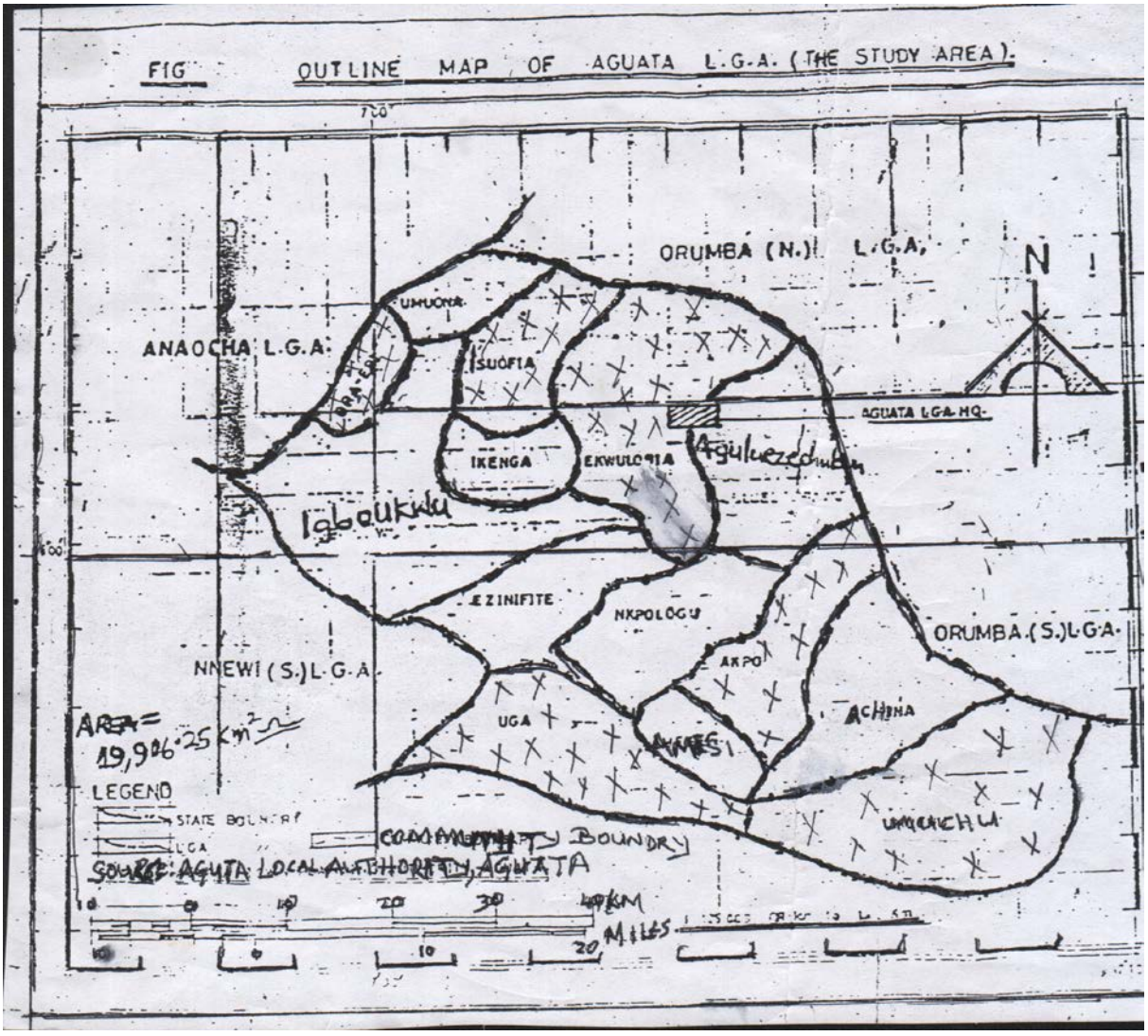

Figure 3: Map of Aguata L. G. A. Source: Aguata Local Authority, Aguata

3.2 STUDY DESIGN

The design is a multi-stage cross sectional study involving both prospective (cohort) and retrospective studies. It was carried out with 450 pre-school children ages 1-5 years. Six study sites out of a total of 13 communities. Next was the sampling of 20 out of the total of 37 schools with pre- primary sections and crèche. The children used in the study were randomly selected to avoid bias. A cohort of children (1-5 years) over time was surveyed to determine the frequency of malaria episodes over a 12 month period. The study was carried out between April 2014 and April 2015 cutting across two major seasons of the year- the dry and the wet seasons.

3.3 Sample population and Sample size

The target populations were all the children 1-5 years in the pre-primary schools. The minimum sample size determined was 353 but was stepped-up to 450 to bridge the error margin. The same allocation technique was used in allocating the sample size to be selected in each school. This is to allow each school a chance to be equally represented in the study sample. The total number of pupils in the schools was 3002. The sample size was 353 as calculated by the sample size calculation formula shown below for epidemiological studies. However, 450 children were sampled to take care of any losses.

$$n = \frac{N}{1+Ne^2}$$

Source: Kasiulevicuis *et al.*, (2006).

n = sample size

N = Total population

e = Confidence interval (0.05)

The sample of the study stood at 450.

3.4 Advocacy and ethical clearance

A letter of introduction was obtained from the Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University, Awka (A letter of permission from the Education Authority of the Aguata Local Government Area in charge of Primary School Education in the study area was obtained and ethical clearance from Nnamdi Azikiwe University Teaching Hospital, Nnewi. A meeting with the traditional leaders of each of the communities involved in the study was undertaken to intimate them about the nature of the study and to seek for their assistance and cooperation throughout the period of the study. Advocacy visits were made to the head-teachers, teachers of the study schools as well as the parents of the children to explain to them the purpose of the study. This was done to establish a harmonious and cordial relationship with all the teachers and parents, thus creating an enabling environment for the field study. And finally an informed consent was obtained from the parents of the children enrolled in the study.

3.5 Inclusion and Exclusion criteria

3.5.1 Inclusion criteria: Participants who were all apparently healthy pre-school children between the ages of 1 and 5 years without fever. These children were tested for malaria infection. Any child with infection was treated so that only children without infection and fever were included in the study.

3.5.2 Exclusion criteria: No participant outside Aguata area was used in the study and no participant was ill. Participant below 1 year and those above 5 years were excluded. Children who had fever, sickle cell haemoglobin were excluded from the study because of the fact that malaria parasites do not grow well in sickled Hb cells.

3.6 Collection of blood sample

Two millimeters (2mls) of venous blood was collected from each child on scheduled days and poured into EDTA bottle that contain an anticoagulant to prevent blood from clotting (Cheesbrough, 2008). A finger prick blood sample was used for subsequent examinations.

3.7 Determination of malaria parasite infection

Microscopy was employed to determine the malaria parasites in the blood as well as the parasite species. The films were examined under the light microscope using x100 objective lens (oil immersion) (Meeuseen *et al.,* 2001). The parasite count was determined using the plus (+) system (Moody, 1998; Cheesbrough, 2006). Careful procedure was adopted in the collection of finger prick blood samples for subsequent examinations. The area for the blood collection was cleaned or swabbed first with 70% ethanol and allowed to dry before pricking the finger for blood collection. Thick and thin films were made on clean slides and labeled accordingly as recommended by the World Health Organization (WHO, 2001). Thick films were used to determine the parasite densities while the thin films were used to determine or identify the parasite species.

3.7.1 Thick Films

One drop of blood (12µl) from a child was placed on free, clean microscope slides and left to dry. The slides were labeled to aid identification. The dried smears were placed on a staining rack and slides flooded with 3% Giemsa stain. The slides were allowed to stain for 30 minutes. The stained slides were rinsed with clean water to remove excess stain deposit. The back of each slide was wiped clean and put on a rack to air dry. The dried slides were viewed under the light microscope using oil immersion (x100) objective.

3.7.2 Thin film:

A drop of blood from each participant was dropped 15mm away from the end of a clean, grease free microscope slide. With the aid of a spreader and at an angle of 45^{o} the drop of whole blood

was evenly spread along the other end of the slide by pulling the blood with the spreader. The films were labeled to aid identification. The smears were allowed to air dry. The dried smears were placed on staining racks and flooded with 10% Giemsa stain for 2 minutes. It was diluted with buffer (water) and allowed to air dry for 8 minutes after which the stain was washed off and the back of the slide cleaned with soft towel. The slides were allowed to air dry on the rack once again. The dried slides were taken and viewed under the light microscope using the (x100) objective to search and identify the species of malaria parasites.

3.8 Determination of Anaemia

Microhaematocrit centrifuge

Anaemia was determined using Packed Cell Volume (PCV) technique.

Procedure

Capillary tube was filled with ¾ of blood from the participant. The unfilled end of the capillary was sealed using a sealant. The filled end of the capillary was carefully located and placed in one of the numbered slot of the haematocrit centrifuge with the sealed end on the rim of the rotor or gasket. The centrifuge was covered and allowed to centrifuge for 5 minutes at rpm of 1200xg. The haematocrit tubes were removed as soon as the centrifuge has stopped spinning. The value of PCV was read using a haematocrit reader; ensuring that the top column of the plasma was at 100%, and the base of the red cells is at zero; then the top column of the red cells was read off with a haematocrit reader. In this way, the PCV of each of the child was obtained (Sood, 2006). PCV helps to determine if someone was anaemic or not. In anaemic condition PCV values are reduced. Normal range of PCV was between 35-54%.

(Hb capillary tube dimensions: size =75mm in length with an internal diameter of 1mm and wall thickness of 0.2-0.25mm).

Children between ages 1-5 years have their Haemoglobin levels as stated below:

Non-anaemia: >11g/dl

Low anaemia: 9-11g/dl

Moderate anaemia: 7-8g/dl

Severe anaemia: <7g/dl (Bouyou-Akotete *et al.*, 2003).

Legend

rpm = Revolving per minute

Xg = Specific Gravity

3.8 Determination of incidence of malaria

All the participants involved in the study were first tested for the presence of malaria parasites; the ones found to be parasitaemic were treated for malaria to ensure that all the participants were free of malaria infection and fever.The entire sample of the children (450) was followed up in time over 12 months period. Sampling was done once every month and an axillary temperature was obtained by simple clinical mercury thermometer. Any participant with a temperature $<37^0$c was tested twice to ensure that apparent low temperature was not as a result of poor placement of the thermometer. Any participant with fever (an axillary temperature $\geq 37^0$ c) is suspected to have malaria. The children were examined for malaria parasites using thick and thin blood smears as already described. Also Hb percentage and PCV for the children were measured monthly. Any children that tested positive for malaria was treated by the public health nurse, who is a member of the research team. The drug used was artemether-lumefantrine (Coartem) as recommended by the WHO.

3. 10 Data Analysis

Data were entered and arranged by the reasercher. Statistical Package for Social Sciences (SPSS), version 21 was used. Proportions are presented as descriptive statistics for all categorical variables. Prevalence of parasitaemia was calculated as overall prevalence. 95% confidence intervals (95% CI) were estimated to provide uncertainty surrounding the point estimate. Means and standard deviations for haemoglobin levels were calculated as overall mean and separated by sex, age and by parasitaemia status. ANOVA was used to analyse more than 2 parametric variables, Chi square was used to analyse non parametric variables. Correlation was used to determine the possible association between two variables. Statistical significance was set as a default alpha of 0.05.

CHAPTER FOUR

RESULTS

Of the 450 pre-school children aged (1-5 years) sampled for anaemia, 435 representing 96.7% had anaemia as shown in Table 1. Among those that had anaemia, 84.2% (379/435) had low anaemia and 12.4% (56/435) with moderate anaemia. No severe anaemia cases were found among the children.

TABLE 1: **Prevalence of Anaemia amongst pre-school Children in Aguata L.G.A**

Anaemia			
Number Sample	**Low-Anaemia (%) (9-11g/dl)**	**Moderate Anaemia (%) (7-8g/dl)**	**Overall Anaemia %**
450	379 (84.2)	56 (12.4)	435(96.7)

Females (97.5%) had higher percentage of anaemia than the males (94.2%). Though males seemed to show more intense anaemia 26(15.1%) than the females 30(10.8%). There was no significant difference in anaemic conditions between both sexes P>0.05 as shown by Table 2.

TABLE 2: Sex-Specific Prevalence of Anaemia among the Pre-school Children

Anaemia					
Sex	**No anaemia (>11g/dl)**	**Low anaemia (9-11g/dl)**	**Moderate anaemia (7-8g/dl)**	**% anaemia for the sexes**	**P-value**
Male (172)	8 (4.7%)	138(80.2%)	26(15.1%)	94.2%	
Female (278)	7(2.5%)	241(86.7%)	30(10.8%)	97.5%	0.167

The ranges of anaemia within different age specifics 1-5 years was shown on Table 3; for low anaemia range age 1(87.5%) had the highest while the age 5(82.3%) had the least. Ages 2, 3, and 4 years had 85.1 %, 84.0% and 84.3 % respectively. Ages 4 and 5 had the highest prevalenc of 19.6% for moderate anaemia followed by 3(12.8%), 1(12.5%) and 2 years (11.3%) respectively. The total percentage of anaemia among the pre-school children was 96.7%.

TABLE 3: Age-Specific Prevalence of Anaemia amongst the pre-school children

Age (yrs)	**Number sampled**	**No anaemia (%) (>11g/dl)**	**Low anaemia (%) (9-11g/dl)**	**Moderate anaemia (%) (7-8g/dl)**	**Overall % of Anaemia**
1	1 6	0.00	14(87.5)	2(12.5)	435(96.7)
2	141	5(3.5)	120(85.1)	16(11.3)	
3	125	4(3.2)	105(84.7)	16(12.8)	
4	89	3(3.4)	75(84.3)	11(19.6)	
5	79	3(3.8)	65(82.3)	11(19.6)	
Total	450	**3.3%**	**84.2%**	**12.4%**	

The result showed that the 2 years old (33.0%) had the higher cases of anaemia followed by the 4 years old (24.5%); the least being the 1 year old (2.8%) as shown on the Table 4 below. The 2 years old children was most at risk. The association that exists between malaria positive cases and anaemia were statistically not significant P> 0.005.

Table 4: Correlation of malaria positive cases with anaemia among different age groups

	Anaema category		
Age (year)	**Anaemia F (%)**	**No anaemia F (%)**	**p-value**
1	6 (2.8)	0 (0.0)	
2	70 (33.0)	1 (100.0)	0.734
3	47 (22.2)	0 (0.0)	
4	52 (24.5)	0 (0.0)	
5	38 (17.8)	0 (0.0)	

The ranges of Hb in male and female, and 1-2 and 3-5 years are 7-12 g/dl indicating that the range of Hb in both sex and age groups are the same table 5. The mean Hb did not differ between sex and age 1-5 years.

TABLE 5: Levels of Hb among Sex and different age groups (Mean±SD)

Sex	**Number of Children**	**Mean Hb (g/dl) (Range)**	**P-value**
Male	172	9.65 ± 1.05 (7-12)	0.837
Female	278	9.67 ± 0.98 (7-12)	
Age(yrs)			
1-2	157	9.73±1.00 (7-12)	0.250
3 -5	293	9.62±1.00 (7-12)	
Total	**450**		

The reslt shows that the children with the positive cases of malaria infection were 7.3 times more associated with anaemia. Therefore malaria has a positive correlation with anaemia Table 6.

TABLE 6: Relative/Contributory risk of malaria parasite to anaemia

Risk Estimate			
	Value	95% Confidence Interval	
		Lower	Upper
Anaemia (Anaemia / Noanaemia)	13.31	1.74	102.10
MP Positive	7.31	1.10	48.68
MP negative	237		
Number sampled	450		
No. anaemic	435		

The overall prevalence of malaria parasite infection among the pre-school children age 1 – 5 years was 47.3% representing 213 positive cases for malaria parasites as shown on Table 7.

Table 7: Overall prevalence of malaria parasite infection among the pre-school in Aguata L.G.A

Number Sampled	Malaria parasites +ve (%)	No. of males (%)	No. of females (%)
450	213 (47.3)	99 (46.5)	114 (33.5)

On average the pre-school children showed 4 episodes of malaria parasite attack per a year as indicated on Table 8. A slightly higher number (5) was recorded for ages 3 and age 5 years.

TABLE 8: Average number of malaria infection episodes per child in relation to age.

Age (yrs)	Number in sample	Total number of episodes per a year	Average number of episodes per child in a year
1	16	71	4
2	141	613	4
3	125	578	5
4	89	315	4
5	79	368	5
Total	**450**	**1,945**	

The result indicated that on average, a child either male or female can experience an episode or attack of malaria infection for upwards of 4-5 times per a year. The study also found out that males have higher number of episodes than the females and these episodes occur on bi-monthly basis Table 9.

TABLE 9: Average number of malaria episodes in relation to Sex

Sex	Number in sample	Total number of episodes per year	Average number of episodes per child in a year
Males	172	768	5
Females	278	1,118	4
	450	**1,886**	

There is a very strong association between total incidence and positive cases of malaria P=0.000 as shown on Table 10.

Table 10: Correlation of total incidence with malaria parasite positive cases amonsgt the pre-school children

Correlations			
Parameters	N	R	P-value
Total Incidence/ Positive cases	12	1.000	0.000

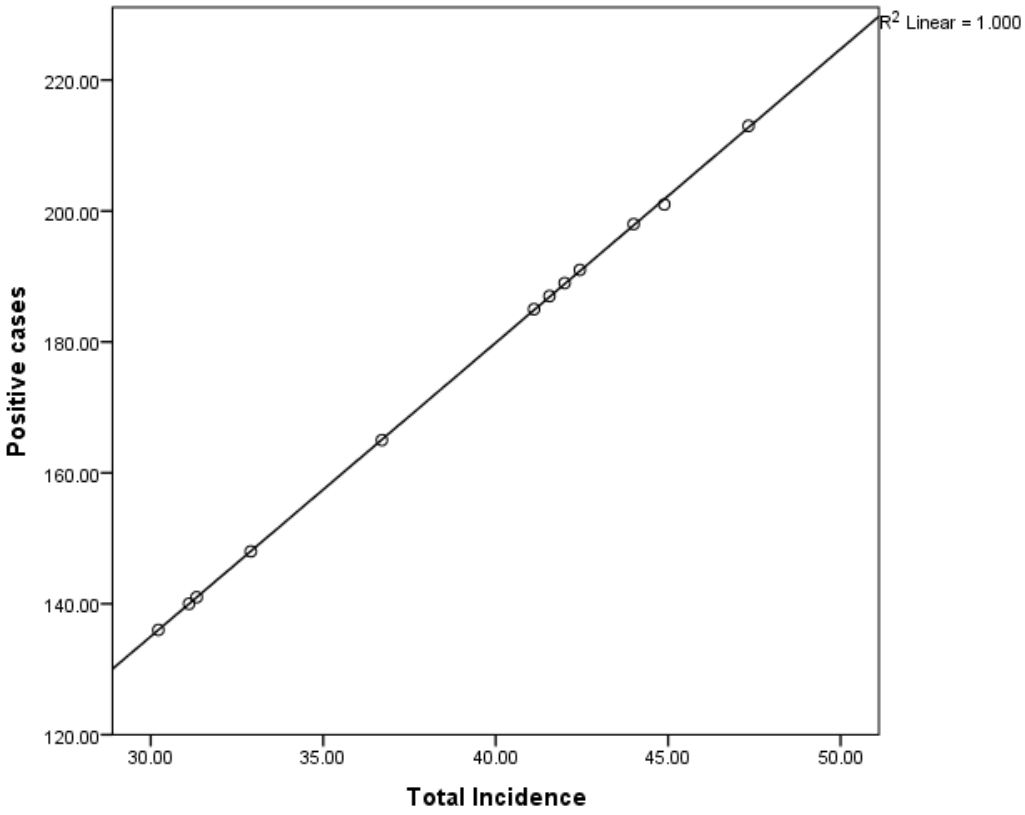

Fig 1: Linear diagram of Positive cases of malaria against Total incidence shows that 213 of pre-school children with positive cases of malaria had a total incidence of 47% of parasitaemia.

The rainy season periods (March -September) showed higher prevalence of malaria parasite infection amongst the children as against the dry season periods (October-February) as shown on Table 11.

Table 11: Seasonal Variation of Malaria parasite Infection in Aguata L.G.A.

Seasonal periods (Rainy & Dry Seasons)	Number sampled 450		Total positive (%)
Rainy season periods			
March	450		187(41.6)
April	450		189(42.0)
May	450		191(42.4)
June	450		198(44.0)
July	450		213(47.3)
August	450		201(44.7)
September	450		185(41.1)
Dry season periods			
October	450		140(31.1)
November	450		141(31.3)
December	450		136(30.2)
January	450		148(32.9)
February	450		165(36.7)

The only species of *Plasmodium* found among the pre-school children in the study area was only *Plasmodium falciparum* as indicated on Table 12.

Table 12: Species of Malaria Parasites found among the pre- school children in the study area.

Features of difference species of Plasmodium	***Plasmodium falciparum***	***Plasmodium malariae***	***Plasmodium ovale***	***Plasmodium vivax***
Trophozoite	Early form has signet ring shape, possess multiple trophozoites in one cell.	Has a rring shape	Presence of large schuffner's dots	Presence of fine schuffner's dots
Size of infected cells	Normal	Smaller than normal	Enlarged and granular in appearance	Enlarged
Gametocytes	Crescent or banana shape	Round with fine granular appearance	Round	Round or Oval
Fever periodicity	48hrs	72hrs	72hrs	72hrs

Prevalence of malaria infection was higher in the month of July (47.3%) followed by August (44.7%), May (44.4%) and June (44.0%) respectively. The months of October (31.1%), November (31.1%) and December (30.0%) experienced reduction in the prevalence of malaria infection. The result also found out that females (25.6%) had higher prevalence of infection than males (24.8%) in the month of July as showm in Table 13. The difference in infection rate between the sexes however was not statistically significant (P > 0.05).

TABLE 13: Monthly Prevalence of Malaria Infection by Sex

Months	Number sampled 450	Males Positive (%)	Female Positive (%)	Total positive (%)
January	450	66(14.7)	82(18.2)	148(32.9)
February	450	63(14.0)	102(22.7)	165(36.7)
March	450	82(18.2)	105(23.3)	187(41.6)
April	450	85(18.9)	104(23.1)	189(42.0)
May	450	86(19)	105(23.3)	191(42.4)
June	450	90(20)	108(24.0)	198(44.0)
July	450	98(24.8)	115(25.6)	213(47.3)
August	450	89(19.8)	112(24.9)	201(44.7)
September	450	83(18.4)	102(22.7)	185(41.1)
October	450	54(12)	86(19.1)	140(31.1)
November	450	58(12.9)	83(18.4)	141(31.3)
December	450	56(12.4)	80(17.8)	136(30.2)

The result showed that the prevalence of malaria infectionwas higher for 2 years old 85(18.9%) in July, followed by 3 years old 83(18.4%) and 4 years 65(14.4%) in the month of June respectively.The prevalence for the 1 year olds did not exceed 2.5%. There was a drop among the 5 years old 24(5.3%) when compared with the 2, 3 and 4 years old. The Months of May, June, July, August and September were all within the rainy season and they recorded higher prevalence of malaria parasite infection across different age groups 1-5 years as shown on Table 14.

TABLE 14: Monthly Prevalence of Malaria Infection by Age 1-5 years

Months/N=450	**1yr** **Number (%)**	**2yrs** **Number (%)**	**3yrs** **Number (%)**	**4yrs** **Number (%)**	**5yrs** **Number (%)**
January	6(1.3)	53(12.2)	54(12.0)	37(8.2)	28(6.2)
February	8(1.8)	56(12.4)	61(13.6)	40(8.9)	31(6.9)
March	6(1.3)	62(13.8)	66(14.7)	45(10.0)	35(7.8)
April	8(1.8)	69(15.3)	70(15.6)	47(10.4)	38(8.8)
May	7(1.6)	72(16.0)	78(17.3)	47(10.4)	41(9.1)
June	10(2.2)	78(17.3)	83(18.4)	65(14.4)	45(10.0)
July	11(2.4)	85(18.9)	78(17.3)	61(13.6)	49(10.9)
August	9(2.0)	82(18.2)	79(17.6)	61(13.6)	48(10.7)
September	8(1.8)	79(17.6)	79(17.6)	58(12.9)	46(10.2)
October	8(1.8)	62(13.8)	71(15.6)	60(13.3)	46(10.2)
November	5(1.1)	54(12.0)	65(14.4)	55(12.2)	30(6.7)
December	3(0.7)	52(11.6)	48(10.7)	41(9.1)	24(5.3)

Malaria parasites prevalence as shown on Table 15 indicated that females had the higher prevalence of 53.5% while the males had a prevalence of 46.5% of malaria parasites. Difference in infection rate between males and females were statistically significant (P= 0.001).

TABLE 15: Sex-Specific Prevalence of Malaria Infection in Pre-school children in Aguata L.G.A

Sex	**No. sampled**	**No. positive (%)**	**P-value**
Male	172	99(46.5)	
Female	278	114(53.5)	0.001
Total	**450**	**213**	

The result showed that children age 2 had higher malaria parasite infection (32.9%) followed by age 4 (24.4%) and 3 (22.1%) respectively. The least group of children with malaria infection was age 1 year old (2, 8%) as indicated by Table 16.

TABLE 16: Age-Specific Prevalence of Malaria Infection amongst the Pre-school Children in Aguata L.G.A.

Age (yrs)	**Number in sample**	**No. positive (%)**
1	6	2.8
2	70	32.9
3	47	22.1
4	52	24.4
5	38	17.8
Total	**213**	

From Table 17 ages 2 (34.9%) are the group that has higher temperature when they have malaria and the least being age 1 (2.3%). However, the difference in association between malaria positive cases and the body temperature was statistically not significant P>0.05.

Table 17: Correlation of Malaria positive cases with body temperature amongst different ages

	Temperature category		
Age (year)	Normal temperature F(%)	High temperature F(%)	p-value
1	1 (2.3)	5 (2.9)	
2	15 (34.9)	56 (32.9)	0.978
3	8 (18.6)	39 (22.9)	
4	11 (25.6)	41 (24.1)	
5	8 (18.6)	29 (17.1)	

The result showed that children with body temperature range = or >37 °C was 63.05 times more associated with positive cases of malaria parasite than those with body temperature range <37 °C as seen on Table 18. Malaria parasites infection has a positive correlation with high body temperature.

TABLE 18: Contributory risk of malaria to temperature

Risk Estimate			
	Value	95% Confidence Interval	
		Lower	Upper
MP (Positive / Negative)	.003	.001	.011
Body temperature range = or < 37	.204	.156	.267
Body temperature range = or >37	63.05	20.44	194.49
Total number sampled	450		

CHAPTER FIVE
DISCUSSION

The overall prevalence of anaemia among the pre-school children 1-5 years was 435(96.7%) and no severe anaemia was found among the children. This was higher than 47.3% by Oladeninde *et al.,* (2012); 53% by Akinbo *et al.,* (2009) and Anumudu *et al.,* (2007) in their study on epidemiological factors that promotes the development of severe anaemia in children in Ibadan; 61.6% by Winham *et al.,* (2013) on anaemia and infection in school aged Egyptian children. Eisele *et al.,* (2011) on malaria infection and anaemia prevalence in Zambia's Luangwa District; Ronald *et al.,* (2006) in studies on malaria and anaemia in two communities of Kumas, Ghana and 19.8% by Kimbi (2013) in Cameroon. The high prevalence of anaemia found in this work may be due to malaria parasite infection, poor nutrition, infection from other parasitic helminths such as hookworm and *Schistomiasis* or it could be by chance.

Females (97.5%) showed higher prevalence of anaemia than males (94.2%) in relation to sex-specifics though the difference was statistically not significant, but males 36(15.1%) showed more intense anaemia than the females 30(10.8%). The reason for this observation could be attributed to the nature of diet these children were fed with since they were from different parental background and hence the level of immunity varies among the children.

In relation to age-specific prevalence, age 1 year 14(87.5%) had higher prevalence of anaemia while the 5 years old 65(82.3%) had the least for low anaemia; ages 4 and 5 years 11(19.6%) had higher prevalence for moderate anaemia with 1 year 2(12.5%) having the least. The result showed that a good number of children were anaemic .This condition could be attributed to the income level of the parents which in most determines the type of nutrition, family size, educational background of mothers and could be the presence of asymptomatic malaria parasite since these children were living within the endemic environment**.**

The age mostly at risk of anaemia was age 2(33.0%) years old followed by the 4(24.5%) years old and 1 (2.8%) year olds the least in relation to correlation of malaria positive cases with anaemia. In the light of Kakkilaya (2015) on malaria in children, the age of 5 years was mostly at risk, the disease tends to be atypical and more severe. The association was statistically not significant P0>05. The reason for this observation could be attributed to reduction in immune level of maternal immunity as the child is growing and exposed to the dangers of the

environment on daily bases he tend to acquire more immunity to contant attack of malaria parasitaemia as Aguata area is within the malaria endemic region of the world.

The range of Hb in both sex and age groups are the same 7-12d/dl. Sex and age did not affect the level of anaemia in children. The mean Hb did not differ between Sex and age 1-5 years in this work. This contradicts with the findings of Yandamuri and Yandamuri (2015) who stated that the amounts of Hb in the blood vessels depend on the age and the sex. The reason for this observation could be explained on the nutrition and background of the children. With reference to haematological values of the infected children, the mean haemoglobin for males (9.65 ±1.05) and females (9.67±0.98; ages 1-2 years and 3-5 years with the mean haemoglobin are 9.73±1.00 and 9.62±1.00 respectively were not statistically significance P = 0.837 and 0.250. These findings agree with the findings of Okafor and Nwaiwu (2001); Cheesbrough (2008) and Ukoli (1990) who reported that anaemia was the commonest complication of malaria among 1 -5 age groups. This showed that malaria parasitaemia is associated with low Hb. When a child is attacked with malaria, during the erthrocytic stage of the parasite lifecycle the red cells of the blood are destroyed by the activities of *Plasmodium* thus leading to a reduction of haemoglobin concentration causing anaemia.

In the contributritory risk of malaria parasite positive cases with anaemia, the result showed that children with positive cases of malaria were 7.3 times more associated with anaemia. Therefore, malaria has positive correlation with anaemia. The finding was in agreement with the report of Fowowe (2011) who equally stated that as malaria parasitaemia decreases the prevalence of anaemia reduces; Ashiton *et al.,* (2011); Otupiri *et al.,* (2012); Oladeinde *et al.,* (2012) and Ezzati *et al.,* (2002) but was against what Elbadr *et al.,* (2011) and Al serouri *et al.,* (2002) in Taiz-Yemen. Other studies conducted by Tatala *et al.,* (1998) in Lindi and Stoltztus *et al.,* (1997) in Zanzibar both in Tanzania also found significant association $P<0.001$ between malaria and anaemia. The insidious nature of malaria presentation means that low-to-moderate degrees of anaemia frequently remain undetectable and untreated by health care providers in the community (Philips-Howards *et al.,* 2003; Schellenberg *et al.,* 2003). Other studies though associate anaemia with other factors such as iron, folate and vitamin deficiencies, worm infestations, HIV/AIDS and haemoglobinopathies (WHO/UNICEF, 2001 and Lozoff *et al.,* 2000). Iron deficiency has an adverse effect on child health development and survival. WHO

(2011) guideline recommends that routine iron supplementation should be given to children aged 6 months to 24 months living in an area where malaria prevalence is 40% or more. Alterations of iron metabolism in human host are however, thought to increase resistance to infection by restricting the availability of iron microorganisms and of iron supplementation of malaria and other infectious diseases Crawley (2010). Malaria causes destruction of red blood cells that are parasitized, which can lead to haemolytic anaemia (Latham, 1997). One randomized study concluded that approximately 60% of anaemia in infancy could be prevented by anti-malarial chemoprophylaxis, illustrating the importance of malaria as a cause of anaemia in their work (Menede *et al.*, 1997). The same study also found that iron supplementation reduced incidence of anaemia by 30%. School age children living in areas of low transmission experience as many, if not more clinical attack per a year than children who are exposed to intense perennial transmission. Incidence rate is positively associated with an increased probability of exposure. Anaemia resulting from persistent parasitaemia may affect concentration and performance although the impact is thought to be minimal compared with iron deficiency anaemia (Holding and Snow, 2001). In contrast, in areas of low or unstable transmission, persistent malaria attack exerts direct as well as indirect effects. Among pre-school children with little immunity, *Plasmodium* infections and clinical attacks are also associated with more anaemia. Although malaria plays a key etiologic role in anaemia in endemic countries like Nigeria, it was clear that other factors make up important additional contributions. Socio-economic status can also affect the risk of anaemia by affecting nutritional status, family size and birth interval, as well as intensifying problems of affordability and accessibility of preventive and curative measures. The children with lower packed cell volume (PCV) 28 had malaria. This showed that malaria parasite positive cases were associated with low packed cell volume (PCV). Malaria parasite exacerbates anaemia giving a significant result when compared to children negative to malaria parasite Oseghale *et al.*, (2012). Similar finding has previously been reported by Van den Broek and Letsky (2000). Observations from this study showed that children in rural areas are more infected with malaria than those in urban areas. Young children from rural areas have been reported to be principal victims of malaria (Nkuo-Akenji *et al.*, 2006) and anaemia (Ekvalli *et al.*, 2001). Anaemia was equally assessed in terms of the packed cell volume (PVC) and all the children involved in the study have anaemia except few. Anaemia range in this study in terms of PVC rating was between 20-36%.

The study showed that on average the pre-school children can experience at least 4 episodes of malaria attack in relation to age per a year on bi- monthly basis. Ages 3 and 5 years have slightly higher number (5). In most local environment like the study area, children of pre-school age mainly males between the ages of 3-5 years are often seen wearing panties or completely naked playing around the environment than their female counterparts; thus exposing their body to frequent mosquito bite, the immune status of the children, the endemicity of the study area or it could be by chance. The study also observed that after the children with malaria infection were treated with artermether-lumefantrin (Coartem) each time, there were remarkable reductions of parasite load in the children previously treated with the drug against the new cases in the preceding month and a corresponding increase in the mean haemoglobin values. This suggests that the treatment and hence parasite clearance may have contributed to the rise in the post treatment haemoglobin concentrates. This was consistent with an improvement of Hb concentrations following treatment with ACTs (Koran *et al.,* 2002).

Males (5) experienced more episodes of malaria infection attack than the females (4) counterparts though not statistically significance P>0.05. This finding was in support of the result of Olasehinde *et al.,* (2013) who recorded higher incidence for females (15.5%) than in males (11%) in their study on incidence of *P. falciparum* infection in asymptomatic rural Nigeria population. The impact of repeated malarial episodes is thought to have detrimental effects on the development of the child, particularly in his/her mental and cognitive function (Ferdinando *et al.,* 2003; Siane *et al;* 2004). Other studies suggest that repeated malaria attack can account for up to 8% of school absenteeism (Brooker *et al.*, 2000). Although in the school, performance of a child depends on multiple factors, repeated absenteeism from school due to malaria significantly affects his/her performance (Jukes, 2005; Sternberg *et al.,* 2001).

There is a very strong association between total incidence and positive cases of malaria P=0.000. This occurrence could be as a result of the endemic nature of the study area, the availability of vectors abundance as a result of existing favourable climatic conditions that encourages its spread thus aiding the steady transmission in the area. The age groups 1-5 years were more prone to play outside to the close watch of their mothers and as such they are more likely to be susceptical to constant malaria attck.

From the study, it was observed that the children experienced higher prevalence of malaria infection from the months of March (41.6%), April (42.0%), May (42.4%), June (44.0%), July (47.3%), August (44.1%) and September (41.1%) which are rainy season within the study area. The months of October, November, December and January were the dry season period and thus experienced reduction in the amount of rainfall. Malaria infection is higher during the rainy season than the dry season in the study area.

The result of this work was in agreement with the findings on seasonal variation of malaria infection in Benin City, Nigeria by Enosolease and Awodu (2003). Eneanya (1998) recorded higher prevalence of malaria in a study among residents in a semi-urban community in South Eastern, Nigeria. Ali *et al.,* (2013) in seasonal prevalence of malaria in a district hospital in N'Djamena, Chad, recorded 44.2% prevalence during rainy season and 37% during the dry season and Opara *et a*l., (2011) recorded higher rate of malaria infection among rural farmers in Ebonyi State during the rainy season. Reports from other African countries and Asian countries such as India, Pakistan, and China support seasonal tie with malaria parasitaemia (Yohannes *et al.,* 2000). Onyido *et al.,* (2009b) stated that the attributes of rate of exposure of the inhabitants to vector bites due to the nature of work and standard of living form a factor in the transmission pattern of the disease. Though similar work conducted in Cameroon by Atangana *et al.,* (2009) revealed that the peak malaria transmission occurred in dry season. Otupiri *et al.,* (2012) reported that malaria parasite prevalence was significantly higher during the wet season (69%) than the dry season (43%); Nkuo-Akenji *et al.,* (2006) and Oladeinde *et al.,* (2012) reported similar observations in their various studies. Ali *et al.,* (2013) noted 98% in their study on seasonal prevalence on malaria. The transmission of malaria seems to occur throughout the year; it showed marked seasonal influence with the peak of transmission in July which was one of the months in rainy season. The reason for this could be as a result that most communities in Aguata area are well known for storing and reserving water in dug wells, septic tanks, drums and other containers during the rainy season for use in dry season. Potholes of water along all the roads, pathways, gutters and empty containers dropped indiscriminately all over the environment; overgrown bushes, grasses and farming activities are common sight during rainy season. These formed a perfect breeding ground for the malaria vector and hence high parasite transmission. World Health Organization (1995) stated that in places like Nigeria, there are higher breeding rate of malaria vectors due to rainfall patterns of the area and that the amount of rainfall determines the abundance of mosquito breeding sites. This issue of variation in climatic

condition of the environment seems to support the development of fertile ground for mosquito breeding which encourages high transmission level of malaria parasites during the wet season March-October in Aguata L.G.A of South Eastern Nigeria with its peak transmission in July. Sutherst (2004) noted that climate is an important determining factor in the distribution of vectors and pathogens. The change in climatic condition affects the rate of incidence of transmissible diseases. Onyido *et al.,* (2009) however noted that temperature, rainfall, and relative humidity are factors of mosquito development as well as an indicator of *Plasmodium* parasite development within the mosquito vector. . Reports from other African countries and Asian countries such as India, Pakistan, and China support seasonal tie with malaria parasitaemia (Yohannes *et al.,* 2000). Onyido *et al.,* (2009b) stated that the attributes of rate of exposure of the inhabitants to vector bites due to the nature of work and standard of living form a factor in the transmission pattern of the disease. Though similar work conducted in Cameroon by Atangana *et al.,* (2009) revealed that the peak malaria transmission occurred in dry season. Otupiri *et al.,* (2012) reported that malaria parasite prevalence was significantly higher during the wet season (69%) than the dry season (43%); Nkuo-Akenji *et al.,* (2006) and Oladeinde *et al.,* (2012) reported similar observations in their various studies. Ali *et al.,* (2013) noted 98% in their study on seasonal prevalence on malaria. The transmission of malaria seems to occur throughout the year; it showed marked seasonal influence with the peak of transmission in July which was one of the months in rainy season. The reason for this could be as a result that most communities in Aguata area are well known for storing and reserving water in dug wells, septic tanks, drums and other containers during the rainy season for use in dry season. Potholes of water along all the roads, pathways, gutters and empty containers dropped indiscriminately all over the environment; overgrown bushes, grasses and farming activities are common sight during rainy season. These formed a perfect breeding ground for the malaria vector and hence high parasite transmission. World Health Organization (1995) stated that in places like Nigeria, there are higher breeding rate of malaria vectors due to rainfall patterns of the area and that the amount of rainfall determines the abundance of mosquito breeding sites. This issue of variation in climatic condition of the environment seems to support the development of fertile ground for mosquito breeding which encourages high transmission level of malaria parasites during the wet season March-October in Aguata L.G.A of South Eastern Nigeria with its peak transmission in July. Sutherst (2004) noted that climate is an important determining factor in the distribution of vectors and pathogens. The change in climatic condition affects the rate of incidence of

transmissible diseases. Onyido *et al.,* (2009) however noted that temperature, rainfall, and relative humidity are factors of mosquito development as well as an indicator of *Plasmodium* parasite development within the mosquito vector. In areas of intense transmission, children gradually acquire immunity that protects them from severe malaria attack and death (Snow and March, 2002). The bulk of malaria morbidity and mortality were concentrated in pre-school age children (Siane *et al.,* 2004).

Plasmodium falciparum was the only malaria species found among the children in this study area. Uzoegwu and Onuwurah (2003) reported only *Plasmodium falciparum* infection in Old Aguata Division, Anambra State, Nigeria. Oladeind *et al.,* (2012) in a study on malaria and anaemia among children in a low resource setting in Nigeria found only *P. falciparum*. Mbanugo and Ejims (2000) recorded only *P. falciparum* in their study at Awka. Aribolor *et al.,* (2003) reported same in Azia. *P.* f*aciparium* was the main malaria species confined wholly in tropics and subtropics (Ukpai and Ajoku, 2001) and as such the observation made was not surprising that *P. falciparum* was the only species encountered. *P. falciparum* accounts for most of the infection in Africa and over one third of the infection in the rest of the world (Ukpai and Ajoku, 2001). In all the African tropical countries, *Plasmodium falciparum* was the most common species responsible for malaria infection. The reason for the dorminance of *falciparum* species in this area could be attributed to the presence of adequate climatic and environmental conditions that favour the habitation for the vectors. In a cross sectional survey in Gambia, *Plasmodium falciparum* was the predominant species in children accounting for 96% of all infections (Alonso *et al.,* 2002). During a four month period of intensive parasitological and clinical monitoring in Senegal, 99% of the thick blood films taken in from children 2-4 years of age showed the presence of *P. falciparum* trophozoite. Malaria is holoendemic in Nigeria with *P. falciparum* as the dominant species (Ukpai and Ajoku, 2001).

The overall prevalence of malaria infectin was 47.3% based on microscopy. This prevalence was similar to overall prevalence of (47.95%) by Uzoegwu and Onwurah (2003) in their study on prevalence of haemoglobinopathy and malaria diseases among the under five in the population of Old Aguata division, Anambra state, Nigeria. Mbanugo *et al.,* (2000) reported 58% for children under five years in Awka; Opara *et al.,* (2011) reported 79.1% in Ebonyi State and 80.4% by

Kalu *et al.,* (2012) in Abia State, 43.1% by Uzochukwu *et al.,* (2010) in Enugu – East Local Government Area of Enugu State, all in the Southeastern part of Nigeria; 42% by Mockenhacept *et al.,*(2000) for the under five years in Ghana; and 50% by Okonkwo *et al.,* (2010) in Ibadan South-West Nigeria, 61% in Abuja by Mature *et al.,* (2001). Other reports included 6% by Ahmed *et al.,* (2001) in Maiduguri; 27.3% by Abdullahi *et al.,* (2009) in Sokoto State. The variations in malaria prevalence may be attributed to differences in climatic factors and behavioural patterns of people in the area which promote mosquito breeding and susceptibility of the people to mosquito bites and equally encourages the proliferation and survival of the vectors. Aguata local government area have an annual rainfall which supports females' Anopheline existence compared to what was obtainable in the Northern regions of the country such as Guasu, Sokoto, Katsina, Maiduguri, and Mubi which are best described as hot and dry regions with scanty amount of rainfall annually. The high prevalence of malaria in the towns/cities may be due to the factors such as higher seasonal amount of rainfall, relative humidity, temperature, over-crowded human populations, and availability of breeding sites for malaria vectors, extent of urbanization, and the behavioural attitude of the inhabitants of the areas. The higher prevalence recorded in Aguata L.G.A among the children in the study even though they were healthy individual (asymptomatic) invariable showed that climatic factors, nature of the area whether rural or urban as well as behavioural attitudes of people directly or indirectly contributed to malaria prevalence or it could be by chance.

In this study, the females (53.5%) had the highest prevalence of malaria parasites than the males (46.5%) and difference was statistically significant. The report agrees with the findings of Kalu *et al.,* (2012): and Okonkwo *et al.,* (2010) who recorded higher prevalence in malaria in females than males in Aba and Umuahia in Abia State and Ibadan in Oyo State on malaria prevalence among the under five children. Females (10.5%) had a higher prevalence of malaria compared to their male (10.0%) counterparts by Oseghale *et al.,* (2012) in their work in Ekpoma, Edo state equally agrees with the finding; but contrast with the findings of Nwaorgu and Orajaka (2011) on prevalence of malaria among children 1-10 years old in communities in Awka North L.G.A who recorded that males (59.2%) had a higher malaria prevalence than females (57.20%); the prevalence of malaria among females in this study was highly statistically significant as against Mbanugo and Ejim (2000) who reported that sex did not affect the prevalence of malaria among

children and Ukpai and Ajoku (2001) in Okigwe and Owerri in Imo State. The higher prevalence of malaria parasite in females as recorded in this study could be attributed to the differences in immunity level, dressing mode of females that seems to show the legs and hands of these girls, parental attention and behaviour towards the care of the children in relation to exposure with the environment.

Prevalence of malaria infection was highest in the month of July (47.3%) followed by August (44.7%), May (44.4%) and June (44.0%) respectively. The months of January (32.9%), February (36.7%), October (31.1%), November (31.1%) and December (30.0%) experienced reduction in the prevalence of malaria infection. The reason for this observation could be attributed to the climatic and environmental conditions that favour the breeding of the vectors that may result in high transmission of the malaria infection among the children in the months ofAugust, May and June respectively. On the other hand , the drop in the amount of rainfall and other cocomitant conditions that favour the habitation of the female Anopheles' mosquitoes were not adequate and hence less transmission of malaria infection during the months of January, February, October, November and December.

Females (25.6%) had higher infection than the males (24.8%) in the July though not statistically significant $P>0.05$. The condition possibly could be as a result of pattern in the mode of dressing the females which may constantly expose greater part of their body to mosquito bites or could be by chance.

The age 2 years old recorded higher malaria prevalence 85(18.9%) which was followed by 3 years 83(18.4%) and 4 years 65(14.4%) respectively for the month of July. Prevalence for 1 year old did not exceed 2.5%. There was a drop by 5 years 24(5.3%). This report was not in agreement with the reports of Akinbo *et al.,* (2009) who reported that the higher prevalence was found in children aged 1 year in their study on prevalence of malaria and anaemia among the under five children in Tertiary hospital in Benin City, Edo State, Nigeria. This finding was partly in support of Fowowe (2011) which stated that malaria parasitaemia and anaemia reduce by the age 5 years in their work on malaria: a major cause of anaemia among the under five children on hospital bed in a State Specialist hospital, Ondo, Ondo State; indeed malaria parasitaemia was a significant risk factor for acquiring anaemia in children Olademide *et al.,* (2012). Reports had it that children born to immune mothers are protected against malaria parasite during their first year of life by maternal antibodies. This could be the reason for the low malaria infection

reported among the age I year olds. As these children grow and develop and encounter series of attack of malaria parasite episodes, they acquire immunity against the disease such that they become relatively protected against the disease and blood stage parasites (Plebanski and Hill, 2000); and usually children acquire active immunity to malaria gradually. Although it has been established that residual immunity derived from mothers could be very effective in younger children but environmental condition and inability of children of this age in the study area to ward-off environmental induced mosquito attack predisposed them to malaria attack. Age was significant risk factor for malaria parasite infection among children. This is consistent with the report of Gahuta *et al.,* (2011) on risk factors of malaria among children in Southern highland of Rwanda.

The correlation of malaria parasite positive cases with body temperature, the age group with higher body temperation who had malaria are the 2 years old (34.9%) which was closely foll owed by 4 years old (25.6%) and1 year olds (2.3%). Ejezie and Ezedinachi, (1992) reported that the number of children with parasite density of 100,000/sq.mm increased progressively with body temperature in their study on malaria parasite density and body temperature in children under 10 years of age in Calabar, Nigeria. The reason for the result could be as a result of level of exposure of these children to the environmental hazards. Fever due to malaria may be continuous, intermittent, remittent, irregular, or absent.

In contributory risk of malaria parasite positive cases to body temperature, it was observed that children with the body temperature = or >37^{o}c were 63.05 times more associated with malaria parasite positive cases than those with body temperature = or <37^{o}c hence malaria parasite infection had a positive correlation with body temperature. With this finding malaria parasite should be suspected in all cases of feverish condition in children less than 5 years old.

In this study fever was observed to be the main symptom of malaria among the pre-school children and closely followed by loss of appetite and weakness of the body. Similar results have been documented in Enugu State (Eneanya, 1996) and Anambra State (Mbanugo and Ejims, 2000). The high proportion of headache and fever attributed to malaria support the policy of presumptive malaria treatment for rural communities of high transmission intensity (Nchinda, 2004). However, this is contrasted by some researchers that fever and headache may also be

attributed to other diseases or environmental and psychological factors (Oliver *et al.*, 1991). Malaria is generally known to be a febrile illness characterized by fever and related symptoms. Fever due to malaria tends to be paroxysmal by anaemia and splenomegally and often by symptoms resulting from lesions of particular organs (Jellife, 2000). Therefore, according to WHO (2001) malaria must be suspected in all cases of fever in endemic areas until proven otherwise.

CONC LUSION

This work on malariainfection, incidence and anaemia among the pre-school children in Aguata L.G.A over a one year period just concluded has demonstrated that the overall prevalence of malaria parasite was 47.3% and anaemia 96.7%. Several factors contribute to anaemia in children in African countries but malaria remains the number one risk factor. The low haemoglobin and packed cell volume observed in the infected children in this work showed that malaria plays an important role in causing anaemia in pre-schildren children. There were strong correlations between malaria parasite positive cases with anaemia as well as body temperature with malaria positive cases $P>0.05$. Age and sex were significant factors in malaria parasite infection $P>0.05$. Females (53.5%) showed higher prevalence of malaria parasite than the males (46.5%). The highest incidence of malaria parasite was recorded in July which was a wet season in the study area and least in December which was in dry season indicating that the incidence of malaria was higher during the rainy season than in the dry season periods. The high incidence in July could be attributed to seasonal variations in climatic conditions leading to the abundance of malaria vectors thus high transmission of the parasite in the locality. This also showed that climate of the area determines the rates of transmission and subsequent episodes of malaria attack possibly as a result of presences of vector abundance during the rainy season. A child can experience at least 4-5 episodes of malaria parasites attack per a year on bi- monthly basis and the contributory risk of malaria to body temperature was 63.05 times more associated with positive cases of malaria as well as the relative risk of malaria parasite to anaemia indicated that malaria had 7.3 times chances of causing anaemia; and that children especially the under 5 years are prone to malaria parasite infection with the males showing more severity than the female; therefore there is need for application of control measures to reduce rate of mortality and mobidity attributed to malaria and anaemia.

It was also found that high body temperature was positively correlated with malaria. Children with malaria also had a high level of anaemia. A combination of malaria infection, anaemia and high body temperature tended to increase the morbidty in this age group. There is therefore a need to augument antimalaria drugs with haematinics and antipyretic in the management of malaria infection amongst the pre-school children 1-5 years.

RECOMMENDATIONS

Malaria is the most prevalent infectious disease in sub-Saharan Africa and the study area; and is known to inflict tremendous adverse effects on the physical, social and economical well being of households; and mortality is predominantly among children of age five years and below. Hence effective control measures against the debilitating disease and its associates are however advocated. To this end, the following recommendations were made:

- Pre-school chidren should take regular checkups for the presence of malaria infection so that appropriate measures can be taken to prevent the complications of malaria in children.
- Children of under five should be treated with antimalaria drugs every three months to prevent malaria and to kill (if any) the early stage of malaria parasite.
- The system of EPI (Expanded Programme on immunization) contacts may be a suitable means of raising awareness about anaemia and delivering effective anaemia control interventions.
- Improving diagnosis and treatment in areas of low and unstable transimission where the incidence of clinical attacks in school is greatest.
- Government should subsidized the cost of malaria treatment so that all levels of socioeconomic class can afford to purchase the right drug for the treatment of their children when they fall sick especially the children 1-5 years of age.
- Mass enlightenment on the importance of environmental hygiene and local means of vector control has to be intensified among the people especially the home keepers.
- It is necessary to organize seminars, workshops for communities where possible, on approaches to malaria prevention, control, elimination and possible eradication.
- Removal of all obstacles that provide breeding sites for mosquitoes around the houses and schools such as potholes, cans, used tyres and keep the environment neat.

- Entomological surveys and description of malaria seasonality are essential for planning effective malaria transmission control since higher prevalence seems to occur during the wet seasons than the dry seasons.
- Iron supplementation should not be withheld from children with anaemia in endemic areas and it should made free for all the children within the age bracket of 1-5 years.
- Malaria interventions which include ITNs and ACTs should be more implemented to cover the whole community for more effectiveness.
- Provision of active control measure in schools, such as intermittent preventive treatment of children can potentially lessen the impact of *P. falciparum* malaria thus reducing the consequences of morbidity and mortality among the under five years pre-school children.

Implementation of afore mentioned recommendations toward prevention and control of malaria and its concomitant squeal however depends on the political will of the federal and State governments.

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APPENDIX

TOWNS/COMMUNITIES IN AGUATA L.G.A.

(A) ACHINA

PUBLIC SCHOOLS

S/N	N ame of Schools	Crèche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	Central School	ECC I	13	10	23	40	1-2
		ECC II	9	8	17		2-4
		ECC III	-				-
2	P/S Eke Achina	ECC I	9	8	17	45	1-2
		ECC II	10	6	16		2-3
		ECC III	6	6	12		3-5
3	Progressive School, Achina	ECC I	6	8	14	34	1-2
		ECC II	7	6	13		2-3
		ECC III	4	3	7		3-5
4	Combined P/S Akpo/Achina	ECC I	10	8	18	52	1-2
		ECC II	12	7	19		2-3
		ECC III	6	9	15		3-5
5	Udoka School Akpo/Achina	ECC I	8	9	17	36	1-2
		ECC II	7	5	12		2-3
		ECC III	4	3	7		3-5
	PRIVATE SCHOOLS						
6	Mercy P/S Achina	ECC I	13	11	24	66	1-2
		ECC II	15	9	24		2-3
		ECC III	10	8	18		3-5
7	Evangel P/S Achina	ECC I	14	12	26	65	1-2
		ECC II	12	7	19		2-3
		ECC III	12	8	20		3-5
8	Christ Church Model P/S Achina	ECC I	10	7	17	66	1-2
		ECC II	13	11	24		2-3
		ECC III	13	12	25		3-5
9	St. Mary's P/S Achina	ECC I	18	14	32	95	1-2
		ECC II	20	16	36		2-3
		ECC III	18	9	27		3-5
	TOTAL		279	220		499	

(B) AGULUEZECHUKWU

PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	Central School	ECC IA	30	17	47	173	1-2
		ECC IB	20	18	38		1-2
		ECC II	44	15	59		2-4
		ECC III	17	12	29		3-5
2	Community School	ECC I - III	8	5	13	13	1-4
3	Primary School	ECC IA	14	17	31	100	1-2
		ECC IB	7	12	19		1-2
		ECC II	10	15	25		2-3
		ECC III	17	8	25		2-4
PRIVATE SCHOOLS							
4	St. Mary's P/S	ECC I	27	18	45	103	1-2
		ECC II	23	15	38		2-3
		ECC III	12	8	20		3-5
5	St. James P/S	ECC I	17	14	3	65	1-2
		ECC II	12	7	19		2-3
		ECC III	9	6	15		3-5
	TOTAL		297	192		459	

(C) AKPO

PUBLIC SCHOOLS

S/N	Name of Schools	Creche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	Central School	ECC I	19	14	33	91	1-2
		ECC II	16	11	27		2-3
		ECC III	17	14	31		3-5
2	Egbuike P/S	ECC I	3	5	8	26	1-2
		ECC II	3	4	7		2-3
		ECC III	5	6	11		3-5
PRIVATE SCHOOLS							
3	St. Paul's P/S	ECC I	25	19	44	97	1-2
		ECC II	18	15	33		2-3
		ECC III	11	9	20		3-5
4	St. Peter's P/S	ECC I	22	18	40	79	1-2
		ECC II	13	10	23		2-3
		ECC III	9	7	16		3-5
	TOTAL		161	132		293	

(D) AMESI

PUBLIC SCHOOLS –

S/N	Name of Schools	Crèche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	Central School	ECC I	8	12	20	54	1-2
		ECC II	12	10	22		2-3
		ECC III	5	7	17		3-5
2	Community School	ECC I	8	6	14	40	1-2
		ECC II	5	9	14		2-3
		ECC III	9	3	12		3-5
PRIVATE SCHOOLS							
3	Angel of Peace	ECC I	15	10	25	59	1-2
		ECC II	11	9	20		2-3
		ECC III	8	6	14		3-5
4	St. Peter's P/S	ECC I	21	18	39	80	1-2
		ECC II	16	8	24		2-3
		ECC III	10	7	17		3-5
	TOTAL		128	105		233	

(E) EKWULOBIA

PUBLIC SCHOOLS-

S/N	Name of Schools	Crèche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	P/S Agba	ECC I	12	5	17	48	1-2
		ECC II	10	10	20		2-3
		ECC III	5	6	11		3-5
2	Central School	ECC IA	16	12	28	146	1-2
		ECC IB	18	11	29		1-2
		ECC IIA	7	18	25		2-3
		ECC IIB	8	11	19		2-3
		ECC IIIA	11	14	25		3-5
		ECC IIIB	8	12	20		3-5
3	Community School	ECC IA	33	35	68	311	1-2
		ECC IB	20	20	40		1-2
		ECC IIA	36	33	69		2-3
		ECC IIB	35	20	55		2-3
		ECC III	33	36	69		3-5
4	Efosie School Umuchiwa Ekwulobia	ECC I	7	13	20	73	1-2
		ECC II	8	13	21		2-3
		ECC III	16	16	32		3-5
5	P/S Eziagulu	ECC I	15	21	36	104	1-2
		ECC II	18	14	32		2-3
		ECC III	18	18	36		3-5
6	Nwannebo	ECC IA	17	18	35	167	1-2

	P/S Ula	ECC IB	18	15	33		1-2
		ECC IIA	12	13	25		2-3
		ECC IIB	11	12	23		2-3
		ECC III	27	24	51		3-5
7	Umuezenafo School	ECC I	8	9	17	55	1-2
		ECC II	8	10	18		2-3
		ECC III	7	13	20		3-5
PRIVATE SCHOOLS							
8	All Saint's P/S	ECC I	47	46	93	271	1-2
		ECC II	45	41	86		2-3
		ECC III	43	49	92		3-5
9	St. Joseph's P/S	ECC I	47	44	91	282	1-2
		ECC II	48	41	89		2-3
		ECC III	50	52	102		3-5
10	Immaculate Heart P/S Ula	ECC I	22	21	43	177	1-2
		ECC II	21	21	42		2-3
		ECC III	23	21	44		3-5
		Creche	28	20	48		1-2
11	Christ the King P/S Umuchi	ECC I	23	20	43	125	1-2
		ECC II	19	22	41		2-3
		ECC III	21	20	41		3-5
12	First Hill P/S Umuchina	ECC I	30	33	63	147	1-2
		ECC II	23	21	44		2-3
		ECC III	21	19	40		3-5
13	Goodness P/S, Nkono	ECC IA	9	14	23	171	1-2
		ECC IB	10	11	21		1-2
		ECC IIA	7	14	21		2-3
		ECC IIB	11	9	20		2-3
		ECC IIIA	14	10	24		3-5
		ECC IIIB	15	9	24		2-5
		Creche	18	20	38		1-2
14	St Anthony's P/S Okpo	ECC I	30	25	55	160	1-2
		ECC IIA	14	13	27		2-3
		ECC IIB	12	13	25		2-3
		ECC IIIA	15	13	28		3-5
		ECC IIIB	18	7	25		3-5
15	African Pride International Umuchina	ECC I	27	30	57	146	1-2
		ECC II	20	21	41		2-3
		ECC III	25	23	48		3-5
16	Concept P/S Okpa	ECC I	13	13	26	68	1-2
		ECC II	11	12	23		2-3
		ECC III	10	9	19		3-5
17	St. Luke's P/S Ituokpala	ECC I	8	10	18	47	1-2
		ECC II	6	7	13		2-3
		ECC III	10	6	16		3-5
18	Our Lord's Livingstone Agba	ECC I	23	8	31	151	1-2
		ECC II	20	17	37		2-3
		ECC III	19	18	37		3-5

		Creche	23	23	46		1-2
19	St Paul's P/S Umuchina	ECC I ECC II ECC III	3 2 2	2 - 1	5 2 3	10	
20	New Generation P/S, Agba	ECC I ECC II ECC III	13 11 9	15 14 8	28 25 17	70	1-2 2-3 3-5
	TOTAL		1,634	1,095		2,729	

(F) EZINFITE

PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex		Number on Roll	Total	Age (years)
			Male	Female			
1	Akpunoji P/S	ECC I ECC II ECC III	4 7 3	5 8 5	9 15 8	32	1-2 2-4 3-5
2	Annuli Community P/S	ECC I ECC II ECC III	21 13 17	14 11 11	35 24 28	87	1-2 2-3 3-5
3	Central School	ECC I ECC II ECC III	26 13 10	24 18 12	50 31 22	103	1-2 2-3 3-5
4	Igwebuike P/S	ECC I ECC II ECC III	17 12 7	6 8 6	23 20 13	56	1-2 2-3 3-5
5	Nwahia P/S	ECC I ECC II ECC III	8 6 6	12 6 11	28 12 17	57	1-2 2-3 3-5
6	Ogbugbogu Community	ECC I ECC II ECC III	8 5 9	3 8 2	11 13 11	35	1-2 2-3 3-5
7	Town School	ECC I ECC II ECC III	9 4 9	10 6 8	19 10 17	46	1-2 2-3 3-5
PRIVATE SCHOOLS							
8	Madonna P/S	ECC I ECC II ECC III Crèche	26 18 12 13	24 16 12 11	50 34 24 24	132	1-2 2-3 3-5
9	Immanuel P/S	ECC I ECC II ECC III	14 10 13	15 12 11	29 22 24	75	1-2 2-3 3-5
	TOTAL		328	295		623	

(G) IGBO-UKWU

PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex		Number on Roll	Total	Age (years)
			Male	Female			
1	AmakpuNgo	ECC IA	15	11	26	117	1-2
		ECC IB	16	11	27		1-2
		ECC II	17	13	30		2-4
		ECC III	18	16	34		3-5
2	Central School	ECC IA	16	11	27	150	1-2
		ECC IB	15	10	25		1-2
		ECC IIA	15	10	25		2-3
		ECC IIB	16	22	38		2-3
		ECC III	21	14	35		3-5
3	Community School, Obiuno	ECC I	3	8	11	31	1-2
		ECC II	3	4	7		2-3
		ECC III	7	6	13		3-5
4	Ezihu P/S	ECC I	4	2	6	19	1-2
		ECC II	5	2	7		2-3
		ECC III	3	3	6		3-5
5	P/S Ngo	ECC IA	20	16	36	128	1-2
		ECC IB	21	16	37		1-2
		ECC II	16	14	30		2-3
		ECC III	12	13	25		3-5
6	Obigbo Central School	ECC I	13	15	28	42	1-2
		ECC II	4	3	7		2-3
		ECC III	3	4	7		3-5
7	Ogwugwu Agu Community	ECC I	10	11	21	53	1-2
		ECC II	8	7	15		2-3
		ECC III	9	8	17		3-5
8	P/S Obiuno	ECC I	8	6	14	44	1-2
		ECC II	9	5	14		2-3
		ECC III	8	8	16		3-5
9	P/S Ifite	ECC I	32	26	58	103	1-2
		ECC II	14	12	26		2-3
		ECC III	9	10	19		3-5
10	Town School	ECC IA	23	15	38	136	1-2
		ECC IB	15	23	38		1-2
		ECC II	15	17	32		2-3
		ECC III	13	15	28		3-5
11	Union P/S	ECC I	10	15	25	76	1-2
		ECC II	12	14	26		2-3
		ECC III	15	10	25		3-5
PRIVATE SCHOOLS							
12	Future Hope	ECC I	15	9	24	66	1-2

	P/S	ECC II ECC III	13 10	11 8	24 18		2-3 3-5
13	Further Hope P/S	ECC I ECC II ECC III	10 10 8	7 11 8	17 21 16	54	1-2 2-3 3-5
14	Fatima P/S	ECC I ECC II ECC III	16 10 12	12 13 9	29 23 21	72	1-2 2-3 3-5
15	Good Shepherd P/S	ECC I ECC II ECC III	25 20 18	18 21 20	43 41 38	122	1-2 2-3 3-5
16	Holy Family P/S	ECC IA ECC IB ECC IIA ECC IIB ECC III Creche	20 22 25 21 22 30	18 20 25 19 18 -	38 42 50 40 40 30	240	1-2 1-2 2-3 2-3 3-5 1-2
17	Our Saviour P/S	ECC I ECC II ECC III	20 19 17	22 15 16	42 34 33	109	1-2 2-3 3-5
18	Model P/S	ECC I ECC II ECC III	14 8 10	11 10 10	25 18 20	63	1-2 2-3 3-5
	TOTAL		868	759		1,627	

(H)IKENGA
PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex		Number on Roll	Total	Age (years)
			Male	Female			
1	Community School	ECC IA ECC IB ECC II ECC III	11 20 18 14	10 16 10 13	21 36 28 27	122	1-2 1-2 2-4 3-5
PRIVATE SCHOOLS							
2	St. Anthony's P/S	ECC I ECC II ECC III	21 20 18	19 22 15	40 42 33	115	1-2 2-3 3-5
			122	124		237	

(H) ISUOFIA
PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex		Number on Roll	Total	Age (years)
			Male	Female			
1	Amooji School	ECC IA ECC IB	15 14	12 16	27 30	135	1-2 1-2

		ECC II	20	23	43		2-4
		ECC III	23	12	35		3-5
2	Central School	ECC I	25	20	45	100	1-2
		ECC II	18	17	35		2-3
		ECC III	11	9	20		3-5
3	Community	ECC I	17	12	29	61	1-2
	School	ECC II	9	12	21		2-3
		ECC III	8	3	11		3-5
4	Ikeme School	ECC I	17	27	44	80	1-2
		ECC II	11	4	15		2-3
		ECC III	15	6	21		3-5
5	Primary	ECC I	14	11	25	70	1-2
	Schools	ECC II	15	10	25		2-3
		ECC III	11	9	20		3-5
PRIVATE SCHOOLS							
6	Holy Child	ECC IA	14	12	26		1-2
	P/S	ECC IB	13	13	26		1-2
		ECC IIA	14	15	29		2-3
		ECC IIB	16	15	31	191	2-3
		ECC IIIA	13	14	27		3-5
		ECC IIIB	17	10	27		3-5
		Crèche	15	10	25		1-2
8	Unique P/S	ECC I	21	28	49		1-2
		ECC II	37	28	65	174	2-3
		ECC III	28	32	60		3-5
9	Model P/S	ECC I	40	16	56		1-2
	Ezioka,	ECC II	15	15	30		2-3
	Isuofia	ECC III	14	10	24		3-5
	TOTAL		500	421			

(J)NKPOLOGWU
PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex		Number on Roll	Total	Age (years)
			Male	Female			
1	Central School	ECC I	7	3	10	22	1-2
		ECC II	3	2	5		2-4
		ECC III	3	4	7		3-5
2	Community	ECC I	10	11	21	150	1-2
	School	ECC II	5	7	12		2-3
		ECC III	6	6	12		3-5
3	Primary	ECC I	13	8	21	53	1-2
	School	ECC II	12	7	19		2-3
		ECC III	6	7	13		3-5
PRIVATE SCHOOL							
4	St Micheal's	ECC I	18	17	35	87	1-2

	P/S	ECC II ECC III	16 11	12 13	28 24		2-3 3-5
5	Emmanuel P/S	ECC I ECC II ECC III	15 10 14	12 7 16	27 17 30	74	1-2 2-3 3-5
	TOTAL		149	132		281	

ORAERI (K)
PUBLIC SCHOOLS –

S/N	Name of Schools	Creche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	Central School	ECC I ECC II ECC III	12 12 15	15 13 10	27 25 25	77	1-2 2-4 3-5
PRIVATE SCHOOLS							
2	St Mary's P/S	ECC I ECC II ECC III	18 12 18	14 15 11	32 27 29	88	1-2 2-3 3-5
	TOTAL		87	78		165	

(L) UGA
PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex Male	Female	Number on Roll	Total	Age (years)
1	Central School	ECC I ECC II ECC III	12 10 8	12 01 4	24 11 12	47	1-2 2-4 3-5
2	Community School, Umueze	ECC I ECC II ECC III	13 11 8	12 1 5	25 12 13	50	1-2 2-3 3-5
3	Ezinkwo P/S Umueze	ECC I ECC II ECC III	6 6 5	9 4 6	15 10 11	36	1-2 2-3 3-5
4	Mbalaoye P/S	ECC IA ECC IB ECC II ECC III	12 12 13 9	13 11 7 10	25 23 20 19	87	1-2 1-2 2-3 3-5
5	Nwagwazi P//S	ECC 1 ECC II	13 10	12 10	25 20	70	1-2 2-3

		ECC III	14	11	25		3-5
6	Oganiru School	ECC I	6	7	13	36	1-2
		ECC II	9	4	13		2-3
		ECC III	8	2	10		3-5
7	Oka Community School	ECC I	18	19	37	78	1-2
		ECC II	7	16	23		2-3
		ECC III	15	3	18		3-5
8	Okwute School	ECC I	9	6	15	38	1-2
		ECC II	5	6	11		2-3
		ECC III	9	3	12		3-5
9	Otiogbata School	ECC I	19	19	38	66	1-2
		ECC II	7	9	16		2-3
		ECC III	9	3	12		3-5
PRIVATE SCHOOLS							
10	Immaculate Heart P/S Umueze	ECC IA	17	10	27		1-2
		ECC IB	15	11	26		1-2
		ECC II	22	28	50	147	2-3
		ECC IIIA	12	10	22		3-5
		ECC IIIB	11	11	22		3-5
11	Our Lady of Waldenstein Nur/Pri Sch Oka	ECC IA	19	11	30		1-2
		ECC IB	14	12	26		1-2
		ECC II	23	23	46	193	2-3
		ECC III	22	24	46		3-5
		Creche	25	20	45		3-5
12	St. James AwalaP/S Uga	ECC I	15	10	25	103	1-2
		ECC II	15	15	30		2-3
		ECC III	15	7	22		3-5
		Crèche	15	11	26		1-2
	TOTAL		569	469		1,038	

(M) UMUCHU
PUBLIC SCHOOLS

S/N	Name of Schools	Crèche/Nursery Classes	Sex		Number on Roll	Total	Age (years)
			Male	Female			
1	Central School	ECC I	8	7	15	40	1-2
		ECC II	7	5	12		2-3
		ECC III	6	7	13		3-5
2	Central School, Ibughugbu	ECC I	16	9	25	72	1-2
		ECC II	9	13	22		2-3
		ECC III	7	18	25		3-5
3	Community School	ECC I	19	36	55	96	1-2
		ECC II	11	10	21		2-3
		ECC III	11	9	20		3-5
4	Community Sch. Achala	ECC I	15	15	30	82	1-2
		ECC II	15	15	30		2-3
		ECC III	13	9	22		3-5

5	Community Sch. Ibughugbu	ECC I ECC II ECC III	11 10 7	9 7 8	20 17 15	53	1-2 2-3 3-5
6	Mbarafor Akukwa	ECC I ECC II ECC III	23 10 10	13 04 7	36 14 17	67	1-2 2-3 3-5
7	Ogbarimgba Akukwa School	ECC I ECC II ECC III	15 10 10	5 6 4	20 16 14	50	1-2 2-3 3-5
8	Primary School	ECC I ECC II ECC III	11 21 16	10 11 10	21 32 26	79	1-2 2-3 3-5

TOTAL NUMBER OF COMMUNITIES WITHIN THE STUDY AREA

S/N	**Towns/ Communities**	**Number of schools in each community**	**Total number of pupils in school in each community**	**Male**	**Female**	**Average age (yrs)**
1	Achina	9	499	279	220	1-5
2	Aguluezechukwu	5	459	267	197	1-5
3	Akpo	4	293	161	132	1-5
4	Amesi	4	233	128	105	1-5
5	Ekwulobia	20	2,013	1,634	1,095	1-5
6	Ezinifite	9	623	328	295	1-5
7	Igbo-ukwu	18	1,627	868	759	1-5
8	Ikenga	2	237	122	115	1-5
9	Isuofia	8	921	500	421	1-5
10	Nkpologwu	5	281	149	132	1-5
11	Oraeri	2	165	87	78	1-5
12	Uga	13	1,038	569	469	1-5
13	Umuchu	13	900	475	425	1-5
14	Umuona	----	----	----	----	----
	Grand total	**112**	**10,005**	**5,567**	**4,438**	**1-5**

SELECTED TOWNS/COMMUNITIES WITH THE CORRESPONDING NUMBER OF CHILDREN IN THE SCHOOLS

S/N	Name **of Schools**	**Total number of preschool children in each community**	**Males**	**Females**
1	Akpo	293	161	132
2	Ekwulobia	2,013	801	1,212
3	Isuofia	921	321	579
4	Oraeri	165	71	94
5	Uga	1,038	469	569
6	Umuchu	900	425	475
		5,309	**2,248**	**3,061**

SELECTED SCHOOLS FROM EACH TOWN/COMMUNITIES IN AGUATA

S/N	Town/Communities	Total number of schools	Number of selected schools	Total of pupils	Males	Females
1	Akpo	4	4	293	133	160
2	Ekwulobia	20	8	953	397	556
3	Isuofia	8	6	575	280	295
4	Oraeri	2	2	165	72	93
5	Uga	13	6	528	272	256
6	Umuchu	13	8	468	205	263
		60	**31**	**3,002**	**1,335**	**1,665**

NUMBER OF SELECTED SCHOOLS AND THE CORRESPONDING NUMBER OF NUSERY PUPILS (MALES/FEMALES) FROM EACH SCHOOL IN AGUATA L.G.A.

S/N	Community	Number of selected schools	Name of the schools	Total number of pupils	Male	Female	Age
1	Akpo	4;4	St. Peter's p/s	79	44	35	1-5
			Central school	91	52	39	1-5
			Egbuike p/s	26	11	15	1-5
			St. Paul's p/s	97	43	54	1-5
				293	**150**	**143**	
2	Isuofia	8;6	Central school,Isuofia	100	46	54	1-5
			Primary school, Isuofia	70	30	40	1-5
			Community School	61	34	27	1-5
			Ikeme school model p/s	80	43	37	1-5
			Ezioka, Isuofia	110	41	69	1-5
			Unique p/s Isuofia	154	84	90	1-5
				575	**278**	**297**	
3	Oraeri	2;2	Central school	77	39	38	1-5
			St. Mary's p/s	88	40	48	1-5
				165	**79**	**86**	
4	Ekwulobia	20;8	Primary school, Agba Ekwulobia	72	32	40	1 – 5
			Central School Ekwulobia	168	70	98	1 – 5
			Efosie School Umuchina Ekwulobia	95	53	42	1 – 5

			Nwannebo P/S, Ula, Ekwulobia	184	85	99	1 – 5
			Umuezenafo school Ekwulobia	77	40	37	1 – 5
			First Hill P/S, UmuchinaEkwulobia	169	76	93	1 – 5
			Concept P/S Okpo, Ekwulobia	90	40	55	1 – 5
			New Generation P/S Ekwulobia	93	45	48	1 – 5

5		13;6	Central School	47	25	22	1 – 5
			Ezinkwo P/S Umueze	36	17	19	1 – 5
			Mbalaoge P/S	87	40	47	1 – 5
			Oka community school	78	40	38	1 – 5
			Our Lady of WaldersteinNur/PriSch, Oka	193	90	103	1 – 5
			St. James P/S, Awada	87	46	41	1 – 5
				528	**270**	**258**	1 – 5
6	Umuchu	13.8	Central school, Umuahu	40	21	21	1 – 5
			Community School, AchalarUmuchu	52	43	39	1 – 5
			OgharimgbaAkukwa Umuchu	50	15	35	1 – 5
			Primary School, IbaghughuUmuchu	47	25	22	1 – 5
			Ndikfa MFS Umuchu	36	15	21	1 – 5
			MbaraforAkuku, Umuchu	67	24	43	1 – 5
			Holy Name P/S	92	47	45	1 – 5
			Primary School Ekwulobia	79	31	48	1 – 5
				493	22	247	
	Grand Total			**3,002**	**1,335**	**1,665**	