SOCIO-ECONOMIC FACTORS INFLUENCING THE SPREAD OF MALARIA IN LIKONI DIVISION, MOMBASA DISTRICT, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University or any other award.

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To my late parents, Hussein Yusuf and Mwanamisi Mohammed, may Almighty God rest their souls in eternal peace and to my wife, Zaituni Ahmed, for her love, perseverance and support.

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ACRONYMS AND ABBREVIATIONS

AMURT:	Ananda Marga Universal Relief Team
CBS:	Central Bureau of Statistics
DDT:	Dichloro-diphenyl-trichloroethane
GDP:	Gross Domestic Product
HCH:	Hexachlorocyclohexane
HSB:	Health Seeking Behaviour
ICIPE:	International Centre of Insect Physiology and Ecology
IEC:	Information, Education and Communication
IMCI:	Integrated Management of Childhood Illnesses
IPT:	Intermittent Presumptive Treatment
KEMRI:	Kenya Medical Research Institute
MCH:	Maternal and Child Health
MOH:	Ministry of Health
NGO:	Non-Governmental Organisation
OTC:	Over The Counter
PSI:	Population Service International
PVs :	Permanent Vents
RBM:	Roll Back Malaria
ROK:	Republic of Kenya
SP:	Sulfadoxine or Sulfalene - pyrimethamine
UNICEF:	United Nations Children's Fund
VHWs:	Village Health Workers
WHO:	World Health Organisation
WHO/AFRO:	World Health Organisation - Africa Regional Office

DEFINITION OF TERMS

Factor:	Any of the things or matters that cause or influence spread of malaria.
Malaria cases:	Both microscopic and clinically (presumptive) diagnosed malaria cases.
Household:	A single house/structure with the entire occupants and the consideration of its outside compound.
"Homa":	To mean fever, general malaise or high body temperature.

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ABSTRACT

A study to identify socio-economic factors that are important in the spread of malaria was conducted in Likoni Division of Coast Province, Kenya, between April and July 2004. The study focused on knowledge about malaria, preventive measures, health seeking behaviour and the economic factors influencing the community treatment seeking behaviour for malaria. A sample of 400 household heads was studied. An average of 69.75% of the respondents knew the signs and symptoms of the disease. Chi-square test of independence was used to establish the relationship between the level of education and level of knowledge on the cause of malaria and it was significant ($p < 0.001$). The respondents were knowledgeable on the cause of malaria. Out 380 (95%) respondents who mentioned 'mosquito bite' as the cause for malaria, 293 respondents (73.3%) attributed it to other causes as well. Although public health facilities were within easy reach, (1 – 5km) from the respondents' households, self-treatment was very common: of the 400 respondents interviewed, 73.8% treated themselves at home with herbal remedies and/or medicine purchased from local shops, chemists and control programs; 7.8% treated themselves through traditional healers; and 18.5% received treatment at the health facilities. Chi-square test of independence was used to establish the relationship between the level of income and the community seeking health behaviour and it was significant ($p < 0.001$). The most commonly bought drug was Malaratab® a proprietary form of chloroquine, while a small percentage (3%) administered analgesics alone thought to be full doses of treatment. Chi-square test of independence was used to establish the relationship between the level of knowledge on the cause of malaria and knowledge on the breeding sites of mosquitoes and it was significant ($p<0.001$) and the same test was used to establish the relationship between the level of knowledge on the cause of malaria and the preventive measures against malaria and was also significant ($p = 0.003$), but preventive measures were hampered by cost implications. Use of mosquito nets was low (28.15%) and there was low coverage on the under fives (40%). The use of commercial pyrethrum aerosol sprayers/coils was high (35%). Majority of the households did not have soak pits, which are essential for control of mosquito breeding in the community. Chi-square test of independence was used to establish the relationship between the level of income and the preventive measures against malaria and it was significant ($p < 0.001$). The antenatal IPT service for pregnant women faced operational problems. The key economic factors such as unemployment (42.5%) and household financial burden (72.25%) on other expenditures accounted for the residents' failure of acquiring/providing the essentials for malaria control. The major factors identified were the high rate of self-treatment, delay in seeking diagnosis or treatment, low household wealth (poverty), cost consideration of prevention and control measures of malaria and unreliable malaria diagnostic method (presumptive judgement). In addition, there was non-compliance of IPT by pregnant women, antimalarial drug resistance, omissions of vital control measures and Government failure in providing essential commodities for malaria control. The results of this study have important implications in the involvement of the community in the control of malaria and other vector-borne diseases.

CHAPTER 1 : INTRODUCTION

1.1 Background information

Malaria is a febrile illness caused by a protozoan parasite of the genus *Plasmodium* of which four species have been identified that affect humans. These are 1) *Plasmodium falciparum*, 2) *P. ovale*, 3) *P. malariae* and *P. vivax*. However, *P. falciparum* is the most virulent species and predominates in sub-Saharan Africa, Asia, Oceania and the Amazons (WHO, 1998a). The infection is usually transmitted by the bite of an infected female *Anopheles* mosquito (Gilles, 1993; ROK, 2003). The clinical features (signs and symptoms) of malaria include: fever, myalgia, joint pains, chills, splenomegaly, mental confusion, abdominal pain and diarrhoea, nausea and lack of appetite. Fever (or history of fever) within the last 2-3 days is the most important feature of malaria. The fever is divided in three stages: (a) cold, (b) hot and (c) sweating. Malaria is characterized clinically by chills, fever and profuse sweating. Malaria is diagnosed by the clinical symptoms and microscopic examination of the blood smears. The symptoms first appear 10 to16 days after the infectious mosquito bite and coincide with the rupturing of the infected red blood cells (RBCs) (WHO, 1998a).

1.1.1 Malaria susceptibility

In endemic regions where transmission is high people are continuously infected, although some may develop immunity to the disease (Allison, 1984). Susceptibility is universal but children under 5 years old and pregnant women in endemic countries of Africa bear the brunt of the burden of malaria because they have lower immunity to the disease compared to the other people in the same environment (WHO/AFRO,2000; ROK,2003, WHO/UNICEF,2003).

1.1.2 Geographical distribution of malaria

Malaria is widespread throughout the tropical and sub-tropical regions of the world: Africa, Asia and Latin America.

1.1.3 Effects of malaria.

Malaria causes human pain and suffering, impairs health (e.g coma due to cerebral malaria) and causes deaths. It contributes to low birth weight as a consequence of malaria infection in pregnant women (WHO/UNICEF, 2003; RBM/WHO, 1998). Malaria also hampers individual and national prosperity in terms of social and economic development such as absenteeism from work, long- term disability to an individual and the lost working hours in an industry.

1.1.4 Malaria treatment

The disease is both curable and preventable though its control and preventive measures are faced with great challenges in enforcing them due to the development of parasites resistance to the common anti-malarial drugs in use and the rising economy as a whole. In Kenya, SP (Fansidar®) is still being used as the first – line treatment drug for malaria despite the reported resistance of the parasites to the drug elsewhere in the world. Some of the preventive measures against malaria in use are: ITNs, protective clothing, mosquito repellents, screening of houses, control of breeding of mosquitoes (environmental management, larva control, biological control) and controlling of the adults mosquitoes by use of adulticides (Bruce-Chwatt, 1980).

1.2. Justification for the study

Malaria is spreading at an alarming rate in all malaria endemic countries in Africa. 25 - 40% of all outpatient clinic visits are due to malaria cases (Appendix VIII). This disease is both preventable and curable, yet it is the leading cause of morbidity and mortality in almost all the areas where it is endemic (WHO, 1996). Malaria causes 300 - 500 million acute illnesses in the world and more than one million deaths annually (RBM/WHO, 2002).

Facility - based interventions, as is the case in many peripheral areas, are not sufficient to reduce the spread of the disease (or burden of disease morbidity and mortality). There is need for outreach services aiming at educating the population on malaria control. This would require a sound Intervention Plan or Plan of Action that would monitor the planned activities (RBM/WHO, 2003). This should be followed by evaluation of the programmes to determine success and failures in instituting measures for the improvement of the programmes.

Malaria prevention/control is a highly complex area and should integrate many factors that play a role in one way or the other in its spread, such as the socio-economic factors. Lack or lower levels of knowledge on malaria control, wealth/poverty, treatment practices, are some of the factors that have a bearing on its control. For instance, health-seeking behaviour is a major problem mostly among the people in Africa. In many parts of rural Kenya as indeed in many parts of sub-Saharan Africa, malaria treatment is never prompt (Ruebush *et al.*, 1995). Detailed studies among mothers in Kilifi, Kakamega, Kisumu and Tharaka-Nithi have concluded that a primary source of fever management in malaria is the use of over-the-counter (OTC) drugs from local shops (Snow *et al.,* 1998). Due to lack of knowledge on malaria control among consumers, overdosing and under dosing may result to resistance by the parasites to the drug (Mwenesi, 1993). Moreover, many adults consider malaria as a normal part of life and so do not seek help; instead they seek traditional treatment or buy over-the-counter drugs when symptoms are severe (Meek, 1997).

Malaria is a disease that is both preventive and curable, yet it is the leading cause of morbidity and mortality in almost all the areas where it is endemic. It is assumed that intervention measures in endemic areas are in place and that the health personnel play a big role through health promotion and education. With the reported cases still being on the increase, there is need to determine socio-economic factors that influence its spread for intervention purposes. This will help in reducing morbidity and mortality from malaria.

1.3 Research questions

1. What preventive measures have been adopted and how effective are they?
2. What is the community health seeking behaviour?
3. What is the level of knowledge of the people of Likoni Division on the cause of malaria?
4. What are the economic factors influencing the community treatment seeking behaviour for malaria?

1.4 Null hypothesis

Economic factors do not influence the community treatment seeking behaviour for malaria.

1.5 Objectives

1.5.1 General objective

To establish the socio-economic factors influencing the spread of malaria in Likoni Division.

1.5.2 Specific objectives

1. To determine preventive measures of malaria in the study area.
2. To establish the community health seeking behaviour for malaria in the study area.
3. To determine the level of knowledge of the cause of malaria among the community members in the study area.
4. To determine the economic factors influencing the community treatment seeking behaviour for malaria in the study area.

CHAPTER 2 : LITERATURE REVIEW

2.1 Malaria situation worldwide

Malaria ranks among the diseases of major concern in the world. Today it is widespread throughout the tropical and sub-tropical regions of the world. There are about 300 - 500 million episodes of malaria illness globally each year, resulting in over a million deaths (RBM/WHO, 2002).

The geographical area affected by malaria has shrunk considerably over the past 50 years due to the successful eradication and cessation of transmission in large areas of North America, Southern Europe, Asia and South America (WHO, 1998a). The disease is now confined to tropical areas of Africa, Asia and Latin America (WHO, 1998a).

2.2 Malaria in Africa

About 90% of all malaria deaths in the world today occur in Africa south of the Sahara. An estimated one million people in Africa die from malaria each year, most of these are children under 5 years (WHO/UNICEF, 2003).

Malaria affects the lives of almost all people living in the areas of Africa defined by the southern fringes of the Sahara desert in the north and latitude of about 28° in the south. Most people at risk of the disease live in areas of relatively stable malaria transmission (WHO/UNICEF, 2003). Infection is common and occurs with sufficient frequency that generates some level of immunity (WHO/UNICEF, 2003). A smaller proportion of people live in areas where the risk of malaria is more seasonal and less predictable because of either latitude or rainfall pattern (WHO/UNICEF, 2003). People living in the peripheral areas north or south where malaria is endemic or bordering highland areas are vulnerable to highly seasonable transmission of malaria causing epidemics (WHO/UNICEF, 2003) .It is estimated that in all malaria endemic countries in Africa, 25 - 40% of all outpatient clinic visits are due to malaria (with most diagnosis made clinically) (WHO/UNICEF, 2003). Between 20% and 50% of all hospital admissions in all malaria endemic countries in Africa are as a result of malaria (WHO/UNICEF, 2003).

2.3 Malaria situation in Kenya

Malaria accounts for 30% of outpatient hospital attendance in Kenya (ROK, 2003). The level of endemicity varies from region to region. It ranges from hyper-holoendemic areas of the Coastal and Lake Regions to the malaria free areas on the high grounds on Aberdare ranges and around Mt. Kenya (Figure 1.1). In the Lake Region and Coastal area at altitude not exceeding 300m above sea level, malaria is transmitted all year round and referred to as stable malaria (ROK, 2003). Endemic malaria (stable) is constantly present in considerable degree and without great fluctuations and quantity; epidemic malaria (unstable) shows great fluctuations in quantity and severity from time to time (Bruce -Chwatt, 1985).

Unstable malaria also occurs in several areas in Kenya including Garrisa, Isiolo, Narok, Kajiado, Turkana and Wajir (Figure 1.1). Areas with seasonal malaria include parts of Eastern Province (Machakos, Embu and Kitui) and Rift Valley (Marigat and Ngurumani) (ROK, 2003). This eco-zone has been extended in recent years by population movements and small-scale irrigation projects (ROK, 2003). In the highlands situated at altitude ranging from1700m - 2500m above sea level and semi arid areas, malaria appears in epidemic forms (ROK, 2003). High mortality was reported in 1926 - 1945 epidemics (Bruce-Chwatt, 1985). As malaria transmission is unstable at these high altitudes and the human population has little or no immunity; the highlands are more prone to explosive outbreaks than the lowlands especially when the density of anopheline mosquitoes increases and weather conditions favour transmission (Lindsay and Martens, 1998; Lindblade *et al.,* 2000; Hay *et al.,* 2002). Since 1988, epidemics have been reported frequently in the highlands. The malaria outbreak of 1994 affected more than 12 districts of varying climatic conditions ranging from the highlands (Kisii, Nyamira and Kericho) to semi-arid lands (Turkana, Narok). Under certain circumstances, migrating populations such as refugees, settlers in new schemes may "import" the disease in areas considered free from malaria (ROK, 2003).

2.3.1 Impact of malaria in Kenya

Malaria is a major public health problem in Kenya. About 8.5 million Kenyans are at risk of epidemics, mainly in the highlands (Kisii, Nyamira and Kericho) while approximately 20 million people (more than half the entire population) are exposed to stable transmissions including 3.5 million children aged below five years (Rapuoda *et al.,* 1997). The cumulative human suffering caused by malaria is immense with children and pregnant women being the most at risk (ROK, 2003). Malaria accounts for 19% of all admissions to the health facilities and each year an estimated 26,000 children die from the direct consequences of its infection translating into 72 deaths each day (ROK, 2001).

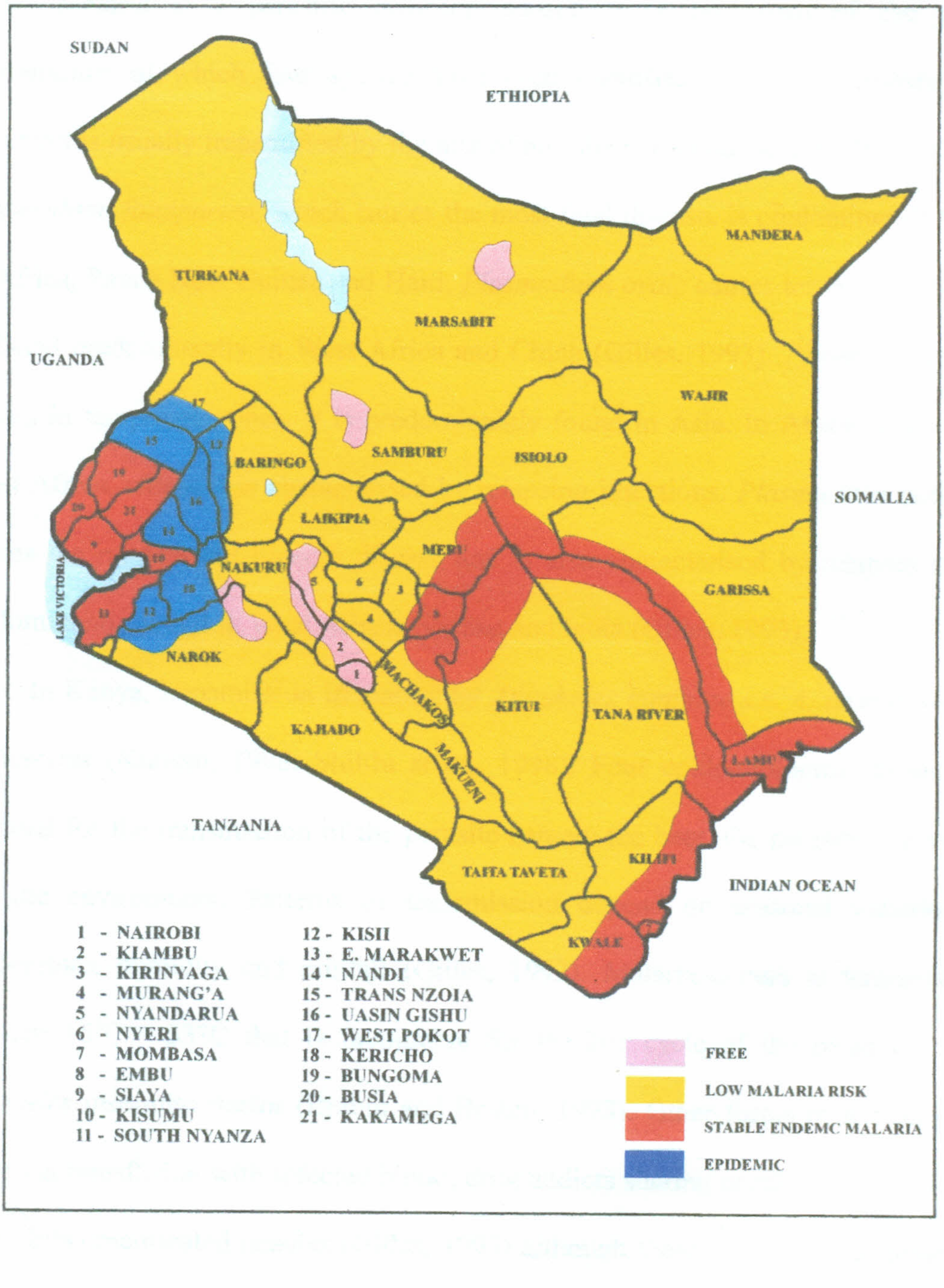

Figure 1.1: The Endemicity of Malaria in Kenya

Source: National Guidelines for Diagnosis Treatment and Prevention of Malaria for Health Workers, Ministry of Health 2003

2.4 Epidemiology of malaria

Malaria is a parasitic infection caused by a protozoan of the genus, *Plasmodium* of which four species have been identified that affect humans. The infection is usually transmitted by the bite of an infected female *Anopheles* mosquito. *Plasmodium falciparum,* which causes the most fatal disease, is predominantly found in Africa, Papua New Guinea and Haiti. *Plasmodium ovale* causes tertian malaria and is found predominantly in West Africa and China (Gilles, 1993). *Plasmodium vivax* occurs in temperate zones. It is predominantly found in Asia. In Africa it occurs in West Africa, where it is characterised by relapsing infections. *Plasmodium malariae* causes the mildest but chronic disease and is also characterised by relapses and is predominantly found in West Africa, Guyana and India (Gilles, 1993).

In Kenya, transmission is mainly by *Anopheles gambiae s.s*, *A. arabiensis* and *A. funestus* (Kubasu, 1998; Shililu *et al.,* 1998). Four epidemiological factors are essential for the transmission of the parasite namely the host, the parasite, the vector and the environment. Patterns of transmission depend on seasonal variation in temperature, humidity and rainfall (Gilles, 1993). Malaria occurs at temperatures between 16°C - 33°C that is favourable for the life cycle of the parasite in the *Anopheles* mosquito vector (Brabin and Brabin, 1993). Other forms of transmission occur via transfusion with infected blood, drug addicts sharing needles and accidental pricks by contaminated needles (Gilles, 1993) although these are negligible routes of infection.

Plasmodium falciparum is the commonest species in Kenya and it accounts for 98% of malaria cases and is associated with significant morbidity and mortality. *P. malariae* and *P. ovale* accounts to 2% of the cases while *P. vivax* is very rare (ROK, 2003). Of the four species mentioned, *P. falciparum* is the most widespread and the most dangerous, and if untreated, may lead to fatal cerebral malaria (WHO, 2002).

Malaria is characterized clinically by chills, fever, and profuse sweating. The clinical features of malaria vary from symptomless to mild or severe disease. These include fever, myalgia, joint pains, splenomegaly, mental confusion, abdominal pain, diarrhoea, nausea and vomiting, irritability and lack of appetite (ROK, 2003). The most important feature of malaria is fever (or a history of fever within the last 2 – 3 days). The fever may be either continuous or irregular at the start of the illness, but soon it may become regular, with attacks every 2 – 3 days. Each attack may last several hours and often begin with shivering, and then there is a period of fever, and finally there is profuse sweating (WHO, 1996). Malaria tends to be particularly severe in infants, children, pregnant women, and adults with low immunity. Usually young children rapidly become very ill and may die within a few days (ROK, 2003; WHO, 1996).

2.5 Diagnosis of malaria

Early diagnosis and prompt treatment is the first step towards the control of malaria (WHO, 1998b). A reliable diagnosis whether it is at home or in the health facility is a prerequisite for selecting the correct treatment and reduction of morbidity and mortality (WHO, 1998b). A strong health system would provide for reliable diagnosis as the basis for optimal treatment. However, in most malaria-endemic areas in Africa, access to curative and diagnostic services is limited with the drugs purchased through the private, informal sector (Thera *et al.,* 2000). In fact, in all malaria-endemic countries in Africa, 25 - 40% of all outpatient clinic visits is for malaria with most diagnosis made clinically (WHO/UNICEF, 2003). Moreover, similarities in clinical presentation between malaria and other diseases (especially in children) make accurate diagnosis of malaria difficult in the absence of a microscopy. Diagnosis is complicated by the lack of a specific clinical presentation, frequent occurrence of several diseases simultaneously and in areas of intense transmission asymptomatic malaria infections (WHO/UNICEF, 2003).

There are several diagnostic tools for malaria: clinical judgment, microscopy, serological tests, molecular biological detection tests and dipstick technology. So far microscopy and clinical judgment are very valuable in diagnosis of acute illness but the dual use is not feasible in developing countries where the only tool readily available is clinical judgment.

2.5.1 Microscopy

Definite diagnosis of malaria infection is established on finding the malaria parasites in the blood (Gilles, 1993). Microscopic techniques to accomplish this include: (a) Light microscopy; (b) Fluorescent stains; (c) Quantified buffy coat method. However, identifying the parasites in the peripheral blood does not always imply that the individual is sick (Schellenberg *et al.,* 1994). Moreover, malaria parasitaemia is common among clinic attendees in many endemic areas, so that a positive laboratory result does not necessarily mean that the patient is ill with malaria (Molyneux, 1997; WHO/UNICEF, 2003; White, 1989). Besides, blood slides may be negative even in the presence of infection due to previous malaria treatment. It has been reported that parasitaemia persists for days or weeks after treatment in patients whose infections eventually recrudesce (Gyrokos, 1995; Svenson, 1995; White, 1989). Microscopy is also valuable in the identification of the infecting malaria parasite species.

Microscopy is quick and easy to apply, and in the rural health facilities with limited infrastructure, light microscopy is ideal for use. Despite the simple technology and relatively low direct costs, microscopic diagnosis is still expensive requiring an infrastructure to purchase and maintain supplies and equipment, train workers and ensure quality services are provided and these pose great challenges in developing countries.

2.5.2 Clinical diagnosis

Clinical diagnosis is widely used on its own in developing countries where the burden of malaria is heavy. The workload makes it a quick method to clear the long queues and lack of resources makes it the only available method in peripheral health facilities. Clinical diagnosis relies on the observation and interpretation of malaria associated signs and symptoms. These include: fever, myalgia, joint pains, chills, splenomegaly, abdominal pain and diarrhoea, nausea and vomiting, periods of sweating, irritability, loss of appetite, anaemia, headache, jaundice and with or without complications (ROK, 2003; WHO, 1996; Eshuis and Manschot, 1978).

In endemic areas every febrile condition would pass as malaria as the clinical features of malaria are mimicked by bacterial and viral infections especially in children. Besides, it is not uncommon for individuals to describe any feeling of being unwell as malaria especially if this follows exposure to rain or cold (Mwenesi, 1993; Sexton, 1994). This poses a big problem because every condition is treated as malaria and this leads to overuse and inappropriate use of anti-malarial drugs.

The most important feature of malaria is fever (or history of fever) within the last 2 -3 days. A typical fever attack is divided in three stages: (a) cold, (b) hot and (c) sweating. Hence, malaria is characterised clinically by chills, fever and profuse sweating (ROK, 2003; WHO, 1996; Eshuis and Manschot, 1978). WHO case definition of malaria in the absence of microscopy is: the presence of/or history of fever without any obvious cause. In endemic settings with high transmission the accepted criteria for treatment of malaria in children below 5 years is history of fever and clinically detectable anaemia (WHO, 2000a). Several studies have suggested that fever alone is a poor predictor of malaria especially in highly endemic areas (Schellenberg *et al.,* 1994; Gomes *et al.,* 1994; Bhatt and Omani, 1984). A study in the Philippines by Gomes found that fever alone did not discriminate well for malaria but rather a sequential occurrence of fever, chills, and sweating was a good predictor. It further found that the diagnosis was most reliable at home (Gomes *et al.,* 1994). Studies in Africa have also given the same results. Rees (1971), demonstrated that due to the reliance on fever alone malaria was over-diagnosed, 1 out of 85 patients treated for malaria had true malaria, so did Bhatt and Omani later on in 1984 at the same hospital (Kenyatta National Hospital), which is a non-endemic malaria of Kenya.

The National Guidelines for Diagnosis Treatment and Prevention of Malaria (2003), recommend treatment based on presumptive diagnosis whereas microscopic diagnosis (which is the definite diagnosis of malaria) to be made whenever possible. The guidelines also highlighted that; in certain cases a slide may be negative even when the patient has malaria, and that malaria parasitaemia may not be the cause of presenting illness. The presumptive diagnosis for older children and adults include fever or history of fever, chills, rigors, headache, joint aches and pains in the absence of any other source of fever. For children under 5 years old, the presumptive symptom is fever or history of fever (ROK, 2003).

Diagnosis of malaria either based on parasitaemia alone or fever alone therefore lacks accuracy. The high burden of malaria cases in the health facilities, may in fact be partly as a result of misdiagnosis, since many facilities lack laboratory capacity and it is often difficult clinically to distinguish malaria from other infectious diseases. Malaria mimics almost any infection for example; it is difficult to distinguish malaria from ARI (WHO/UNICEF, 2003; Molyneux, 1997) and many children in highly endemic areas have asymptomatic parasitaemia (Olaleye *et al.*, 1998; Greenwood *et al.,* 1997; WHO, 1990a). For this reason epidemiologists include the two, fever or history of fever and detection of parasites in the blood to define malaria. But even this leads to over-diagnosis in highly endemic areas.

2.6 Health seeking behaviour for malaria

2.6.1 Self-treatment practices

Self-medication/treatment has been defined as "actions taken by lay people in their own health interest without formal medical supervision" (De Friese *et al.,* 1989). Recently, the definition has been modified to include the use of medicines with or without instructions from health workers (Mwenesi, 1993). Self-medication for malaria is widely practiced around the world and occurs in approximately 80% of all illness episodes (Van der Geest, 1987), especially for illnesses perceived as minor, such as fever, headache, indigestion and sore throat (Mwenesi, 1993).

The risk of under or overdosing is always present even though many home treatment episodes are successful. Reasons for the widespread use of self-medication range from the distance and cost of seeking care from the formal health services to cultural beliefs, which suggest that traditional care is more appropriate, and even that modern care may be fatal. The vast majority of malaria cases in both adults and children are treated at home. Only if the case is very severe or the health services very convenient are the health services likely to be used for malaria (Foster, 1995).

Brinkmann and Brinkmann (1991) have reviewed the literature on malaria in Africa and found rates for self-treatment ranging from a low of 19% in Guinea to a high of 94% in rural Ghana; the average of the 12 studies cited is about 66%. Clearly self-treatment in Africa, especially in rural areas, where about 75% of the population lives, is the rule rather than the exception. Mothers in Africa often give anti-malarial (chloroquine) to their children for episodes of fever (Glik *et al.,* 1989; Deming *et al.,* 1989). In Thailand studies on health seeking behaviour (HSB) in relation to malaria showed that there is a complex pattern of seeking care beginning with self-medication and shifting to a health facility, especially a malaria clinic after failure of the initial treatment (Mwenesi, 1993; Fungladda and Sommani, 1986). The study also showed that malaria clinics set up in malaria endemic areas of Thailand were seriously under utilized (Fungladda and Sommani, 1986). The Philippines, Lariosa (1986) noted an even more complex pattern for seeking care for malaria. It began with treatment with home remedies and palliatives, followed by self-medication with either medicinal plants or anti-malarial drugs (if available and when affordable), followed by consulting a traditional healer especially when a patient exhibited paroxysms. When all this failed then the patient was taken to a medical doctor. Studies conducted in Kenya also found the same pattern of seeking care for malaria (Kasege *et al.,* 1987a, Ongore *et al.,* 1989; Snow *et al.,* 1992). However, anti-malarial drugs were used more often than home remedies. Lipowsky *et al.* (1992) working in Columbia found that treatment commenced at home with a home remedy on its own or in combination with anti-malarial drugs. Their data showed urban/rural differences, with urban dwellers using traditional medications after using health facilities. In Ghana, Agyepong (1992) found a similar pattern. She further reported that people resorted to health facilities when symptoms did not abate or when symptom presentation changed.

Some of the reasons for the widespread practice of self-medication include inappropriate or unrealistic treatment policies and inconvenient or poor quality health services, resulting in lack of confidence in the health services and in the availability of drugs (Foster, 1991a,b). Inappropriate treatment policies contribute to widespread of self-medication as a result of trying to set a high standard of services with the set goals being so high to be obtainable, especially in an era of economic crisis, thereby introducing distortion into the picture. People may be forced by the health services to resort to self-medication (Foster, 1995). An example of such a policy failure occurred in the Philippines where malaria treatment policy geared to “best practice” and requiring microscopic diagnosis had become impracticable due to policy changes. The policy was to treat only upon confirmation of a positive blood slide but in remote rural areas, as much as six weeks could elapse between the first visit and confirmation of positive smear. Only 10% returned for the results of their smear, and most resorted to self-medication with a few tablets of SP purchased in the local shop (Gomes and Salazar, 1990). Another area where policy needs to be matched to reality is in the area of what guidance is given to health staff regarding the initial treatment to be given in health facilities. Most treatment manuals assume that no self-treatment has occurred; yet it is known that this is not to be true in the majority of cases. Specific guidance on asking about previous treatment ought to be included in treatment guidelines (Foster, 1995). Another reason is the waiting time at health facilities (Igun, 1987). More recently, it has been reported that even health workers encourage patients to self-medicate by advising them to purchase drugs from shops and chemists (Cunningham - Burley and MacLean, 1987; Mnyika and Killewo, 1991). One problem, which affects health services, in general not just treatment of malaria is that insufficient attention is given to the interaction between the health staff and the patient. Mwenesi (1993) in a study of beliefs and practices regarding treatment of malaria in children carried out on the Kenyan coast found that 55% of mothers who received drugs did not understand, and could not follow, the instructions given, yet none asked for clarification. The reason was that they believed that health workers had no time to explain things and "could be harsh when asked too many questions."

2.6.2 Disadvantages of self -treatment practices

Two main disadvantages with self-treatment for malaria are the incorrect dosage and delay in seeking care in serious cases. Typically, dosages of anti-malarial used are incorrect and under-dosing may have contributed to anti-malarial resistance. In Kinshasa, Zaire, Trape *et al.* (1987) reported that 74.7% of their sample of children aged 5 - 13 were treated with anti-malarial drugs alone or in combination with other drugs by their mothers. In Kilifi, Kenya, between 59% and 72% of the mothers chose OTC drugs therapy as the first- line treatment at home and only a small proportion of febrile episodes received the correct dosage of OTC, 4% of 250 febrile episodes (Snow *et al.,* 1998). Greenwood *et al.* (1988) also found that VHWs in their study treated children with inadequate doses of chloroquine for fever. Delay in seeking treatment, whatever its cause; it is probably a very important factor in mortality from malaria. The usual pattern of treatment begins with self-treatment with drugs already in the home or with drugs purchased locally on the market. Only when home treatment is not effective will the child be taken for professional care. It may take a day or more to organize the trip to the health facility. Given the time already spent waiting to see the effect of the self-medication, a two-day delay in seeking care would not be unusual. In Thailand, people came to the malaria clinics on average 7.8 days after onset of symptoms, and most of them had used self-medication prior to seeking care at the clinics (Kaewsanthi, 1989). In Togo, only 17% of children with malaria seen in health facilities were seen on the first day of fever (Deming *et al.,* 1989). Unfortunately, a delay of a few days can prove fatal. In The Gambia, the mean duration of symptoms in children who died of malaria was only 2.8 days, but half of the children had been ill for 2 days or less (Greenwood *et al.,* 1987). In a sample of 1323 paediatrics deaths from malaria in Kinshasa, Zaire, 62% occurred in the emergency ward prior to admission to hospital (Greenberg *et al.,* 1989). In Kenya, a mean of 0.6 ± 0.8 days elapsed between the onset of illness and the initial treatment step in the 108 episodes of illness (out of 138 episodes) for which treatment was sought (Ruebush *et al.,* 1995). Similarly, in Malawi, 28% of a group of 96 children with cerebral malaria had been ill less than 24 hours before presenting to the hospital; and 58% had anti-malarials prior to arrival at hospital (Taylor and Molyneux, 1988). There are doubtless other examples of cases where a delay of only a few days proves fatal.

2.7 Chemotherapy

Prompt and effective treatment of malaria is a critical element of malaria control (WHO, 1993). In Africa south of the Sahara, malaria is predominantly due to *Plasmodium falciparum* and potentially fatal, early and effective treatment could save many lives. It is vital that sufferers, especially children aged less than 5 years, start treatment within 24hours of the onset of symptoms, to prevent progression - often rapid - to severe malaria and death (Greenwood *et al.,* 1987). In April 2000, African heads of state participating in the Abuja Summit agreed that by the year 2005 at least 60% of those suffering from malaria should have prompt access to and be able to use correct, affordable and appropriate treatment within 24 hours of the onset of symptoms (RBM/WHO, 2003). In high transmission malaria-endemic areas, WHO therefore recommend that as part of the strategy of Integrated Management of Childhood Illnesses (IMCI), all children aged less than 5 years with fever be presumptively treated with anti-malarials (Nicoll, 2000). Home-based management of fever (HBMF) is a promising strategy for improving the coverage of prompt effective treatment. Community health workers and mothers of young children are trained in recognition of symptoms and the benefits of prompt anti-malarial treatment (WHO/UNICEF, 2003).

Various anti-malarial drugs have been used for curative and prophylactic purposes. Use has been made of drugs such as quinine, chloroquine, mefloquine, proguanil, 4-aminoquinolines, halofantrin, artemesinin, pyrimethamine and sulfadoxine. Anti-malarial drug resistance has become one of the greatest challenges in malaria treatment. One of most widely used drug and the cheapest is chloroquine. However, *P. falciparum* have developed resistance to chloroquine in most parts of Africa, South America and South East Asia (Rosenthal, 2001; Ridley, 2002; Sachs, 2002; WHO, 2000b).

Chloroquine has been the traditional first line drug in malaria treatment for a long time. Resistance was first reported in 1961 in Colombia. In Kenya the first reported case was in a tourist in 1979 (Fogh *et al.,* 1983). The second reported case of resistance was in a child from western Kenya (Spencer *et al.,* 1987). In 1984, resistance was observed in another Kenyan who originally came from Machakos but lived at the coast (Bhatt and Omani, 1984).

The spread of parasite resistance to chloroquine has been accompanied by increasing incidence of severe malaria (Bruce-Chwatt, 1982; Kofi Ekue *et al.,* 1983; Kabiru *et al.,* 1987). In some countries resistance has become so widespread and intense that existing drug regimens have had to be changed and chloroquine has been replaced by more expensive alternative drugs (Fogh *et al.,* 1983; Bruce-Chwatt, 1982; Cook, 1988). In Kenya, sulfadoxine/pyrimethamine (Fansidar®), a more expensive second-line drug, was recommended by MOH to replace chloroquine as the first -line drug in the treatment of clinical malaria at Government health services in March 1997 (Snow *et al.,* 1998). Malaria parasite resistance to alternative anti-malarial drugs such as quinine, amodiaquine and sulfadoxine/pyrimethamine has also been reported (Rosenthal, 2001; Ridley, 2002; Sachs, 2002; WHO, 2000b). Chloroquine and fansidar® are no longer effective in many parts of East Africa where chloroquine resistance is rampant (Rosenthal, 2001; Ridley, 2002; Sachs, 2002). The availability of the drugs in retail outlets contributes to the indiscriminate use of drugs without medical supervision. These will include counterfeit drugs, drugs of poor quality and incorrect dosing and irrational prescription practices.

Several newly developed drugs could replace those that are no longer effective. In particular, artemesinin – based combination therapies (ACTs) have enormous potential in malaria therapy. The combination of multiple drugs enhances clinical efficacy and may delay the development of resistance of parasites (WHO, 2001). However, these drugs are not yet widely available and not always affordable. In some selected provices of South Africa (Kaw Zulu and Mpumalanga) change has been made to ACTs as the first-line treatment of malaria in 2001 and it has been fully implemented (WHO/UNICEF, 2003). Countries that have adopted ACTs but have yet to implement this policy fully: Tanzania (Zanzibar) in 2001and Burundi in 2002 (WHO/UNICEF, 2003).

2.8 Anti-malarial prophylaxis

In the endemic countries of Africa, children under 5 years old and pregnant women bear the brunt of the burden of malaria. This is because they have lower immunity to the disease compared to the other people in the same environment (WHO/AFRO, 2000). Malaria infection during pregnancy is a major public health problem in tropical and sub-tropical regions throughout the world. In most endemic areas of Africa, pregnant women are the main adult risk group for malaria.

Some countries have, therefore, adopted malaria prophylaxis practice for pregnant women to prevent them from malaria attacks, notably Malawi. Malawi has made considerable efforts to increase malaria prophylaxis practice among pregnant women. Their studies found out that poor compliance with regimen was associated with antenatal service practice of giving women chloroquine to take at home. Simpler dosage regimens allowing for in-clinic dosing increased compliance among other barriers, like the community beliefs. In fact, the results had led to the adoption of a regimen which is claimed to be both more clinically effective and more cost-effective; this consists of giving women a one treatment dose of SP during the second trimester (usually coinciding with the first ante-natal visit) and a second dose at the beginning of the third trimester (this is what is now called Intermittent Presumptive Treatment, IPT). This regimen does not depend on women taking the tablets at home (Hill *et al.*, 1996).

For many years WHO recommended that pregnant women in malaria endemic areas should receive an initial anti-malarial treatment dose on their first contact with ante-natal services, followed by weekly chemoprophylaxis (given at less than therapeutic dose) with an effective and safe anti-malarial drug (WHO, 1986). In most countries in Africa, chloroquine has been the drug of choice. However, the emergence and spread of chloroquine-resistant *falciparum* malaria, poor patient compliance with multiple doses, and a high incidence of chloroquine-induced *pruritus* have limited the effectiveness and hence the implementation of this policy.

In 2000, the WHO Expert Committee on Malaria recommended that Intermittent Presumptive Treatment (IPT) with an effective, preferably one-dose, anti-malarial drug, should be made available as a routine part of ante-natal care to women in their first and second pregnancies in highly endemic areas (WHO, 2000a). But to date, according to WHO/UNICEF (2003) pg. 43 on Policy Summary (Best practices for malaria control during pregnancies); all pregnant women should receive at least 2 doses of IPT after quickening, during routinely scheduled ante-natal clinic visits as recommended by WHO (WHO/UNICEF, 2003).

Studies in Kenya (Shulman *et al.,* 1999; Parise *et al.,* 1998) have shown that IPT with at least two treatment doses of SP is highly effective in reducing the proportion of women with anaemia and placental malaria infection at delivery. In the Abuja Declaration, African heads of states agreed to achieve by 2005, that at least 60% of all pregnant women who are at risk of malaria, especially those in their first pregnancies have access to chemoprophylaxis or intermittent presumptive treatment (RBM/WHO, 2003).

The other major risk group for malaria are the under fives. Prophylaxis is considered necessary for pregnant women, but prophylaxis for small children is debatable because of the risk of long-term side effects and danger of increased selection for resistant parasite strains (Carnevalle and Mouchet, 1987). In addition, drug administration can prevent development of natural immunity or simply delay disease development until children are older (Carnevalle and Mouchet, 1987). According to the National Guidelines on Malaria, Kenya has adopted the IPT policy on the pregnant mothers attending antenatal clinics and too had recommended chemoprophylaxis to children under 5 years with recurrent febrile convulsions (ROK, 2003).

2.9 Malaria infection in pregnant women

Malaria parasite prevalence rate and parasite density have been reported to increase in pregnant women who have malaria infections, than non-pregnant women (Gilles *et al.,* 1969; Brabin *et al.,* 1990). The main burden of malaria infection during pregnancy results from infection with *Plasmodium falciparum.* The impact of the other three human malaria parasites (*P. vivax, P. malariae* and *P. ovale)* is less clear (WHO/UNICEF, 2003). Women in their first and second pregnancy are at greatest risk of the effects of malaria. The primigravidae have been reported to be more susceptible to malaria infection with a high incidence and parasitaemia than the multigravidae (Hamilton *et al.,* 1972; Brabin, 1983; McGregor, 1984; Brabin *et al.,* 1990). Every year at least 30 million women in malarious areas of Africa become pregnant, most of these women live in areas of relatively stable malaria transmission.

Malaria transmission intensity may vary within the same country from areas of relatively stable transmission to areas of unstable or epidemic transmission; the clinical picture of malaria infection during pregnancy may likewise range from asymptomatic to severe, life-threatening illness. Immunity is an important factor to pregnant women in as far as the malaria transmission is concerned. Maternal mortality due to severe malaria is high in non-immune individuals, and the risk is increased by anaemia (Armon, 1979; Sholapurkar, 1988). In Malaysia and Thailand a risk of 13.6% (Menon, 1972) and 10% (Meek, 1988) were reported in anaemic pregnant women with low malaria immunity. In stable malaria areas transmission is high, though seasonal fluctuation may exist. In these high transmission areas malaria is perennial and is usually associated with a high level of immunity in the human population (Lawson, 1967; Harrison, 1982; McGregor, 1984). In these areas, most adult women have developed sufficient immunity that even during pregnancy, *P. falciparum* infection does not usually result in fever or other clinical symptoms. The principal impact of malaria, in these areas, is malaria-related anaemia in the mother and the presence of parasites in the placenta. The resulting impairment of foetal nutrition contributes to low birth weight and is a leading cause of poorer infant survival and development. In areas of Africa with stable malaria transmission, *P. falciparum* infection during pregnancy is estimated to cause an estimated 75,000 to 200,000 infant deaths each year (Steketee *et al.,* 2001). On the other hand, in malaria unstable areas, transmission is low and the level of immunity in the population is also low (Lawson, 1967; McGregor, 1986; Brabin *et al.,* 1988). In these areas of malaria transmission, adult women have not acquired any significant level of immunity and usually become ill when infected with *P. falciparum.* For pregnant women in these areas the risk of developing severe malaria is 2 - 3 times higher than that for non-pregnant women living in the same area. Maternal death may result either directly from severe malaria or indirectly from malaria-related severe anaemia. In addition, malaria may result in a range of adverse pregnancy outcomes, including low birth weight, spontaneous abortion and neonatal death.

The season of malaria transmission also influences the severity of malaria infection (Bruce-Chwatt, 1985). During a high transmission season, there is likely to be a higher challenge in infection, which may increase the level of antibodies in the pregnant women as compared to a low season period when transmission challenges are few. Bray and Anderson (1979) observed that mean antibody levels in pregnant women changed with season being highest, immediately after the peak malaria transmission period.

2.10 Immunity against malaria for the under fives

From birth to 6 months the infant has malaria antibodies (passive natural immunity) inherited from mother and there are few or no malaria attacks; from 6 months to 5 years, there are no more antibodies and the child gets severe attacks of malaria, the spleen usually palpable and blood slides show a high parasite density (number of infected erythrocytes high); from 5 to 10 years, the clinical symptoms decrease and the parasite density still high (the immunity is developing); and during the adult stage there are no more clinical signs of malaria, spleen no longer palpable and a blood slide may reveal few parasites (low parasite density) without the person suffering from malaria. This is the semi-immune state (Eshuis and Manschot, 1978)

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2.11 Malaria control

In 1955 the World Health Assembly endorsed a concept paper on worldwide eradication of malaria (Derek, 1985). This did not achieve desirable results particularly in Africa where the ravaging effects of the disease have persisted. The magnitude of the malaria situation in Africa is affected by a variety of factors, none of which addressed alone is likely to provide a sustainable solution. The high vector population with its varied unknown habits and resistance to insecticides, the diversity of the parasite and its evolving resistance to drugs, the declining economy and low level of economic development, the relationship of malaria to other diseases and lastly the diverse cultural, social and environmental factors which affect acceptance and use of preventive and control measures collectively impact negatively on the malaria situation. The strategy of eradication was therefore abandoned especially for Africa and control adopted.

2.11.1 The global malaria control strategy

The revised global malaria strategy was approved in Amsterdam in 1992 by the health ministries of several malarious countries, with the aim of reducing the disease burden at all levels (WHO, 1993). Specifically the overall global malaria control goal is to prevent mortality and reduce morbidity and social economic losses through the progressive improvement and strengthening of local and national capabilities. The four basic technical elements of the strategy are: to provide early diagnosis and prompt treatment; to plan and implement selective and sustainable preventive measures, including vector control; to detect early, contain or prevent epidemics; and to strengthen local capabilities in basic and applied research to permit and promote the regular assessment of a country's malaria situation, in particular the ecological, social and economical determinants of the disease.

The 49th session of the United Nations General Assembly in 1994 endorsed the strategy on control of malaria and requested the World Health Organisation to develop an action plan for the years 1995 – 2000. In 1997, the OAU States' heads of government adopted the Harare Declaration on malaria prevention and control and pledged to make malaria control a priority.

In order to strengthen research capacity in Africa, a Multilateral Initiative on malaria was established. Prior to the 1997 Harare meeting, there was a meeting of technical experts in the WHO regional office for Africa in 1991, where regional strategies for malaria control were evolved. This evolved an accelerated programme of malaria control and advocacy (WHO/AFRO, 1999). Kenya being one of the countries involved launched the Malaria Control Programme in 1994.

2.11.2 The new malaria control initiative: Roll Back Malaria

Roll Back Malaria is the new global initiative against malaria. It is a global partnership founded by the governments of malaria–afflicted countries, the World Health Organisation, the United Nations Development Programme, the United Nations Children's Fund and the World Bank. It was launched in 1998 (RBM/WHO, 2000). It offers a great opportunity for joint action to tackle the threat of malaria for human development. Its objective is to halve the burden of malaria for the world's people by the year 2010 by saving lives, reducing poverty, boosting school attendance and making life better for millions of people living in poor countries, especially Africa. It has six key elements that have received widespread support. These built the WHO global malaria control strategy, endorsed in Amsterdam in 1992, with its emphasis on: 1) effective management of malaria including malaria outbreaks; 2) rapid diagnosis and treatment of those who are ill; 3) multiple and cost - effective means of preventing infections; 4) focussed research to develop and test, and introduce new products; 5) a well co-ordinated movement through stronger capability to health sector and community -level effort; and 6) a dynamic global partnership supported by a coalition of partners working within a common approach (RBM/WHO, 2000).

The elements of the Roll Back Malaria initiative incorporated within the Kenya malaria control policy include: early diagnosis and treatment, chemoprophylaxis among high risk groups including pregnant women, children under 5 years, non-immune visitors to endemic areas, selective and sustainable preventive measures in vector control, early detection and containment, and prevention of epidemics and strengthening capacities on malaria health education (ROK, 2003)

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2.11.3 The Abuja Declaration and the Plan of Action

The African Summit on Roll Back Malaria was held in Abuja, Nigeria on the 25th of April 2000. Forty-four of the fifty malaria - affected countries in Africa attended the summit. The Summit concluded by signing of the Declaration and the Plan of Action (RBM/WHO, 2000). The African leaders therefore committed themselves to an intensive effort to halve the malaria mortality for Africa's people by 2010, through implementing strategies and actions for Roll Back Malaria, as agreed at the summit.

Some of the Abuja targets were: to ensure that by the year 2005 that at least 60% of those suffering from malaria have prompt access to and are able to correctly use, affordable and appropriate treatment within 24 hours of the onset of symptoms (RBM strategy – prompt access to effective treatment); at least 60% of those at risk of malaria particularly children under five years of age and pregnant women, will benefit from the most suitable combinations of personal and community protective measures such as ITNs and other interventions which are accessible and affordable to prevent infection and suffering (RBM strategy – provision of ITNs); and at least 60% of all pregnant women who are at risk of malaria, especially those in the first pregnancies, have access to chemoprophylaxis or intermittent presumptive treatment (RBM strategy – prevention and control of malaria in pregnant women) (RBM/WHO, 2000; WHO/UNICEF, 2003).

The leaders pledged to implement the agreed Plan of Action within their own countries whose contents are: organisation and management of health system; disease management; provision of anti-malarial drugs and malaria control related materials; disease prevention; disease surveillance, epidemic preparedness and response; sustainable control; human resources development; and research, including interdisciplinary operational research.

2.11.4 National Malaria Strategy (2001 – 2010)

The National Malaria Control Programme (NMCP) was launched in 1994 under the Division of Vector Borne Diseases. In the 1998, the Roll Back Malaria (RBM) movement started by WHO compelled the MOH to formulate a National Malaria Strategy to achieve the global RBM objectives. The NMS is mandated by, embraces and conforms to: MOH Health Sector Strategic Plan; Kenya's Interim Poverty Alleviation Strategy; and the global "Roll Back Malaria" movement (ROK, 2001). In view of this, the Abuja Declaration of April 2000 at the African Heads' Summit on "Roll Back Malaria" recognised "the disease and economic burden that malaria places on hundreds of millions of Africans and the barrier it constitutes to development and alleviation of poverty". The President committed the Government of Kenya to an intensive effort in support of the Abuja Declaration. The RBM has set a ten-year target to realise tangible differences in malaria control and prevention in Africa. The NMS, under the new Division of Malaria Control, is Kenya's response to this challenge.

The NMS is not a technical manual for preventing and control of malaria. It aims to set up an enabling environment for the creation and implementation of such guidelines by: coordinating stakeholders and efforts; strengthening partnerships; integrating systems; advocating resource priority; focusing national commitment; and designing national guidelines like the National Guidelines on Malaria of the Republic of Kenya of the year 2003.

The key targets by 2006 are: 80% of ROK health facilities to have continuous and adequate supplies of drugs essential for the management of malaria; 60% of fever cases which are treated at home by family members or caretakers will be managed appropriately; 60% of the at-risk population will sleep under ITNs; and at least 50% of these nets will be regularly treated with insecticides (ROK, 2001).

2.11.5 Principles of malaria prevention and control

The control of malaria may be an individual matter, for the protection of one man or one house or a community. It may have to be undertaken at short notice in the middle of an epidemic, or may be planned and arranged during the off-season. It may be necessary for a short period only, or for a long period, even throughout the year. The measures for prevention of malaria in individuals and for larger scale control of the disease can be divided to: measures designed to eliminate the malaria parasites in the human host; measures designed to prevent mosquitoes from biting people; measures designed to control mosquito breeding; and measures designed to kill adult mosquitoes.

2.11.5.1 Personal or Individual protection

2.11.5.1.1 Insecticide treated bed nets

Before the development of insecticide-treated bed nets (ITBNs) as a new technology in the mid-1980s people in many countries were already using nets, mainly to protect themselves against biting insects and for cultural reasons (MacCormack and Snow, 1986; Robert and Carnevale, 1991; Aikins *et al.*, 1994). It was only recently appreciated that a net treated with insecticide offers much greater protection against malaria: not only does the net act as a barrier to prevent mosquitoes biting, but also the insecticide kills any mosquitoes attracted to feed. Thus ITBNs provide protection both to individuals sleeping under them and to other community members. The effect is so significant that use of ITNs is considered to be one of the most effective prevention measures for malaria. In 1983, WHO recommended the initiation of field trials of ITBN as a disease control measure (Lengeler, 1996). The World Health Organisation sanctioned four randomised multi-centre controlled trials in African settings of different transmission intensities. Three trials looked at the impact of insecticide-treated bed nets; Kenya (Nevil *et al.,* 1996); The Gambian (D'Alessandro *et al.,* 1995); and Ghana (Binka *et al.,* 1996). The Burkina Faso study looked at the impact of treated window eaves and door curtains (Habluetzel *et al.,* 1997). All the studies reported positive results. The Gambia study yielding a 25% reduction in all cause child mortality, the Kenyan study showed 33% reduction on all cause child mortality, a 41% reduction in rates of admission and a 44% reduction in malaria morbidity (Nevil *et al.,* 1996). The Burkina Faso study showed a 15% reduction in all cause child mortality (Habluetzel *et al.,* 1997) and the Ghana study yielded a 17% reduction in all cause child mortality (Binka *et al.,* 1996).

In a study in The Gambia, a 60% reduction was noted in all cause child mortality in the ages 1 - 4 years associated with ITNs (Alonso *et al.,* 1991). When used by pregnant women, ITBNs are also efficacious in reducing maternal anaemia, placental infection, and low birth weight (Garner and Gulmezoglu, 2000). The challenge facing this method of prevention of malaria is sustainability. In a study in the Gambia when the participants were required to pay for the nets, the usage dropped with a return to pre-intervention mortality rates (D'Alessandro *et al*., 1995). Moreover insecticide for net treatment is still an unfamiliar commodity in Africa. People's motivation for using nets is often to reduce mosquito nuisance, not to repel or kill malaria-transmitting mosquitoes, this resulting in low insecticides re-treatment rates.

The Abuja target required that at least 60% of those at risk for malaria, particularly children under 5 years of age and pregnant women, to benefit from the most suitable combination of personal and community protective measures such as ITBNs by 2005 (RBM/WHO, 2003).

2.11.5.1.2 Protective clothing

"Mosquito boots" made of soft leather or canvases are useful to protect the ankles in the evening. Alternatively a pair of thick socks may be pulled up outside the bottom of trousers. Colour is important: dark colours tend to be more attractive to mosquitoes than light colours. Sleeves should be rolled down and trousers substituted for skirts or shorts after sunset. Special hoods and gloves are sometimes used for military personnel to protect them while on duty at night (Warrell and Gilles, 2002).

2.11.5.1.3 Repellents

These are substances applied to the skin, clothing or bed-nets to repel mosquitoes and prevent them from biting. In the past citronella or eucalyptus oil were used on the skin but its effect is very short not exceeding 15-20 minutes. More recently a number of synthetic repellents have been developed, with duration of protection of 2 - 4 hours. The most useful of those developed are indalone, Rutgers 612®, diamethylphthalate (DMP), dibutylphthalate (DBP) and a mixture known as

6-2-2 (Bruce-Chwatt, 1980). The most effective against *Anopheles* is DBP (average protection 4 hours) and DMP (average protection 3 hours). Several new compounds are now available - diethyltoluamide (DEET®) shows much promise as the best repellent (Bruce-Chwatt, 1980; Knell, 1991). The repellents should be applied liberally, especially about the neck, ankles and wrists. Eyelids and other skin surfaces or mucous membranes are irritated by these substances and should be avoided. Generally repellents are applied at dusk or dawn when *Anopheles* are most active. For added protection repellents may be applied to clothing especially socks. Mosquito coils or joss sticks containing pyrethrum can be considered as a type of repellent. Uses of plants as traditional natural repellents have been documented from many areas (Curtis *et al.,* 1990), but most of the products from plants have not been analysed. Citronella products are used in India and are effective against *Anopheles* mosquitoes. However, their protective effects do not last long (Sukumar *et al*., 1991). In Tanzania, the smoke from burning plants provided some protection (Trigg, 1996). However, the effectiveness of these methods is probably limited and will depend on both the biology of the local vectors and the intensity of the transmission.

2.11.5.1.4 Screening of houses

A single mosquito net provides protection only for those sleeping under it, but screening the house will protect the whole family. The use of wire gauze in dwellings, especially where electricity is also available for light and fans, has made a great difference to the health and comfort in the tropics (Bruce-Chwatt, 1980; WHO, 1996). Effective screening is possible only in houses that are well built and in good repair. Every aperture in the building must be screened. Many materials have been used for screening: zinc-coated, brass or aluminium being the most common. A salt-laden atmosphere is very destructive to screening and under such conditions it is economical in the end to install the most resistant screen available. Certain plastic screens are of good quality and quite durable. Frequent inspection is necessary for the detection of dents in the screen and defects in the wooden frame work, the latter being especially likely to develop where there is extreme variation in humidity between the dry and wet season. Curtains made from netting or similar materials can keep out mosquitoes as well. The curtains must be treated with repellents (special insecticide) and must be hung up in away that they cover all openings to the house.

2.11.5.2 Control of mosquito breeding

2.11.5.2.1 Environmental management

This involves practices that create unfavourable habitats for larval survival. It may also involve the elimination of aquatic habitats. A simple approach is to fill with rubble, sand and earth larval habitats of different sizes (Service, 1996). Environmental control is the oldest method in use. Not all collections of water breed vector mosquitoes. Careful species identification and location are necessary if resources are to be used efficiently. Health public works and agricultural authorities must work together. Other environmental modifications include: proper drainage, proper water management, removal of discarded containers that might collect water, covering cisterns (water tanks) with mosquito nets or lids and clearing away vegetation and other matter from the banks of streams, this will speed up the flow of water (ROK, 2003; WHO, 1996).

Environmental control is often very expensive. It may be practicable only near main towns, however local small communities can often achieve such by filling in small ponds, and keeping in the edges of streams and irrigation canals free of vegetation. Deforestation can also eliminate the malaria vectors by destroying adult mosquito resting habitats (Knell, 1991; Service, 1996). This method of control has not archived much because it is impossible to fill in all the scattered, small and temporary collections of water (Service, 1996). Secondly, the environmental changes such as agricultural irrigation schemes, creation of the dams for water reservoirs and road construction or mining sites may favour the breeding of other species that were previously present in only small members or absent (Service, 1996).

2.11.5.2.2 Larva control

A potential target of malaria control is the mosquito larva (*Anopheline* larva). This is because the life cycle can be interrupted before the emergency of adults that bite and transmit malaria parasites. Source reduction through modification of larval habitats was the key to malaria parasite eradication efforts in the United States, Italy and Israel (Kitron and Spileman, 1989). It is therefore rational that appropriate management of larval habitats in the sub-Saharan Africa may also help to suppress vector densities and malaria transmission rates (WHO, 1998b). The control of mosquito larvae may be one of the efficient and economical means of controlling malaria epidemics.

One method that has been used to kill mosquito larvae involves the application of oil on water. *Anopheles* larvae die from suffocation as they cannot come out of the water for air (Wigglesworth, 1976). Various synthetic chemical larvicides have been used in mosquito control, especially where the use of residual adulticides was not effective or too expensive. The choice of such larvicides for mosquito control has been based on the species and behaviour of the mosquitoes, effects to domestic animals, wildlife, fish, other aquatic organisms, environmental pollution, presence of insecticide resistant mosquitoes and cost factors (Michael *et al.,* 1991). Paris green dust has been commonly used to control larvae (Service, 1996) and its advantages are: comparatively low cost; high toxicity for *Anopheles* larvae; its portability; ease of distribution by wind; there is no need to remove vegetation; and no evidence of ill effects to domestic animals, fish or other natural enemies of larvae, or to crops (Bruce-Chwatt, 1980). Chlorinated hydrocarbons (like DDT or dieldrin) are not recommended as larvicides, but organo-phosphorous compounds such as temephos (Abate®) or fenthion may be of value (Benenson, 1975). Most of the larvicides are organo-chlorines, organo-phosphates or carbamates. For most malaria vectors, reducing mosquito population densities by means of larvicide application may be an efficient way of reducing malaria transmission especially when a large proportion of the larval habitat can easily be identified and targeted. The behaviour and ecology of the target vector determines the efficacy of the larvicide. The number and wide distribution of these small pools may present insurmountable difficulties in control efforts using larvicides except in circumstances such as the eradication campaigns where the introduced species occurred in a limited geographic region (Laird and Miles, 1985).

The use of insect growth regulators (IGR) to control mosquitoes has also been attempted. IGR are chemicals which inhibit/disrupt growth of the insects. These compounds generally have no toxicity to other non-target organisms. They are relatively specific to the insect and primarily active against the immature stages of mosquitoes. Currently, the most widely used IGR is Altosid® (Laird and Miles, 1985). It has no remarkable effects on non-target aquatic organisms but it is not recommended for use in drinking water sources.

2.11.5.2.3 Biological control

In its strict sense this means the use of one plant or animal to control another and exploits predator - prey and parasite - host relationships. This implies the use of predators and parasites to reduce the population of other organism (Cohen *et al.*, 1982). Larvivorous fish are natural enemies of mosquitoes' larvae and have been utilised with advantage for malaria control in Spain, Italy, Greece and other countries in southern Europe and northern Africa, and also in India, New Guinea, Malaysia, Madagascar and many other countries. There are a number of species of fish that are particularly valuable in the control of malaria. The most important and best known is the top feeding minnows, *Gambusia finis*, which originated in the U.S.A (Bruce-Chwatt, 1980; Cohen, 1982).

The use of North American fish (*Gambusia affinis*) successfully reduced malaria incidences in Italy and Greece, where malaria transmission was unstable (Wickramasinghe and Costa, 1986). Prior to this other fishes such as Armagosa pupfish (*Cyprinoden nevadensis armagosae)* and Guppies *(Poecillia reticulata)* were used (Moyle, 1976). These species reduced the number of mosquito larvae by almost half in most of larval habitats during the entire study period (Moyle, 1976). Naturally, the use of larvivorous fish is limited to some special situation where the water and other conditions are suitable. Cisterns, shallow ponds, small streams, ornamental pools, water tanks are among other places ideal for mosquito control by fish. However, the use of larvivorous fish has its own disadvantages: they are only effective if present in very large numbers; they are less effective for control of *Anopheles*, especially in the presence of weed and floating debris; constant inspection is necessary to see that the fish are flourishing and are in sufficient numbers and that the water is free from horizontal vegetation (Bruce-Chwatt, 1980).

The bacterial endospore toxins produced by various strains of Bacillus species such as *B. thuringiensis* var. *israelensis* (BTI) or serotype H-14 of *B. thuringiensis* and *B. spaericus* have also been used as larvacidal agents (De Barjae and Sutherland, 1989; Davidson and Yousten, 1990; Cohen, 1982; Knell, 1991). When the endotoxins are ingested by mosquito larvae the mouthparts and gut are paralysed and the gut epithelium is destroyed, leading to eventual death. As well as these two agents numerous other predators and pathogens (viruses, bacteria, protozoa, fungi and nematodes) are under investigation.

Genetic control is a special type of biological control. It has been defined as the use of any method that can reduce the reproductive potential of insects by altering the hereditary material of the vector species. Various methods of genetic control have been used but the release of males sterilized by ionizing irradiation or chemical compounds has received most attention. The principle of this method is that sterilized males seek out and mate with the wild female in the natural population thus preventing the hutching of their eggs and lowering their reproductive potential (Bruce-Chwatt, 1980). The main and difficult requirement for success of all genetic method of mosquito control is the production of very large numbers of healthy competitive though genetically different mosquitoes and their release in the right place and at the right time to mate successfully with wild insects. Although some of these methods have shown promise in fields trials they have not come into practical use.

2.11.5.3 Control of adult mosquitoes

Insecticides to kill adult mosquitoes may be used as space sprays or as application to a surface (residual sprays) on which mosquitoes may alight. Space sprays require large volumes, but the insecticide can be short acting. Surface sprays need smaller volumes, but the insecticide should be persistent, colourless and odourless (Bruce-Chwatt, 1980).

Residual spraying retain their toxic action for a considerable period when applied to a surface with which adult mosquitoes come into contact, in contrast to the space spraying which usually has an immediate knock-down effect that lasts for a short time. Residual insecticides are almost invariably applied in some liquid form, which, on drying, leaves a crystalline deposit on the wall. Some wall surfaces absorb the original fluid, which is put on, and if this is a solution or an emulsion, much of the active insecticide is drawn into the inner part of the wall where the insect cannot come into contact with it. This causes some loss of insecticidal power on mud and porous plaster walls. Surfaces such as wood may not absorb much of the insecticide, which remains on the surface in an active form for months (Bruce-Chwatt, 1980). House spraying involves the uniform application of specific concentrations of insecticide to the internal walls and roofs of human dwellings and sometimes to other surfaces, like under eaves and under the floors of houses "on stilts". Where vectors are partly zoophilic, animal shelters may also be sprayed. The recommended spray is one coarse, which is enough to thoroughly wet the surface without run-off, and delivered at such a pressure to assure maximum adherence (Cohen *et al.,* 1982). In spite of the tremendous success of the technique of residual insecticide spraying the method of space dispersion of fast acting compounds is still of value. A degree of local control of mosquitoes (and other flying insects) may be achieved by "space-spraying", via releasing the insecticides into the air as smoke, fumigants or as fine droplets. This measure may be necessary adjunct where vectors are particular biting nuisances or do not rest in houses for long periods and are primarily exophilic. This will require both interior and exterior space treatment (Cohen *et al.,* 1982; Bruce-Chwatt, 1980). Naturally, such measures of protection must be frequently repeated to result in any significant effect. However, in epidemics of insect-borne diseases the "space-spraying" technique can rapidly reduce the members of mosquitoes not only in dwellings but also in outside breeding grounds.

It is now fully acknowledged that insecticide resistance is one of the major obstacles in the struggle against vector borne diseases. Insecticides such as pyrethrum extracts have been used extensively in mosquito control, but their quick bio-degradability and high costs of isolation of natural pyrethrins reduced their use (Sukumar *et al.,* 1991). This accelerated the development of affordable and persistent synthetic pyrethrum like permetrin and allethrin, which have been effective insecticides (Shidrawi, 1990; Chandre, 2001). These compounds have however been found to be toxic to many non-target organisms. Moreover, increased vector resistance has been reported against synthetic pyrethrins (Shidrawi, 1990). House spraying and residual insecticide is highly effective in reducing malaria in some parts of Africa (Chandre, 2001). However, their effectiveness is already under threat as a result of the emergence of pyrethroid resistance in *An. funestus* in Mozambique and *An. gambiae* in West Africa (Chandre, 2001). Vector resistance to synthetic insecticides is a recurring theme and a major problem in malaria control programmes (Shidrawi, 1990; Chandre, 2001). The value of insecticides in malaria control is really much reduced. Some 50 Anopheles species are now resistant to one or more insecticides. Specifically, 49 species are resistant to DDT (Chlorinated hydrocarbons); 24 species are resistant to organophosphates; 14 species are resistant to carbamates; 10 species are resistant to pyrethroids; and 14 species are resistant to three or more insecticides (Bruce-Chwatt, 1980). At least 11 out of 50 resistant species are important malaria carriers. The extension of resistance from DDT to other chlorinated hydrocarbons (HCH and dieldrin) led to giving up these efficient and cheap compounds in many parts of the world. The alternative use of organophosphorus and carbamates insecticides proved to be expensive and few developing tropical countries are able to afford it without help. Moreover, in some countries mosquito vectors have developed a degree of resistance to several newer insecticides, and particularly those widely used in agriculture (Bruce-Chwatt, 1980). Organophosphate pesticides are alternatives to pyrethrins since they have short persistence but resistance has been reported to these insecticides: Malathion resistance has been recorded in *An. arabiensis* in the Gezira District of Sudan (Lines, 1988).

Tactics of malaria control to counteract insecticide resistance would include: the co-ordination of anti-malarial activities with other schemes like the agriculture sector, based on the outdoor use of pesticides since contamination of mosquito breeding sites by extensive use of agricultural pesticides often leads to marked resistance of *Anopheles* vectors; the judicious use of alternative methods of vector control (integrated control) such as source reduction, environmental or biological control means, in preference to relying on the use of synthetic insecticides; whenever the use of insecticides is unavoidable, the type, dosage and cycle of their application should be such that only the vector population involved in the transmission of malaria is affected; to change to a different insecticide, taking into account the operational and financial consequences of the decision; and consequent monitoring of the progress of malaria control by entomological methods like testing for resistance by the standardised WHO tests and epidemiological evaluation of the impact of the new insecticide on the transmission of malaria (Bruce-Chwatt, 1980).

2.11.6 Vaccine development

An effective malaria vaccine has been a goal of researchers for more than 30 years. Many malariologists believe that different types of malaria vaccines may be necessary for different populations. Whether or not this turns out to be the case, it is found useful to think about the extremes of requirements for a malaria vaccine.

One requirement is to reduce the incidence of severe malaria and malaria associated mortality in infants and children with heavy exposure to *Plasmodium falciparum*, such as those living in the sub-Saharan Africa - type 1 vaccine. At the other extreme is the requirement to prevent all clinical manifestation of malaria in individuals from areas with no exposure who travel to regions where malaria is endemic, primarily malaria caused by *P. falciparum* and *P. vivax* - type 2 vaccine, (Warrell and Gilles, 2002). These "extreme" approaches to malaria vaccine development do not take into account specifically populations affected by malaria who fall between these extremes, particularly individuals in endemic regions at high risk of *P. vivax* infections. As type 1 and type 2 vaccines are developed they will need to be assessed in many different types of populations.

There is a third type of vaccine being developed, a transmission blocking vaccine. This is not designed to protect the immunized individual, but the entire community by reducing transmission intensity (Warrell and Gilles, 2002).

During the past two decades, there has been much interest in developing a vaccine that induces anti-bodies to attack the sexual stage of the parasites *(gametocytes gametes, zygotes, ookinetes),* either in the human host or within the mosquito (Kaslow, 1996). If administered alone, such a vaccine would not provide any direct benefits to the recipient but could reduce transmission in the community (altruistic vaccine). It is believed that such a vaccine will eventually be combined with type 1 and/or type 2 vaccines. The target populations for such a vaccine are not clearly defined. Such a vaccine would unquestionable be of great value, perhaps even on its own, on islands with malaria, and in areas with only modest transmission. It might also be useful during prolonged epidemics. It is not clear how such a vaccine will be in areas like sub-Saharan Africa, where transmission is intense.

A number of clinical trials on developed malaria vaccines have already been completed and numerous others are planned or in progress but have shown no significant efficacy (Stoute *et al*., 1998; Kester *et al.,* 2001; D'Alessandro *et al.,* 1995; Nonsten *et al.,* 1996; Urdeneta *et al.,* 1998). However, the human models the type 1 and type 2 (the naturally acquired immunity and the irradiated *sporozoite*) indicates that the development of a malaria vaccine is feasible. It is believed that the next 10 - 25 years will see the development of effective malaria vaccines, and that these will be used to control the effects of the disease worldwide and, when combined with other interventions, will be able to eradicate malaria from many areas (Warrell and Gilles, 2002).

2.12 Economic costs of malaria

Malaria presents major obstacles to social and economic development. Malaria has been estimated to cost Africa more than US$ 12 billion every year in lost GDP, though it could be controlled for a fraction of that sum (RBM, 1998). In Africa today, malaria is understood to be both a disease of poverty and a cause of poverty. Nine out of ten cases of malaria worldwide occur in Africa south of Sahara and those who suffer most are some of the continents most impoverished and malaria keeps them poor. A poor family living in malaria-affected areas may spend up to 25% or more of its annual income on prevention and treatment. It has slowed economic growth in

African countries by 1.3% per year and as a result of the compounded effect over 35 years, the GDP level for African countries is now up to 32% lower than it would have been in the absence of malaria (RBM/WHO, 2000). Malaria has significant measurable direct and indirect costs, and is a major constraint to economic development. The direct costs of malaria include a combination of personal and public expenditures on preventive and treatment of the diseases. Personal expenditures include individual or family spending on ITNs, doctors' fees, anti-malarial drugs, transport to health facilities, support for the patient and sometimes on accompanying family member during hospital stays. Public expenditures include spending by government on maintaining health facilities and health care infrastructure, publicly managed vector control, education and research. The indirect costs of malaria include lost productivity or income associated with illness or death like lost workdays or absenteeism from formal employment (RBM/WHO, 1998; Warrell and Gilles, 2002; Goodman *et al.,* 2000).

Several studies have been carried out on the effect of malaria on labour productivity in sub-Saharan Africa (Audibert, 1986; Saurborn *et al.,* 1995; Shepard *et al.,* 1991; Ettling *et al.,* 1994). Shiff *et al.,* (1996) found that children unprotected by impregnated bed nets grew less in a 5 month period and were twice as likely to be anaemic as protected children, although presumptive treatment was available to both groups. There is good evidence on the association between Iron Deficiency Anaemia (IDA) and poor performance in infant development scales, IQ and learning tasks in pre-school children and educational achievement among school – age children (Pollitt, 1997; Pollitt, 1993; Soewondo *et al.,* 1989). Lozoff *et al.,* (1991) observed that IDA among infants predicted poorer performance in cognitive tests at a later development period. In Africa, malaria is considered the single most important cause of seizures in early childhood. In Kenya, Wariuru *et al.,* (1996) found that malaria accounted for 31.3% cases of seizure. Asindi *et al.,* (1993) and Axton and Siebert (1982) have provided further evidence on the proportion of seizures attributed to malaria, ranging from 70% in Nigeria to 16% in Zimbabwe. Around 10% of children with cerebral malaria and 1% to 3% of adults have residual neurological sequelae (Mai, 1996). Brewster *et al.,* (1990) followed up Gambian children with cerebral malaria, and found that 11% of survivors had neurological sequelae at discharge, of whom half made a full recovery and 26% had major residual handicaps, mainly severe cerebral palsy and blindness. They suggested that the possibility that cerebral malaria produced intellectual impairment in children who have apparently recovered could not be discounted.

Cost is an important consideration in the choice of treatment and economic factors and can also be related to delays in seeking treatment. Even when treatment in a health centre is free, individuals may incur costs for transportation. Self -medication for malaria is widely practised in the world and the reasons range from the distance and cost of seeking care from the formal health services to cultural beliefs (Foster, 1995). Governments are increasingly asking their populations to pay for services or for drugs or for both. If such user charges are well designed and affordable, they can have a positive impact on rational use of drugs. However, there is a growing body of evidence to show that user charges often have four types of negative impact which are relevant to malaria control (WHO, 1990b): utilization of health facilities declines; self- medication from "unofficial" sources increases; those patients who continue to frequent health services demand better services; and finally people cannot find the cash at the times of the year when malaria is most prevalent, that is, during the rainy season just before the harvest. People in Ashanti-Akim district in Ghana found fees to meet health services too high and instead turned to self- medication at local shops and market sellers, since they could obtain small amounts of drugs there, which were cheaper than the fees at the health services (Waddington and Enyimayew, 1989). If self-medication failed, patients could go for treatment on about the fourth or fifth day of their illness.

Since the inception of Roll Back Malaria in 1998, and particularly since the Abuja Summit 2000, malaria prevention and control have once again become domestic and international priorities. International spending for malaria has increased at least two-fold since 1998 (US$ 60 million to US$ 120 million for 2002) (WHO/UNICEF, 2003). Through the work of national and international RBM partners, the renewed importance of malaria is reflected in the development of country strategic plans, the recognition of malaria control actions as a global public goal and the prioritization of malaria in development initiatives.

Resources required to roll back malaria are located in adverse set of institutions including governments, NGOs, the international community, the private sector and civil society. Malaria control is thus financed through mainly three methods: private – primarily household; government expenditures; and the donor support. The contribution of different sources in African health expenditure is: private (out-of-pocket), 42%; donors, 39%; and government, 19%. These make up the bulk of health and malaria control financing in Africa south of the Sahara (WHO/UNICEF, 2003). Where governments have a budget line for malaria; this generally relates to specific preventive measures (e.g. purchase of insecticide), which are likely to be a very small percentage of total malaria-related expenditures (Goodman *et al.,* 2000). The numbers of patients seeking care for suspected malaria and estimates of the unit cost of treatment suggest that public expenditure on malaria is likely to be substantial.

For example, around 20% to 40% of outpatient visits in sub-Saharan Africa are for fever (the proportion of these that are actually malaria will vary greatly by area and season), and suspected malaria amongst inpatients ranges in different studies from between 0.5% to 50% of admissions (Hill *et al.,* 1996; Brinkman and Brinkman, 1991; Najera and Hempel, 1996). The average recurred cost for inpatient treatment for severe malaria is US$ 35 per admission in a typical Kenyan district hospital (Kirigia *et al.,* 1998). Ettling and Shepard (1991) estimated that approximately 19% of the operating budget of the Rwandan MOH was spent on malaria treatment in public facilities. Kirigia *et al.,* (1998) estimated that 15% of the annual recurrent costs on inpatient care in the Kilifi district hospital, and 9% in the adjacent Malindi sub-district hospital were absorbed by paediatric malaria admissions.

People in Africa south of the Sahara are overwhelmed by the burden of paying for malaria prevention and treatment through out-of-pocket expenditure. The lack of government resources for malaria prevention and treatment contributes to shifting the burden of expenditure to households. Evidence suggests that most of this expenditure is on pharmaceuticals, the cost of which will further rise with the introduction of new anti-malarial made necessary by increasing resistance to current drugs (WHO/UNICEF, 2003).

The Global Fund for AIDS, Tuberculosis and Malaria is an exciting new source for significant direct support for malaria control in Africa. Commitments from the Global Fund to fight AIDS, Tuberculosis and Malaria have significantly increased the financial resources for malaria control in Africa. Over the next 2 years, the Global Fund is expected to disburse US$ 256 million for malaria control activities in 25 African countries (WHO/UNICEF, 2003).

In the Abuja Declaration, African heads of states called for the allocation of new resources - at least US$ 1 billion per year - from African countries and their development partners. They also pledged to reduce or waive taxes and tariffs for mosquito nets and materials, insecticides, anti-malarial drugs and other recommended goods and services that are needed for malaria control strategies (RBM/WHO, 2000).

CHAPTER 3 : MATERIALS AND METHODS

3.1 Study area/site

The study was conducted in the three locations of the Likoni Division namely Likoni, Mtongwe and Shika Adabu (Figure 3.1). Likoni Division is one of the four divisions in Mombasa District in the Coast Province of Kenya. The other three are Kisauni, Changamwe and the Island.

Mombasa District lies between the latitudes 3° 80' and 4° 10' south of the Equator and between 39° 60' and 39° 80' east of the Greenwich Meridian. It borders Kilifi District to the north, Kwale District to the south and west and the Indian Ocean to the east (ROK, 1997). Likoni Division is situated on the mainland south of the District and about 3km from Mombasa town. It has a population of 105,736. Likoni, Mtongwe and Shika Adabu have a population of 66163, 23604 and 15964 respectively (CBS, 2002). It has an area of $64km^2$.

The rainfall pattern has two distinct seasons. Long rains occur between the months of March and June, with a 60% reliability. The mean annual rainfall is about 1,100mm, with the months of May and June recording the heaviest rains. The month of May has the highest precipitation with a mean monthly rainfall of about 375.44mm. The long rains decrease gradually after May. The short rains start from October to December or January. Besides the seasonal rainfall, the area also experience localised conventional type of rainfall due to the land and sea breeze.

Malaria is the leading cause of morbidity and mortality constituting 33.4% of all illnesses reported in Mombasa District (ROK, 1997). Conversely, it is the leading cause of morbidity in Likoni Division accounting to 49.9% of all outpatient cases reported followed by respiratory diseases with 21.1% (ROK, 1997). Three

Government health facilities: a health centre and two dispensaries with several other private clinics serve the Likoni Division. The population is cosmopolitan but majority in the study area are the Digo tribe. In fact, in few villages, almost the entire population is the Digo tribe. The study area is basically urban with most of its land area occupied by residential settlements, therefore, very little agriculture activities are carried out, and there are no large farms. These include growing of maize and cassava for subsistence and coconuts, cashew nuts and mangoes as cash crops. People earn their living through subsistence farming, fishing, businesses, salaries and wages. Very few people keep goats, cattle and poultry for both domestic consumption and as a source of income.

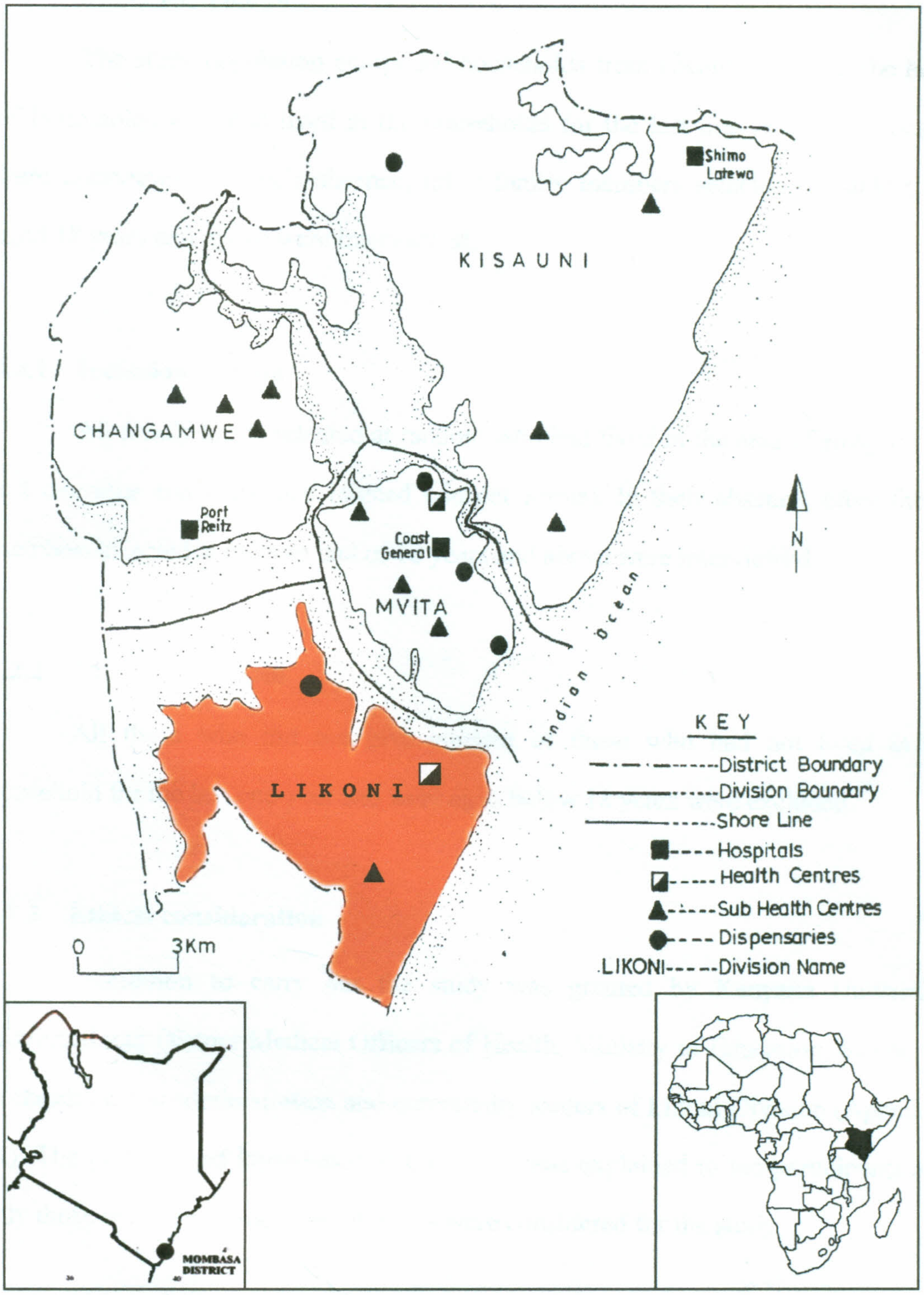

Figure 3.1: Map of Mombasa District showing the position of the study area

3.2 Study population

The study population comprised households from Likoni Division. The heads of households who had lived in the households for the last one-year and consented were interviewed. In their absence, other family members selected at random and aged 18 years and above were interviewed.

3.2.1 Inclusion criteria

All family heads selected at random who had lived in the area of study for the last one-year and consented (signed consent forms). In their absence, other family members selected at random and of 18 years and above were interviewed.

3.2.2 Exclusion criteria

All those who did not give consent or those who had not lived in the household for the last one-year and were aged below 18 years were excluded.

3.2.3 Ethical consideration

Permission to carry out the study was granted by Kenyatta University, Provincial and District Medical Officers of Health, Ministry of Education, Science & Technology, the administration and community leaders of Likoni Division (Appendix IX). The purpose and importance of this study was explained to the participants and only those who signed the consent forms were considered for the study.

3.3 Study design

The study was descriptive, cross-sectional and both qualitative and quantitative data was collected. This included socio-demographic characteristics of study population, level of knowledge on malaria, health-seeking behaviour for malaria and preventive measures of malaria by respondents.

3.4 Sampling and Sample size determination

3.4.1 Sampling

The study area has three locations: Likoni, Mtongwe and Shika Adabu with 6616, 2360 and 1596 households respectively (CBS, 2002). Cluster sampling procedure was used to recruit 400 households from all 39 villages in the study area. Likoni location has 23 villages, Mtongwe 9 villages and Shika Adabu 7 villages. The villages formed the clusters in each location. The clusters of each location were listed in a random order and by using a table of random numbers, three clusters (villages), one from each location, were selected (Bomani, Midodoni and Vijiweni). For determination of the number of households to be sampled in each location, a simple random sampling method was used. The households in each location were given numbers, marked on the doors with a chalk, and the same numbers were put down on pieces of paper that were placed in a container. The numbers were then picked at random until the required sample size for that location was attained. The required sizes of sampling units (households) were then recruited from each of the three locations. Bomani village was selected among the villages of Likoni Location, Midodoni and Vijiweni villages from Mtongwe and Shika Adabu locations respectively.

3.4.2 Sample size determination

Sample size was determined using the formula as used by Fisher *et al.* (1998)

$$N = \frac{Z^2 pqD}{d^2}$$

Where:

n = the desired sample of households (target population > 10,000)

Z = the standard normal deviate usually 1.96 (≈ 2) which corresponds to 95% confidence level

p = the proportion in the target population estimated to have particular characteristics being measured = 0.05

q = 1-p i.e. (1-0.5) = 0.5 D = Design effect = 1

d = Degree of accuracy = 0.05

Therefore the sample size will be: $n = \frac{(2^2)(0.5)(0.5) I}{0.05^2}$

n = 400 households.

Probability proportional to the size of the number of households in each location was used to get the required sample size for each location.

Thus:

For Likoni location $\frac{6616 \times 400}{10572}$ = 250 households

Mtongwe location $\frac{2360 \times 400}{10572}$ = 89 households

Shika Adabu location $\frac{1596 \times 400}{10572}$ = 61 households

Total = **400** households

3.5 Data collection & Research instruments

The data was collected from April to July 2004. Both qualitative and quantitative data collection methods were used in this study. Data collection was done using interview schedules, observation checklists and focus group discussions. The responses were all recorded down as the respondents were interrogated. A pre-test of the research instruments was done in a place similar in characteristics to Likoni community and were restructured accordingly to meet the needs.

3.5.1 Data collection by interview schedules and observation checklists

The first phase of data collection was by the use of interview schedules and the observation checklists (Appendices I and II). Both quantitative and qualitative data were collected since the interview schedules had both structured and unstructured questions while observations were made through the observation checklists.

The research tools were subjected to field pre-tests before the actual data collection commenced. The exercise helped in refining the wording and order of questions in the research instruments. The pilot study also assisted in establishing codes for most possible responses. It is also during the pre-tests that a decision was arrived at of picking at random the head of the household among the other heads of the household members to be interviewed. Going by the mere picking of the head of the household would be recruiting very old people in the exercise, as most of the heads of households are old. The interview schedules were administered by the researcher because of the technicalities of some of the questions and partly due to respondents' educational level. At times the responses were written in Swahili to help in clarity during English translation. The observation checklists had 10 behaviours to be observed but the respondents assisted where there was need.

I was also accompanied by the headman of each village to ease the exercise, as he facilitated contacts with the community and at times used as the "on the spot" interpreter - assisted the interviewer in both literal and cultural translation. The interview schedules were administered in Kiswahili (the national language), the language that the respondents were most conversant in and on rare occasions in English. The numbers of households covered were 250 for Bomani, 89 for Midodoni and 61 for Vijiweni villages of Likoni Division.

3.5.2 Focus group discussions (FGDs)

The second phase of data collection was through focus group discussions in each of the location (Likoni, Mtongwe and Shika Adabu). Three FGDs were, therefore, conducted with representatives from community's control programmes (Bamako Village Initiatives), headmen of villages, members of women groups and representatives of NGO community projects like PSI and AMURT. Each group comprised of eight members with both men and women included. All the questions were discussed exhaustively with the members (Appendix III).

3.5.3 Interview guides

Qualitative method of data collection was used to get deeper information on malaria disease. Quantitative method of data collection was also used. In fact both quantitative and qualitative methods of data collection supplement each other in that some objectives in a research are better addressed using qualitative methods while others are better addressed using quantitative methods (Mwenesi, 1993; Mugenda and Mugenda, 1999).

In-depth interviews conducted, comprised the Government Health facilities' staff of the three locations, Likoni, Mtongwe and Shika Adabu of Likoni division. Some of the issues sought in this study were the problems associated with malaria and what preventive and control measures were adopted. All the ten issues as per the interviews guide (Appendix IV) were discussed to obtain in-depth information on the interviews. Members of Likoni Health Centre included a Clinical Officer In-Charge, a Public Health Officer, a Public Health Technician and a Nursing Officer; Mtongwe Dispensary - three Nursing Officers and a Malaria Control Technician; and Shika Adabu Dispensary - two Nursing Officers, a Public Health Technician and a Malaria Control Technician.

3.6 Data management and Analysis

Data collected was processed by using SPSS (Statistical Packages for Social Sciences) software. The data was analysed using Chi- square test relationships between variables. Data analysis was restricted to specific variables, which fell in categories of the stated objectives.

CHAPTER 4 : RESULTS

4.1 Socio-demographic characteristics of the respondents

Data from a total of 400 respondents was analysed. The mean age of the respondents was 32.5 years with a standard deviation of 4.5 and a range of 38 - 47 years. There were more females (70%) than the male (30%) respondents. Majority of the respondents were married (72%). 17.5% of the respondents were employed. The rest included businessmen (35%), farmers (1.0%) and 4.0% part-time jobs (wage employment). The Muslim faith had the majority of respondents (80%), with Christians accounting 20%. At least 23.3% of the respondents completed primary level of education while 7.5% of the respondents had no formal education at all (Table 4.1).

4.2 Knowledge on malaria

Out of 400 respondents only 2 (0.5%) claimed not to have suffered from malaria in their lifetime but virtually all the respondents had heard about malaria. 380 (95%) respondents at least mentioned "mosquito bite" as the cause of malaria. 73.3% of the respondents, however, confused the cause of malaria with other causes like eating too many mangoes and contaminated water. 87 (21.8%) respondents mentioned mosquito bite and none other cause (Table 4.2).

Table 4.1: Socio-demographic characteristics of the respondents

Variable	Frequency	Percentage
Age of respondents		
18 - 27	180	45.0
28 - 37	100	25.0
38 - 47	80	20.0
48 +	40	10.0
Sex of respondents		
Female	280	70.0
Male	120	30.0
Religion of respondents		
Muslim	320	80.0
Christian	80	20.0
Marital status of respondents		
Single	70	17.5
Married	288	72.0
Divorced	38	9.5
Separated	4	1.0
Level of education of respondents		
Primary education	233	58.3
Secondary education	130	32.5
University	2	0.5
Adult education	5	1.3
None	30	7.5
Occupation of respondents		
Farmers	4	1.0
Salaried	70	17.5
Business	140	35.0
Unemployed / Housewife	170	42.5
Other (wage employment)	16	4.0

Table 4.2: Modes of malaria transmission by respondents (n = 400)

	Frequency	Percentage
Mosquito bite and other causes	293	73.3
Through mosquito bites	87	21.7
Contaminated water	10	2.5
Eating too many mangoes	2	0.5
When heavily rained on	4	1.0
It is inherited	4	1.0

An average of 69.75% of the respondents knew the signs and symptoms of malaria with fever, nausea and vomiting, headache and chills mentioned as the principal features. Only 6 respondents (1.5%) claimed not to know signs (Table 4.3).

210 respondents (52.5%) mentioned radio as the main source of information about malaria followed by health personnel 99 (24.8%) (Table 4.4).

80 (20%) of the respondents knew how malaria is spread from an infected person to a healthy person. 50 (12.5%) of the respondents said it was not possible and 40 (10%) of them affirmed not knowing.

For the level of knowledge on the cause of malaria among respondents refer to Appendix V and Figure 4.1.

A significant statistical association was found between the level of education and the level of knowledge on the cause of malaria among the respondents ($\chi^2 = 48.19$; $df = 8$; $p < 0.001$) (Table 4.5).

4.3 Health seeking behaviour in malaria

240 (60%) respondents bought drugs from shops, 40 (10%) bought from chemists, 15 (3.75%) bought from control programmes (Bamako and Village Initiatives), 74 (18.5%) visited health facilities and 31 (7.75%) were treated by traditional healers. The study revealed that majority of the respondents (73.75%) self-treated themselves (Figure 4.2).

Table 4.3: Signs and symptoms of malaria as reported by the respondents

	Frequency	Percentage
Chills	286	71.5
Headache	304	76.0
Joint pains	240	60.0
Nausea & vomiting	361	90.25
Loss of appetite	209	52.25
Sweating	190	47.5
Abdominal pain	95	23.75
Fever	361	90.25
Body weakness	140	35.0
Dizziness	120	30.0
Do not know	6	1.5

Table 4.4: Sources of information on malaria (n = 400)

	Frequency	Percentage
Radio	210	52.5
Newspaper/magazines	50	12.5
Health personnel	99	24.75
TV	20	5.0
Friends	21	5.25

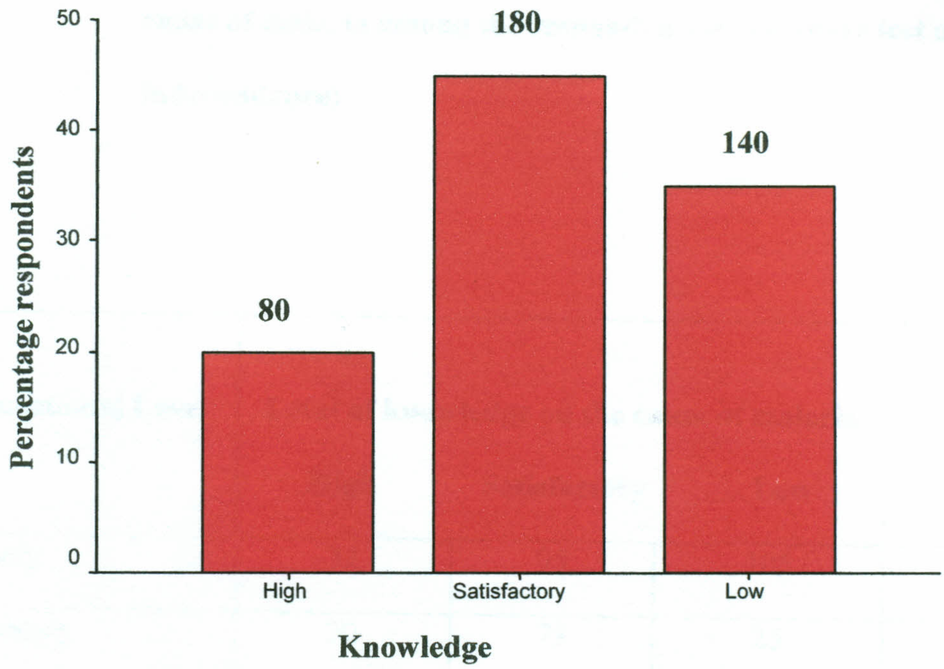

Figure 4.1: Level of knowledge on the cause of malaria among the respondents

Table 4.5: Level of education in relation to the level of knowledge on the cause of malaria among the respondents (Chi-square test of independence)

Educational Level	Level of knowledge on the cause of malaria			Total
	High	Satisfactory	Low	
Primary	33	95	105	233
Secondary	30	75	25	130
University	2	0	0	2
Adult education	3	2	0	5
None	12	8	10	30
Total	**80**	**180**	**140**	**400**

($\chi^2 = 48.19$; df = 8; $p < 0.001$)

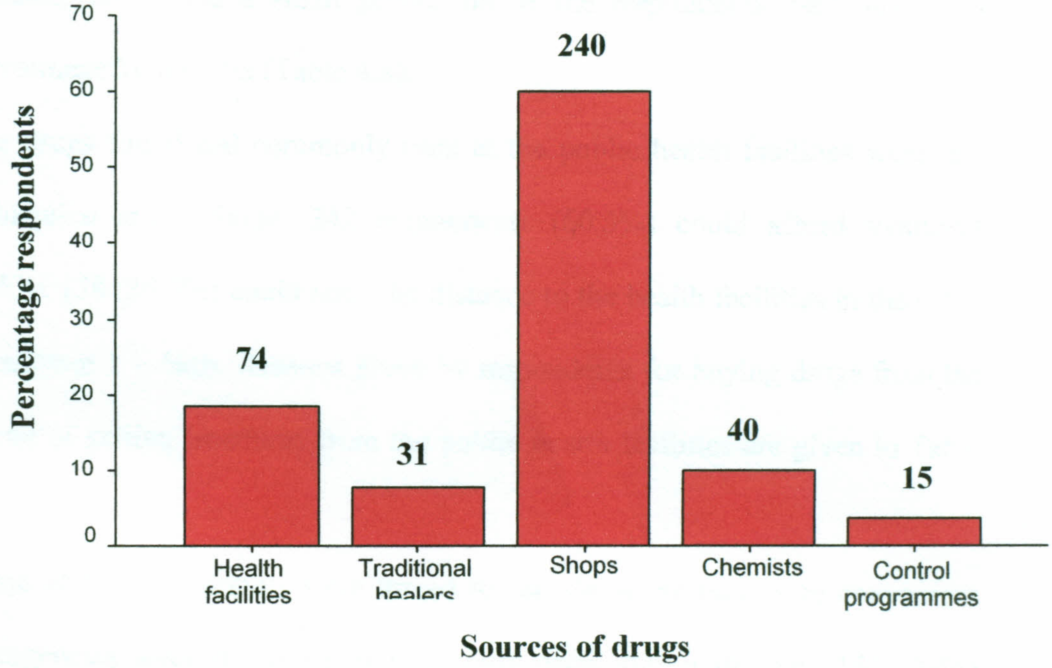

Figure 4.2: Health seeking for malaria among respondents

The most frequently reported types of drugs purchased/used were the Malaratab® followed by the SP drugs (Fansidar® and Metakelfin®). Traditional herbs had (10.2%), combination of traditional herbs and common anti-malarials (2.7%). These drugs were either used alone or in combination with the analgesics/antipyretics and a small proportion of the respondents used analgesics alone as treatment for malaria (Table 4.6).

The drugs found and commonly used at the public health facilities were: the SP, amodiaquine and quinine. 242 respondents (60.5%) could afford treatment services while 158 (39.5%) could not. The distance to the health facilities in the study area was between 1 – 5km. Reasons given by respondents for buying drugs from the shops instead of getting treatment from the public health facilities are given in Table 4.7.

Some of the respondents were forced to use shops, as they were convenient during emergencies since dispensaries were only open during the day. 156 (39%) respondents were satisfied with the services at public health facilities while 244 (61%) were not.

For the level on health seeking behaviour among the respondents refer to Appendix VI and Figure 4.3.

4.4 Preventive measures

The mosquito breeding sites by respondents were mainly stagnant water (50%), banana plantations (10.25%), discarded containers that hold water (20.75%), vegetation which includes tall green grass (10%), heaps of refuse (6%), dark places (0.75%) while 2.25% did not know (Table 4.8).

Table 4.6: Drugs used in treatment of malaria among respondents (n = 295)

	Frequency	Percentage
Metakelfin®	15	5.1
Malaratab®	135	45.76
Hedex®	5	1.7
Action	3	1.0
Fansidar®	20	6.8
Traditional herbs ("Muarubaini")	30	10.2
Aspirin	4	1.3
"Muarubaini" plus common anti-malarials mentioned	8	2.7
Malaratab® plus analgesics/antipyretics	55	18.64
Fansidar® plus analgesics/antipyretics	10	3.4
Metakelfin® plus analgesics/antipyretics	10	3.4

Table 4.7: Reasons for under utility of public health facilities by respondents

	Frequency	Percentage
Shortage of drugs	244	61.0
Fears of long queues	113	28.3
Members of staff not cooperative	90	22.5
Drugs given seem not to heal malaria	101	25.3
Lack of laboratory facilities	70	17.5

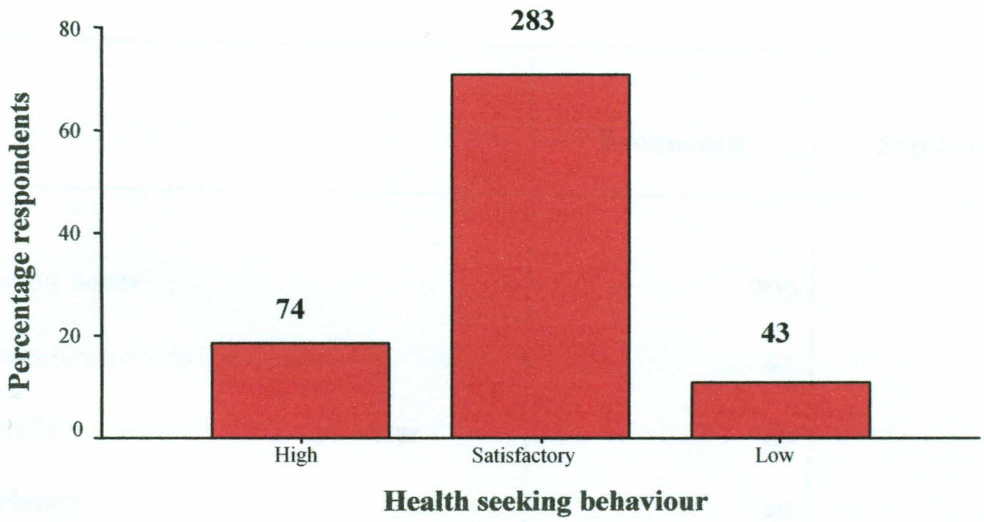

Figure 4.3: Level on health seeking behaviour among the respondents

Table 4.8: Knowledge on breeding sites of mosquitoes among respondents (n=400)

	Frequency	Percentage
Stagnant water	200	50.0
Banana plantations	41	10.25
Discarded containers that hold water	83	20.75
Vegetation	40	10.0
Heaps of refuse	24	6.0
Dark places	3	0.75
Do not know	9	2.25

The responses on the controlling of breeding of mosquitoes were by the elimination or abating of nuisances or imposing corrective measures on the different categories as has been highlighted in Table 4.8. Thus, this became apparent as two major areas of action: environmental sanitation by 388 (97%) of the respondents, which ranged from draining/filling with soil water catchment areas/trenches, drains etc to dosing stagnant water with oil (used engine oil); and good housing by 3 (0.75%) of the respondents, to live in houses with good lighting and ventilation to eliminate dark places. 9 (2.25%) respondents affirmed not knowing anything.

On the methods to prevent mosquito bites, 35% of the respondents used mosquito coils/aerosol sprays, 28.25% of the respondents used bed nets (25.7% of the nets were treated) and 16.5% of the respondents used local repellents. 48 (12%) of the respondents just depended on cover-up with bed sheets when sleeping and closing windows early during the day. 100 (25%) of the respondents used aerosol sprays to kill mosquitoes (Table 4.9).

Majority of the respondents (71.8%) were against malaria prophylaxis regimens expressing fear that this could lead to drug resistance. 46% of the respondents thought taking of alcohol heavily reduced chances of getting infected and 10.3% thought making body active through exercises repelled malaria parasites invasion. Of those who took prophylaxis drugs 26 (6.5%), 10 of them bought drugs from the shops while 16 of them took “muarubaini” (neem) medication (Table 4.10).

190 pregnant women (90.5%) attended MCH clinic, while 20 (9.5%) never attended the clinic at all. The number of pregnant women that were given IPT on site was 73 (34.8%) compared to 100 (47.6%) given to administer at home. Out of the 210 women, 37 (17.6%) were not given IPT at all (Table 4.11). For the level of preventive measures among the respondents refer to Appendix VII and Figure 4.4.

Table 4.9: Protective measures against mosquito bites by respondents

	Frequency	**Percentage**
Mosquito coils/aerosol sprays	140	35.0
Mosquito net (treated)	29	7.25
Mosquito net (untreated)	84	21.0
Mosquito repellents	12	3.0
Local repellents (herbs):	66	
"Kivumbani" leaves (*Ocium canum*)	30	7.5
"Muarubaini" leaves (*Azadirachta indica*)	36	9.0
Coconut shells/dry grass	21	5.25
Cover-up with bed-sheets and closing of windows alone	48	12.0

Table 4.10: Self protection from malaria among respondents

	Frequency	Percentage
Taking alcohol	46	11.5
Making the body active through exercise	41	10.3
Taking prophylactic drugs	26	6.5
None	287	71.8

Table 4.11: MCH Clinic attendance by pregnant women (n = 210)

	Frequency	Percentage
No. of pregnant women attended clinic	190	90.5
No. of pregnant women not attended clinic	20	9.5
No. of pregnant women given IPT on site	73	34.8
No. of pregnant women given IPT but not on site	100	47.6
No. of pregnant women not given IPT at all	37	17.6

No. = Number.

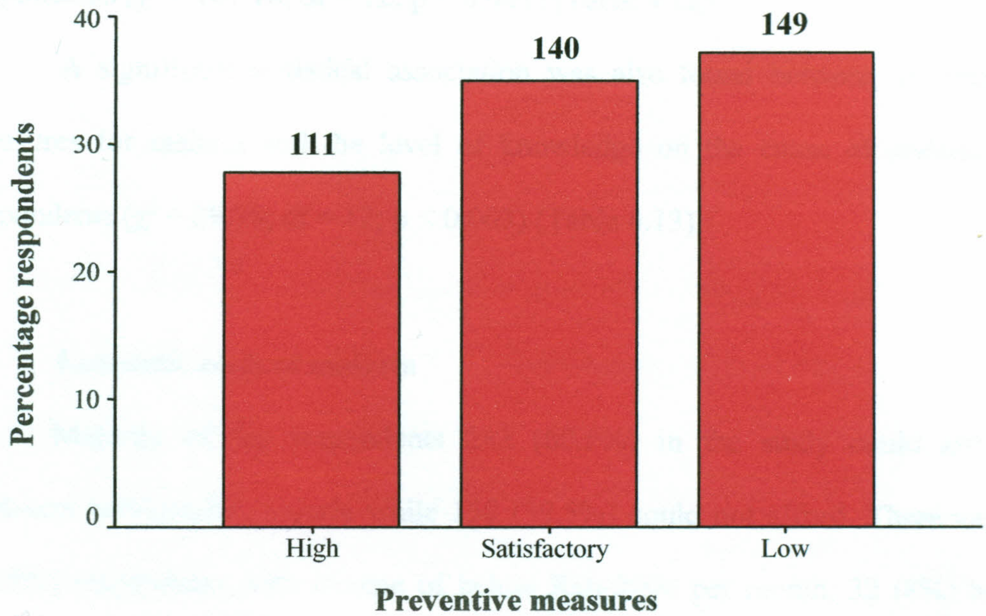

Figure 4.4: Level of preventive measures among the respondents

A significant statistical association was found between knowledge of the breeding sites of mosquitoes and the level of knowledge on the cause of malaria of the respondents ($\chi^2 = 167.18$; df = 12; $p < 0.001$) (Table 4.12).

A significant statistical association was also found between the preventive measures for malaria and the level of knowledge on the cause of malaria of the respondents ($\chi^2 = 29.78$; df = 12; $p < 0.003$) (Table 4.13).

4.5 Economic costs of malaria

Majority of the respondents 242 (60.5%) in the study could afford the treatment services for malaria while 158 (39.5%) could not afford. There were 150 (37.5%) respondents with income of below Ksh 2000 per month, 32 (8%) between Ksh 2000 to 4000 per month and 218 (54.5%) of above Ksh 4000 per month (Figure 4.5).

A significant statistical association was found between the level of income and the community health seeking behaviour ($\chi^2 = 73.70$; df = 8; $p < 0.001$) (Table 4.14).

A significant statistical association was also found between the level of income and the preventive measures against malaria among the respondents ($\chi^2 = 57.35$; df = 12; $p < 0.001$) (Table 4.15).

The burden of meeting the costs of malaria by the residents is evidenced by the results gathered through the observation checklists. Many households did not have soak pits (72.25%) and window screens (87.5%) (Table 4.16).

Table 4.12: Knowledge on breeding sites of mosquitoes in relation to the level of knowledge on the cause of malaria among the respondents (Chi-square test of independence)

Breeding sites	Level of knowledge on the cause of malaria			Total
	High	Satisfactory	Low	
Stagnant water	10.	104	86	200
Banana plantations	31	7	3	41
Discarded containers that hold water	7	48	28	83
Vegetation	20	12	8	40
Heaps of refuse	10	8	6	24
Dark places	2	1	0	3
Do not know	0	0	9	9
Total	**80**	**180**	**140**	**400**

($\chi^2 = 167.18$; df = 12; $p < 0.001$)

Table 4.13: Relationship between the preventive measures for malaria and the level of knowledge on the cause of malaria among the respondents (Chi-square test of independence)

Preventive measures	Level of knowledge on the cause of malaria			Total
	High	Satisfactory	Low	
Mosquito coils/aerosol sprays	40	60	40	140
Mosquito net (treated)	5	12	12	29
Mosquito net (untreated)	14	40	30	84
Mosquito repellents	7	4	1	12
Local repellents	4	32	30	66
Coconut shells/dry grass	3	10	8	21
Cover up with bedsheets and closing of windows	7	22	19	48
Total	**80**	**180**	**140**	**400**

($\chi^2 = 29.78$; df = 12; p = 0.003)

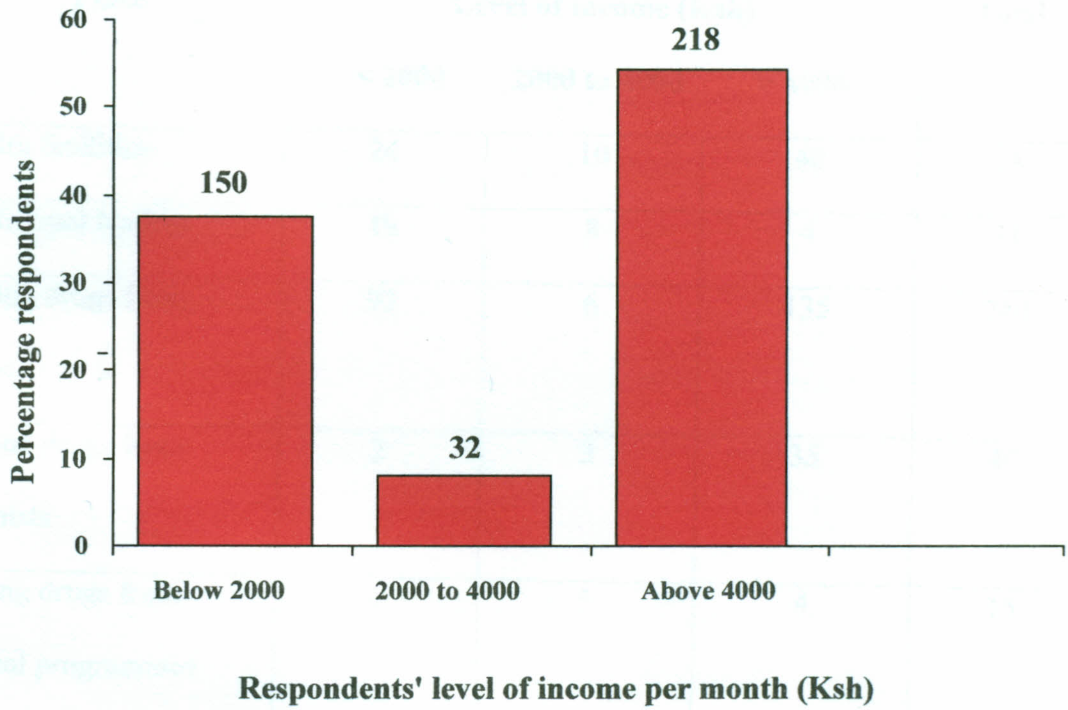

Figure 4.5: Level of income of the respondents

Table 4.14: Association between the level of income and the community health seeking behaviour (Chi-square test of independence)

Place	**Level of income (Ksh)**			**Total**
	< 2000	**2000 to 4000**	**> 4000**	
Health facilities	24	10	40	74
Traditional healers	19	8	4	31
Buying drugs from shops	99	6	135	240
Buying drugs from chemists	2	3	35	40
Buying drugs from control programmes	6	5	4	15
Total	**80**	**180**	**140**	**400**

($\chi^2 = 73.70$; df = 8; $p < 0.001$)

Table 4.15: Level of income in relation to the preventive measures against malaria among the respondents (Chi-square test of independence)

Preventive measures	**Level of income (Ksh)**			**Total**
	< 2000	**2000 to 4000**	**> 4000**	
Mosquito coils/aerosol sprays	50	8	82	140
Mosquito net (treated)	2	9	18	29
Mosquito net (untreated)	31	6	47	84
Mosquito repellents	3	2	7	12
Local repellents	28	3	35	66
Coconut shells/dry grass	19	1	1	21
Cover up with bedsheets and closing of windows	17	3	28	48
Total	**150**	**32**	**218**	**400**

($\chi^2 = 57.35$; df = 12; $p < 0.001$)

Table 4.16: Conditions prevailing among households in the study area

Variable	Frequency	Percentage
Mosquito screens on windows		
Present	50	12.5
Absent	350	87.5
Pools of stagnant water		
Present (with larvae)	95	23.75
Present (without larvae)	44	11.0
Absent	261	62.25
Soak pits		
Present	111	27.75
Absent	289	72.25
Discarded empty containers		
Present	12	3.0
Absent	388	97.0
Lighting and ventilation		
Windows present	373	93.25
Windows absent	27	6.75

CHAPTER 5 : DISCUSSION

5.1 Knowledge on Malaria

Most of the respondents had heard or suffered from malaria in the past. This study revealed that the community was knowledgeable on the cause of malaria as 380 (95%) respondents mentioned "mosquito bite" as the cause of malaria. 73.3% of the respondents, however, confused the cause "the bite of a mosquito" with other causes compared with 21.7% who were absolutely correct. A smaller proportion of the respondents (5%) missed the cause altogether. The statistical relationship (Chi-square test of independence) between the level of education and the level of knowledge on malaria was significant ($p < 0.001$). Majority of the respondents (92.5%) attained some education while 30 (7.5%) never went to school at all. At least 12 respondents (40%) of those who never went to school correctly mentioned the cause, but these being less than a half of them, still conform to the statistical relationship. These got the information from the health personnel in the health facilities. Those who confused it, further associated malaria with taking contaminated water or wading in contaminated water where mosquitoes breed, eating too many mangoes and exposed to cold, especially when rained on. Mangoes were conceived infected by "poisons" of mosquitoes when the mosquitoes suck them whereas others thought mangoes themselves to be infectious especially those that are very sweet. This is not surprising as the causation of malaria, is not well appreciated by many communities in developing countries (Ongore *et al.,* 1989; Ruebush *et al.,* 1992). Another striking outcome was on the mode of transmission of malaria. Only 21.8% of the respondents were on the right track in response to the question "can malaria be passed from an infected person to a healthy person?" The varied responses were: sharing food/water contaminated by a victim; droplet infection; skin contact because of the heat/sweat especially of a mother and her baby; sexual contact, through blood and mucous membranes; and breast feeding- mother to a child transmission. As has been seen that mosquitoes were by far the most commonly reported cause of malaria, views differed as to how the insects acquired the infection: few informants considered that this happened when an infected person was bitten, majority almost 80% said the infection originated in dirty water and still a few believed that it was intrinsic to the mosquitoes. An average of 69.75% of the respondents knew the signs and symptoms of malaria. The main features mentioned by more than 70% were fever, nausea/vomiting, headache and chills, tallying with some other studies carried out (Kaseje *et al.,* 1987 b; Ruebush *et al.,* 1995).

The results of the study have also shown that radio was the main source of information on malaria. This is dependent on the ability of the respondent to afford a radio and the initiative to listen to which cannot be controlled. The respondents rather claimed to have learnt/benefited more on malaria through the health personnel but only through clinic attendance or by visiting health facilities contrary to their preference of getting it through public meetings, community mobilisation or from heath education and promotion from house to house as per the FGDs. Only PSI organisation was active in circulating pamphlets on malaria in the community, otherwise even through the researcher's observation, note was made on scarcity of posters and pamphlets from both the shops and at the public health facilities within. Malaria campaign and awareness has been overtaken by the HIV/AIDS scourge, no such activities are in existence, and if any, then very negligible.

5.2 Health seeking behaviour

Prompt and effective treatment of malaria is a critical element of malaria control (WHO, 1993). The primary goal of national health services for malaria treatment in sub-Saharan Africa is to reduce morbidity and mortality through prompt, effective therapy. The trends of seeking treatment by the residents showed that health care was not prompt and may not even be effective in the manner that very few respondents (18.5%) sought treatment from the health facilities as their first choice. 73.8% of them bought drugs from the shops\chemists\control programmes and a few others (7.8%) went to traditional healers. Single treatment of fevers at home with shop-bought drugs was the most common practice and has been well documented in various studies (Snow *et al.,* 1992; Baume *et al.,* 2000; Trape *et al.,* 1987). The public health facilities of the villages that were sampled are within easy reach, in fact just by mere walking but the respondents dodged them. Notably, shortages of drugs and the long waiting times due to long queues and shortages of staff are the key reasons for the respondents absconding the services (Foster, 1991a, b; Igun, 1987; Ruebush *et al.,* 1995). Another reason claimed by the respondents is that the drugs from the public health facilities do not seem to heal malaria but this problem jumps to "drug resistance" section that shall be discussed later. More importantly, still are the discouraging practices of the health workers in that they are encouraging patients to purchase drugs from shops and chemists (Cunningham-Burley and MacClean, 1987; Mnyika and Killewo, 1991). This practise needs to be handled with care, if it should be the case.

Cost was another reason that made the respondents self-medicate themselves. 39.5% of them could not afford the services at the health facilities. Therefore, some used home remedies while others resorted to traditional healers that they thought to be cheap or due to cultural beliefs.

Early diagnosis and prompt treatment is the first step towards the control of malaria. Therefore, a reliable diagnosis whether it is at home or in the health facility is a prerequisite for selecting the correct treatment and reduction of morbidity and mortality (WHO, 1998b). In the 3 villages sampled only one of the three public health facilities had a laboratory with a microscope (Likoni Health Centre). Otherwise the two dispensaries did not have microscopes. Diagnosis of malaria was therefore, presumptive (made clinically). This was not the case with the dispensaries only, but even with the health centre diagnoses are only done when the cases are complicated, severe or chronic (resistant to first drugs administered). In fact, similarities in clinical presentation between malaria and other diseases (especially children) make accurate diagnosis of malaria difficult in the absence of a microscopy (WHO, 1998b; WHO/UNICEF, 2003). However, identifying the parasites in the peripheral blood does not always imply that the individual is sick (Schellenberg *et al.,* 1994). The dual use, should therefore be very valuable in diagnoses of malaria, that is both clinical judgment and microscopic. Those respondents, who bought drugs from the shops, self-diagnosed themselves using the clinical features of malaria (presumptive diagnosis). The most frequently reported symptom for malaria is *homa.* While *homa* is mandatory, reported by 361 respondents, a broad range of other signs and symptoms are important for the respondents to conclude "homa ya malaria" (malaria fever). These included chills, severe headache, joint pains, yellowish vomiting, stomachache, diarrhoea, loss of appetite, general body weakness and dizziness. The most commonly features reported by the residents were fever, nausea/vomiting, headache and chills. Several studies have suggested that fever alone is a poor predictor of malaria especially in highly endemic areas (Schellenberg *et al.,* 1994; Bhatt and Omani, 1984). Likewise, a study in the Philippines by Gomes found that fever alone did not discriminate well for malaria but rather a sequential occurrence of fever, chills and sweating was a good predicator. It further found that the diagnosis was most reliable at home (Gomes *et al.,* 1994). This is backed up (WHO, 1996; Eshuis and Manschot, 1978) in the 3 circles of malaria attack: hot, cold and sweating stages. The minimum number of the respondents that mentioned sweating was 190, which likewise denotes the respondents who collectively mentioned, chills, fever and sweating. Presumably, these are the ones that correct self-diagnosed themselves for malaria the rest may have been fake malaria.

Of the 295 respondents who self-medicated themselves with drugs bought from the shops, chemists, control programmes, only 190 could have been "true" cases of malaria. Moreover, some may have taken incorrect dosages allowing disease progression. This is the "dark area" which is difficult to judge and keenly needs to be looked into because obtaining a full course of anti-malarials does not necessarily lead to completion of a full course and not all self-treated cases could be true malaria cases.

The pattern for seeking health care for the respondents began with either self-medication (majority) or medicinal plants (minority) and shifting to either a health facility or to a traditional healer after failure of the initial treatment. For the latter, it is in the case when a patient (especially children) exhibited convulsions. Convulsions, splenomegaly, anaemia as a result of severe complications of malaria are perceived to be disease entities in themselves and thus have different modes of management depending on perceived aetiological factors (Mwenesi, 1993) and through the FGDs. One common "folk illness" of children given by the members of the FGDs was the

"Nyuni" (degedege). "Nyuni" a Swahili word for weaver birds is thought to be a "jin" (spirit) afflicted disease to children, could be via the birds but its real mode of transmission from the "jin" to child is unknown. This is in accordance to the discussions. This disease accounts for the convulsions to the child.

Another one mentioned is purely "a spirit afflicted" disease to a child also causing convulsions. This occurs in the event that a child was born and had not be shown to the "jin" that the mother possesses - this must have angered the "jin" to afflict the disease to the child in return. Traditional healers who have the skills to detect that or witchcraft through spirit divination can only make these diagnoses. The traditional healer treats them. If at household level at times, like the Nyuni, fails, they resort help from the health facility. In fact, all options must be exhausted before a mother takes a child to a health facility where it is believed that the chances of dying as a result of mishandling are high. For the adult patients, the last option would be to see a medical doctor out of a malaria clinic or a folk healer. In southern Ghana, malaria is thought to be caused by exposure to external heat; very few of those interviewed mentioned mosquitoes as a cause. It is treated at home with herbs or with analgesics; only severe or unusual cases are brought to the health services (Agyepong, 1992). In western Colombia, malaria is thought to be an inflammation of the spleen caused by strenuous exercise or by ingestion of hot food; most rural people do not mention mosquitoes as a cause and some express scepticism about their role, considering them one of many possible causes of malaria. The traditional treatment is to consult a "spleen-prayer" who uses conjurations, ceremonies and herbal remedies (Lipowsky *et al.,* 1992). Under such circumstances, it is easy to understand why delay in presentation at the health services is common and is in fact one reason for the wide spread practice of self-medication.

The drug commonly bought for self-medication by the 295 respondents was mostly the Malaratab® (a proprietary form of chloroquine). A few bought the SP (Metakelfin® and Fansidar®). These drugs were administered either singly or in combination with analgesics/antipyretics. Others who were not well informed on malaria drugs could only use analgesics as treatment for malaria. (Table 4.6) thereby allowing the disease to take its course by giving it time. People came to the health facilities on average of 7 days after onset of signs and symptoms and most of them had used self-medication prior to seeking care at the health facilities (through the interview guide). It is vital that sufferers, especially children aged under 5 years, start treatment within 24 hours of onset of symptoms to prevent progression – often rapid to severe malaria and death (Greenwood *et al.,* 1987) which was not the case. The common anti-malarials that were in use in the public health facilities were the SP (Metakelfin® and Fansidar®), amodiaquine and quinine. All the drugs in use had been reported to be resistant to malaria parasites elsewhere in the world (Rosenthal, 2001; Ridley, 2002: WHO, 2000b). The availability of the drugs in retail contributes to indiscriminate use of drugs, especially under-dosing, which may have contributed to anti-malarial resistance. Drug resistance is a major contributing factor to the spread of malaria especially in Kenyan communities where malaria is endemic.

5.3 Preventive measures

There was a significant statistical association (Chi-square test of independence) between the knowledge of the breeding sites of mosquitoes and the level of knowledge on the cause of malaria ($p < 0.001$). This conforms to the respondents (70.75%) who at least mentioned water as the breeding site. Mosquitoes were mainly thought to breed in stagnant water. 40 respondents (10%) thought mosquitoes breed in vegetation, that is, tall green grass which is a hiding place for mosquitoes. Heaps of refuse was also perceived as a breeding site for mosquitoes as the stagnant water. This was affirmed by 24 (6%) of the respondents. Dark places, by 3 respondents (0.75%), which are the hiding places for mosquitoes. Accounting on their knowledge on breeding sites of mosquitoes, it is obvious that to some, preventive measures on breeding of mosquitoes would not be target specific which could otherwise save a considerable effort in terms of money, time and labour when concentrated on the ideal preventive measures. Fruitless is to those who cling only on clearing of heaps of refuse within their environment in pretext of controlling breeding mosquitoes even though it is a healthy upkeep. Health education generally on the controlling of mosquitoes is a necessary step in the area.

On the methods of protection against mosquito bites, overall use of mosquito nets was low (28.25%). Of the group at risk, the under fives, only 40% of 101 families with under fives were provided with mosquito nets. Majority of the respondents asserted that they used mosquito nets mainly to protect themselves against bites from mosquitoes other than from protection against malaria. Other studies carried out also showed the same effect (MacCormack *et al.,* 1986; Aikins *et al.,* 1994; Bradley *et al.,* 1985). The very few respondents that treated their nets supported this (29 out of 113). Insecticide treated nets (ITNs) offer much greater protection against malaria, not only does the net act as a barrier to prevent mosquitoes, but also the insecticide kills any mosquitoes attracted to feed. Multi-centre controlled trials (Nevil *et al.,* 1995; Binka *et al.,* 1996; D'Alessandro *et al.,* 1995) in African settings of different intensities proved that challenges are facing this method of prevention in that some respondents could not afford them though they had expressed the importance of having them. Some had their own personal reasons for not using them like feeling too hot, suffocated and buried when sleeping under them. All in all the overwhelming burden is the cost of the nets, for people tend to think the cost is too high for them and would be motivated to buy them at a reasonably reduced cost. Other personal protection devices against mosquito bites were used in small scales by the respondents notably, the mosquito repellents. This was used by 12 (3%) respondents. The repellent was diethyltoluamide (DEET®), which is one of the best repellents in use. However, the respondents seemed not to be much knowledgeable in such methods of prevention. The others were the local repellents on which the respondents had formal knowledge on the usage of traditional herbs to expel mosquitoes from their dwellings. The herb like "kivumbani" is claimed to expel mosquitoes from dwellings because of its strong scent and its dry leaves when burnt off the strong smell and smoke does the same. "Muarubaini" leaves also expel mosquitoes from dwellings when its dry leaves are burnt off to give out smoke. It is high time that these herbs be investigated for efficacy, effectiveness and toxicity for man use. Any sort of smoke was also considered to expel mosquitoes out of dwellings, such as burning coconut shells and dry grass by some of the respondents.

Screening of the house will protect the whole family against mosquito bites in contrast to a mosquito bed net that provides protection only for those sleeping under it. The residents screened their houses but only on the window openings leaving openings of the doors. Another constraint is that some houses do not have ceilings making this method incompatible to them. Only 50 households (12.5%) had installed window screens and only an average of 30% of the households' windows had been screened. Those who never used anything, 12% of the respondents, at least adopted the cover-up with bed sheets and closing of windows early in the day as a protection method.

Use of pyrethrum-based products like "doom" and coils was common (60%) but no residual spraying was established in any of the households investigated. Residual spraying has the advantage in that it retains its action for a considerable period when applied to a surface with which adult mosquitoes come into contact whereas space spraying (e.g. doom) usually has an immediate knockdown effect that lasts for a short time only. House spraying and residual insecticide is highly effective in reducing malaria in some parts of Africa (Chandre, 2001). However, the effectiveness is already under threats as a result of emergence of resistance of insecticides reported. Thus, they require constant monitoring to keep pace with the problem.

Controlling of mosquito breeding by use of larvicides (use of used engine oil) was appreciated by very few respondents (7.5%). This activity had been the duty of the municipal public health staff, which is no longer in operation long time back. Filling in of water collection points (habitats for mosquitoes) like small ponds was not practicable to the residents, this requires government interventions.

Another aspect of environmental control of mosquito breeding is by the provisions of soak pits that drain away waste water from dwellings as a result of domestic operations such as water used for washing utensils. This was also a major problem facing the area in that only 25.25% of the households had provided soak pits, posing dangers of waste water discharging within the environment causing stagnation and eventually breeding of mosquitoes. Soak pits are ideal measures of controlling mosquito breeding and ought to be provided by each and every household. No biological method of control (use of fish) was established in the area simply because the residents did not have water tanks in their toilets like the people of Lamu town.

Pregnant women are the main adult risk group for malaria. Pregnancy predisposes a pregnant woman to a high degree of malaria infection. The Abuja declaration recommended chemoprophylaxis on pregnant women (RBM/WHO, 2000), but present WHO and RBM policy strongly recommends intermittent presumptive treatment (IPT) and not chemoprophylaxis for prevention of malaria during pregnancy (WHO/UNICEF, 2003). In Kenya, this involves giving pregnant women a treatment dose of SP (3 tablets as a single dose, oral dose) at the first antenatal clinic visit occurring after the first trimester of pregnancy is completed. These women then have to receive a second dose of SP, at the beginning of their 3rd trimester (between weeks 28 and 34). SP doses to be given on site in the clinic and may be coupled with the tetanus toxoid injections which should be given at the same intervals (ROK, 2003). Unfortunately only 73 out of 190 women who attended clinic were given IPT on site, 100 women were given doses for IPT to take at home while 37 women were not given IPT at all. The number of women who never attended clinic at all was 20. The reasons for not giving IPT on site were varied; water shortage, conditions of pregnant women, like hunger, shortages of drugs and lack of ideal/clean storage facilities for water. Malawi adopted the new policy of giving the pregnant women IPT on site in the clinic. Compliance increased with high take-ups of the antenatal regimen (Hills *et al.*, 1996).

Majority of the respondents (71.75%) feared using anti-malarial drugs as a prophylactic measure, as it may lead to drug resistance to the parasites. In fact their allegations were quite reasonable, as the following drugs are not recommended for chemoprophylaxis: mepacrine, artemisinins, quinine, pryimethamine-sulphonamide combinations (Fansidar®, Metakelfin®), amodiaquine and halofantrine (Warrell and Gilles, 2002). Being the group at risk, pregnant women are recommended to use ITNs for prevention of malaria as they are efficacious in reducing maternal anaemia, placental infection and low birth weight (Garner and Gulmazoglu, 2000). Generally, practices on prevention of malaria in the study area were found to be rather poor as supported by the data (Figure 4.4).

5.4 Economic costs of malaria

Majority of the respondents (42.5%) were unemployed. 39.5% of respondents could not afford the treatment services for malaria. 113 (28.25%) respondents had mosquito nets while 247 (61.75%) expressed the desire to have mosquito nets but were overwhelmed by the burden of life due to poverty. The respondents, therefore, overwhelmingly paid for malaria prevention and control through out-of-pocket expenditure. 40 (10%) of the respondents could afford mosquito nets but were adamant to use them for their own personal reasons: feel its too hot, feel suffocated and feel as if buried in a grave when using them.

Most of the households lacked soak pits (72.25%), which are essential in controlling mosquito breeding, and this was attributed to being over-burdened by other household expenditures, suggesting poverty to be the key reason for the majority of the respondents. Frequent shortages of drugs at the public health facilities suggest lack of government resources for malaria prevention and treatment within the establishments. This has in turn shifted the burden of expenditure to households forcing the respondents to self-medicate themselves and thus the utilisation of the public health facilities declined. In fact, cost consideration for the services, delayed the respondents in their use of government facilities and this was also reported in Ghana (Waddington and Enyimayew, 1989). Barriers to increasing demand for ITNs were also related to the price, to their affordability for households and to promotion.

Household wealth also affected the quality of anti-malarial drugs administered; drugs were saved for the other members of the family or for future use. Under- dosing contributes to the development of parasites resistance

The relationship (Chi-square test of independence) between the level of knowledge on the cause of malaria and the preventive measures against malaria was significant ($p = 0.003$) but still preventive measures against malaria were hampered by the cost implications. The relationship (Chi-square test of independence) between the level of income and the preventive measures against malaria was significant ($p < 0.001$) and the relationship (Chi-square test of independence) between the level of income and the community seeking health behaviour was also significant ($p < 0.001$). This is evidenced by the data collected in that poverty is one of the very important economic factors, which affected both preventive, and control measures of malaria in the area.

CHAPTER 6 : CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

1. There was adequate knowledge on the cause of malaria by residents of the study area.
2. There was delay in seeking effective treatment by the residents. Many treatments were not within 24 hours of onset of symptoms that allowed progression and potential spread of the disease.
3. There was high rate of self- medication of using drugs purchased from over the counter than those sought from the health facilities. This placed the residents at a greater risk of misuse of drugs, which may have contributed to the common anti-malarial drug resistance in use.
4. Lack of diagnostic equipment such as microscopes in dispensaries and the use of the clinical diagnosis (the presumptive judgment) may have greatly contributed to the spread of malaria due to misdiagnosis.
5. There were acute shortages of drugs and staff (trained personnel) at the public health facilities in the study area. These affected malaria control in the establishments.
6. Poverty (low household wealth) probably due to high unemployment levels was one of the very important economic factors that affected preventive and control measures of malaria in the area.
7. Cost of drugs and ITNs was also another factor that affected preventive and control measures of malaria in the area.

6.2 RECOMMENDATIONS

From the results of this study, it is recommended that:

1. There is need for provision of prompt access to effective treatment of malaria (in terms of availability of drugs, diagnostic equipments and adequately staffed public health facilities) by the government to avert delays and dodges in seeking treatment in the health facilities.
2. The practice of self-medication by using drugs purchased from over the counter should be improved by educating the population at large about anti-malarial drugs, dosages and the importance of seeking further treatment without delay. In addition, shop owners who are the major source of oral anti-malarial drugs should be made partners in the health care network and provided with information about the dosages and appropriate use of antimalarial drugs and encouraged to pass it on to their customers.
3. Malaria control programmes should be revived or planned by the health personnel in their establishments for outreach services in the community and also aiming at educating the population on preventive and control measures of malaria.

6.2.1 Suggestions for future research

1. Research on traditional beliefs in controlling of malaria needs to be carried out.
2. Studies on the traditional herbs such as "kivumbani" (*Ocium canum*) in prevention and controlling of malaria need to be carried out.

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Section D: Preventive measures

25. Where do mosquitoes breed?

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…………………………………………………………………………………………

…………………………………………………………………………………………

26. How do you control breeding of mosquitoes?

…………………………………………………………………………………………

…………………………………………………………………………………………

27. What measures do you take to protect yourself from mosquito bites and

especially in your sleeping quarters? ……………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

28. How can you prevent yourself from getting malaria attack?
a) By taking alcohol [ ]
b) By taking prophylactic drugs [ ]
c) By making the body active through exercises [ ]

d) Others (specify) ……………………………………………………………

…………………………………………………………………………………………

29. What is your role as a community member in the control and prevention of malaria?

a) Organize community /village health talks on malaria campaign
b) Wait only for government intervention
c) Take malaria cases to hospital immediately.

d) Others (specify)……………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

Appendix II: Observation checklist

Housing

1. Screening of windows and any other wall opening.
2. Conditions of the screens if any.
3. Lighting and ventilation.
4. Provision of bed nets (where possible to include for children)
5. No. of families with children under five years old.

Environment

6. Presence of stagnant water (and whether larvae present).
7. Bush (especially banana plantations around the house)
8. Used tins scattered in the compound. IEC
9. Presence of any information on malaria (e.g. posters).
10. Any observed factors/conditions that contribute to spread of malaria.

....

Appendix III: Focus group guide for community members

1. Malaria is the leading disease among the top ten diseases in your community, what do you think are the main causes of the disease?
2. How does one know / confirm that he/she is suffering from malaria?
3. Where do you get information on malaria? (Probe if it is inadequate)
4. When do people of your community seek medical assistance once they fall sick and where?
5. What are the cultural beliefs associated with malaria?
6. What is then done to cultural beliefs associated with malaria in terms of prevention/control and treatment?
7. What are the traditional herbs used for curing malaria?
8. How are the public health facility services? (Probe the problems)
9. What are the people in the community doing to prevent/control malaria?
10. What do you think should be done to alleviate the menace?

Appendix IV: Interview guide

In-depth interview with Clinical Officer In-charge, Public Health Officer In-charge/Public Health Technician, Nursing Officer In-charge and Malaria Control Officer of the Health Facility.

1. Looking back at the literature review, malaria is the major problem in this community. What could be the contributing factors?

2. Which are the most vulnerable groups?

3. What measures are there in place or you have instituted to reduce the problem? (Analyse the largest group of the patients)

4. Do you think there are any failures to the measures?

5. What reasons do you attribute to the failures? (Probe the circumstances).

6. What are the commonest drugs you use for the treatment of malaria in all cadres?

7. What are the commonest forms of malaria?

8. Are there any reported/documented cases of anti-malarial drug resistance in the community? If so, what could be the reasons?

9. What strategies do you have for malaria control in the community?

10. What are the constraints you are facing in the control of malaria?

Appendix V: Level of knowledge of the cause of malaria

The individual's score on the level of knowledge of the cause of malaria was based on the responses to questions 11, 13, 14 and 15 of the interview schedule (pgs. 114 and 115). They were rated accordingly as high, satisfactory and low levels of knowledge on malaria. The study revealed to have 80 (high), 180 (satisfactory) and 140 (low) respondents' levels.

Rating:

High – correct responses to questions 11, 13 14, 15

Satisfactory – correct responses to question 11 and "mixed up" with other causes. Failed question 14

Low – all "mixed up" and not even mentioning the mosquito bite as a cause. Failed question 14.

Appendix VI: Level on community seeking health behaviour

The community seeking health behaviour was based on responses to questions 18 and 19 of the interview schedule (page 115 and page 116; see Figure 4.2). They were also rated accordingly as high, satisfactory and low levels. The study revealed to have 74 (high), 283 (satisfactory) and 43 (low) respondents' levels.

Rating:

High – those using health facilities for treatment.

Satisfactory – buying drugs from shops\chemists\control programmes (excluding those buying analgesics/antipyretics alone).

Low – those going to traditional healers including those buying incorrect drugs.

Appendix VII: Level on preventive measures

The score for preventive measures of the respondent was awarded on the responses to questions 26, 27 and 28 of the interview schedule and questions 6 and 10 of the observation checklist. They were rated accordingly as high, satisfactory and low levels. The study revealed to have 111 (high), 140 (satisfactory) and 149 (low) respondents' levels.

Rating:

High – at least mentioning care of water, use of mosquito net (treated or untreated), have a soak pit, no presence of stagnant water, use of prophylaxis or not.

Satisfactory – at least mentioning care of water, use of conventional methods of mosquito control, no soak pit, presence or absence of stagnant water, use of prophylaxis or not.

Low – no mentioning of care of water, use of traditional herbs to control mosquitoes, no soak pit, presence or absence of stagnant water, use of prophylaxis or not.

Appendix VIII: Malaria situation in the study area

Malaria cases attended to at each health facility per month in the year 2004

Month	Likoni	Mtongwe	Shika Adabu
Jan	990	172	120
Feb	1006	304	281
March	1140	74	202
April	998	150	251
May	2500	426	439
June	2402	327	347
July	2300	280	373
Aug	1800	221	337
Sept	1439	104	299
Oct	1668	251	130
Nov	2355	124	194
Dec	1014	165	369
Total	**19612**	**2598**	**3342**
Total cases	**39303**	**5292**	**6752**

Source: From Likoni Health Centre, Mtongwe and Shika Adabu dispensaries.

Malaria is therefore the leading cause of morbidity in the three (3) locations (Likoni, Mtongwe and Shika Adabu) accounting to 49.9%, 49.1% and 49.5% of all out-patient cases reported respectively.

Some of the outpatient diseases reported for the whole year (2004) in comparison to malaria cases reported.

Diseases	**Likoni**	**Mtongwe**	**Shika Adabu**
Malaria	1962	2598	3342
Diarrhoeal diseases	3198	490	350
Pneumonia	1404	3	29
Diseases of respiratory system	14251	1937	1723
Dysentery	171	11	7
Intestinal worms	1092	94	213
Sexual transmitted infections	473	134	132
Eye infections	662	143	116
Bilharzia	77	0	30
Disease of the skin	3706	961	640
Tuberculosis	33	0	0

Source: From Likoni Health Centre, Mtongwe and Shika Adabu dispensaries.

Appendix IX: Research authorisation

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

Telegrams: "EDUCATION", Nairobi
Telephone: Nairobi 334411
When replying please quote
Ref. No. MOEST 13/001/34C 82/2
and date

JOGOO HOUSE "B"
HARAMBEE AVENUE
P.O. Box 30040-00100
NAIROBI

23rd March, 2004

Hassan Hussein Yusuf
Kenyatta University
P.O. BOX 43844
NAIROBI

Dear Sir

RE: RESEARCH AUTHORISATION

Following your application for authority to conduct research on 'A study on Socio -Economic factors contributing to prevalence of Malaria in Likoni Division, Mombasa District, I am pleased to inform you that you have been authorised to conduct research in Mombasa District for a period ending 30th October, 2005.

You are advised to report to the District Commissioner, the District Education Officer and the District Medical Officer of Health, Mombasa District before embarking on your research project.

It is noted that the research is a requirement in part fulfilment for the award of MPHE Degree by Kenyatta University.

Upon completion of the research project, you are expected to deposit two copies of your research findings to this Office.

Yours faithfully

T. MOTURI
FOR: PERMANENT SECRETARY/EDUCATION

CC
The District Commissioner
Mombasa

The District Education Officer
Mombasa

The District Medical Officer of Health
Mombasa Districts