PREVALENCE AND DETERMINANTS OF SYMPTOMATIC AND ASYMPTOMATIC MALARIA

A THESIS

PRESENTED TO THE

SCHOOL OF GRADUATE STUDIES OF

ADDIS ABABA UNIVERSITY

IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF PUBLIC HEALTH

BY

DESTA ALAMEREW, MD

MAY, 1989

ADDIS ABABA UNIVERSITY
School of Graduate Studies

Prevalence and Determinants of Symptomatic and Asymptomatic Malaria

by

Dr. Desta Alamerew

Department of Community Health / Faculty of Medicine

Approved by the Examining Board:

Dr. Tadesse Alemu
Chairman, Department Graduate Committee

Dr. Gebreselassie Okubagzhi
Advisor

Dr. Ascher Segall
Examiner

Dr. Gary Peckeles
Examiner

Dr. Derege Kebede
Examiner

ACKNOWLEDGMENT

I am very grateful to the International Development and Research Center of Canada (IDRC) for funding this research project. Then my thanks goes to my thesis adviser Dr. Gebreselssie Okubagzie for all his encouragement, persuasion and critical comments rendered from the very beginning of the this project.

Thanks are also due to the Pawi resettlement area Worker's Party of Ethiopia and the mass organization leaders in the resettlement area, for allowing me to proceed smoothly with my work.

I would like to extend my gratitude to Dr. Joyce Pickering and Dr. Kay Wotton for their critical & important comments and corrections of the manuscript. Ato Negussie G/Mariam and Dr. Awash T/Haimanot, Dr. Tesfamicheal Tesfa-yohannes receive no less thanks for providing me important advice, timely help and critical comments.

Finally my gratitude goes to Wr/t Elizabeth Wubayehu who typed the manuscript in time, and all the research project staff and those who have made considerable effort towards the success of all the research activities.

April, 1989

CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ENI - Ethiopian Nutrition Institute

MOH - Ministry of Health of Ethiopia

MDT - Mase Drug Therapy (Administration)

NCHS- National Center for Health Statatistics

SPSS- Statistical Package for Social Sciences

WHO - World Health Organization

ABSTRACT

A cross-sectional study was carried out to examine the interrelationship of age, sex, nutritional status and the effect of residing in malarious areas, with the development of malaria infection with and without symptoms. The study population consisted of 2,708 individuals from Pawi resettlement area, of whom 1,513 (55.87 %)were children under the age of 5 years and the rest 1,195 (44.13 %) above the age of 5 years.

Symptomatic malaria, defined as fever plus shivering or sweating , coupled with a positive smear for malaria parasite had a prevalence of 10.2 %. Asymptomatic malaria, defined as a positive smear for malaria, with none of the above symptoms had a prevalence of 7.0 %. The overall prevalence of malaria was significantly lower during infancy (9 %) and higher in the second year of life (22 %), P = 0.0001. Similarly the prevalence of symptomatic malaria was significantly lower (4 %) during infancy and higher (14 %) in children in the second year of life, P = 0.001. No significant variation with age in the prevalence of asymptomatic malaria was observed. No significant association between age, sex, nutritional status of children or residence in malarious areas with the proportion of malaria infection with and without symptoms was detected.

Children in the second year of life were identified as having higher risk of clinical malaria therefore due attention should be paid to provide them with facilities for early diagnosis and treatment. The study also suggests that

relatively short experience, in areas with high transmission of malaria may lead to the development of certain level of protective immunity against the disease.

CHAPTER I

INTRODUCTION

Almost 2,600 million people or half of the world's population in 1984 resided in areas where there is a high risk of contracting malaria. Although only 5.3 million cases were reported to WHO in 1984, it is estimated that around 93 million cases of malaria are occurring every year worldwide. Deaths from the disease are estimated to be in the hundreds of thousands worldwide each year . [1]

In Africa south of the Sahara more than 85% of the population live in areas where malaria is endemic. Although endemicity varies greatly from country to country, about 60% reside where the disease is hyperendemic to holoendemic . [2]The burden of the disease is thus particularly high in Africa with an estimated number of deaths in the order of 150,000 annually, south of the Sahara alone . [1]

In Ethiopia more than 64% of the population or above 26 million live in malaria endemic areas while, about 75% of the land mass is regarded as endemic for the disease . [3]Malaria is among the ten top leading cause of morbidity in Ethiopia, according to the statistics from the heath services . [4]

In the last few years there has been an expanding migration within Ethiopia, mainly involving movement of people from drought stricken highlands where malaria is uncommon to lowlands where

malaria is a major health problem [5]. The population movement is associated with various developmental activities, such as state farms and resettlement programs. Pawi, the site of this study, is a resettlement area located in Metekel Awraja, Gojjam region. Here, as in many of the lowland areas of the country, malaria is the leading cause of morbidity and mortality in the health services statistics [6].

It is not uncommon to discover incidentally people with positive blood film for malaria, among those investigated for other illnesses. But, the proportion of people who are infected and don't develop symptoms, and why some develop symptoms and others do not, and whether age, sex, and nutritional status (particularly under 5 years) have any role to play has not been investigated, at least in Ethiopia.

Immunity, which results from intense and repeated infection has been recognized as a major factor in determining the clinical outcome of the disease. In areas where most of the adult population have developed protective immunity, the condition results in a stable form of malaria. In such a situation children carry the burden of morbidity and mortality resulting from this disease, because the development of immunity increases with age [7,8]. Gradually individuals acquire tolerance to the parasite and despite a relatively high parasitemia they remain asymptomatic or develop mild symptoms [9].

Since, those who don't have symptom at the time of investigation are less likely to suffer morbidity and mortality from the disease it would be important to determine the role of age, sex, and nutritional status in the occurrence of the disease with and without symptoms [7].

The objectives of the present study were to:

- determine the prevalence of both symptomatic and asymptomatic malaria in different age groups and in the population;
- compare the relationship of factors, such as age, sex and nutritional status, etc. in people with symptomatic and asymptomatic malaria.

CHAPTER II

STATE OF KNOWLEDGE

PREVALENCE OF MALARIA

Malaria is a worldwide health problem affecting 56% of the world's population, most of which are living in the tropics. The magnitude of the problem measured in various ways reveals wide variation. In Ethiopia it takes the 10th place among the leading causes of out-patient morbidity accounting for the 3.4% of the visits to the health institutions [4]. In Metekel Awraja malaria is more of a problem being the first cause of outpatient visits and accounting for 24.9% of the visits . [6]

The prevalence of the disease can also vary from season to season, and from place to place, depending on the immune status of that particular community, the mosquito population and the availability and strength of the control measure employed.

In Ethiopia the prevalence of malaria was 5.1%, and 31% of the slides taken in febrile patients were positive for malaria . [10] In Pawi resettlement area the prevalence was reported to be 4.6% by G/Yesus et al . [11] The occurrence of malaria infection without symptoms is well established. But nothing was said about the actual prevalence of malaria infection without symptoms except the knowledge that majority of the population living in endemic areas would be smear positive and remain asymptomatic or develop minor symptoms. [12]

AGE, SEX AND MALARIA

Although both sexes and all ages are susceptible to infection with the parasite, the development of clinical illness and its outcome can vary greatly with age. The risk of morbidity and mortality from the disease at different ages is influenced by other factors, such as preventive and curative facilities in the area, immunity and the endemicity of the disease. In any situation children at early age always suffer a lot from the disease [7,8,12].

In endemic areas, infants in the first 3-6 months have a lower chance of developing clinical malaria, due to transfer of immunoglobulins from the partially immune mother through the placenta and breast feeding [9,13]. But, soon they become increasingly more susceptible to infection with malaria parasite in the period between the fall in maternal antibody protection and the development of acquired immunity [13]. However, the risk levels out by the end of the second year of age and thereafter there is no increased risk of the disease as they tend to develop partial immunity from repeated infections at a cost of death and ill health [14,15,16]. Bruce mentioned that by the end of second year of life children who live in highly endemic areas will have much lower danger of high morbidity and mortality, and thereafter there will be no increase in the parasite rate or density [14].

The development of resistance continue until adult age but this shows the death and suffering from the disease at younger

ages and not a sign of healthy population [14,15]. Wenlock has noted a rapid and consistent decline of infection rate with age among Zambian children under the age of 5 years, unlike the findings of Fatih in the Sudan who observed no increased risk beyond the age of 2 years [8,16]. But, the two studies differ basically in their methodologies in that in the former study both laboratory findings and clinical symptoms were considered in diagnosing malaria where as the latter relied only on the clinical symptoms.

A striking sex difference is observed in the case of mortality and morbidity rates from varying causes. In general mortality is more among males and morbidity among females at all ages [17]. Concerning the role of sex in malaria infection, Fatih has noted slight but not significantly increased risk of infection among boys. It is not known whether both sexes have an equal chance of developing malaria infection either with or without symptoms.

NUTRITION AND MALARIA

Under nutrition is a common problem in developing countries. It's particularly prominent in early childhood, where the nutritional demand is higher and critical for growth and development. In addition to this physiological requirement, the demand gets even greater due to the repeated episodes of infection, which commonly occur in early ages in the tropics, leading to malnutrition. The prevalence of malnutrition has

varied widely as determined in different parts of Ethiopia. In one study, children less than 80 % of the median weight for height were reported to be 6.4 % [18] and in another 20.8% [19]. In a recent study done in south-east Ethiopia 29.8% [20] of children under five years of age were below -2 SD as determined by Wt/Ht in NCHS reference.

Nutritional deficiencies have been noted to be interrelated with susceptibility to malaria. Although all children have increased risk of malaria compared to adults, malnutrition was higher in those children who were diagnosed as having malaria infection [6]. In Sudan, in children under the age of 5 years, a positive association was noted between the occurrence of malaria and degree of malnutrition [16]. On the other hand, a 'nutritional immunity' theory has been hypothesized by Murray et al that under nutrition may even protect the host from dangerous consequences of the infecting organism [21]. The theory was based on some observations, such as an increased rate of infection among famine victims following re-feeding [21,22]. In a controlled study Murray et al also noted an increased risk of post treatment malaria infection among children who received radical treatment for heavy ascariasis [23]. The explanation forwarded for these observations was that the deficiency of some factors may enhance the resistance conferred by certain genetic traits or the deficient nutrient might be more critical for the parasite than for the host [22,23,24].

CHAPTER III

METHODS AND MATERIALS

STUDY ENVIRONMENT

Pawi resettlement village was established in the year 1984-85. The majority of the settlers came from drought affected areas of Shoa, Wollo, Tigray and Gojjam regions. There are 6 woredas and 44 villages under the resettlement program. Almost all the villages have a clinic. The total population of the settlers was reported to be 90,000 , out of which 14% are children under the age of 5 years.

All the villages are situated in the lowland which is drained by two major rivers, the Beles, and the Minor Beles and many small rivers and streams. The rainy season starts in May and continues through September with annual rainfall ranging between 100-1200 mm.. The annual temperature ranges from 15-30 C. The altitude of the area is below 1500 meters.

Malaria control activities have been under way since the establishment of the resettlement villages. The activities include microscopic diagnosis of fever cases and treatment of positive ones, house to house case detection monitoring of mosquito breeding sites, source reduction through environmental management during a weekly "health working day" and two rounds of intra-domiciliary DDT spraying during the period of July and June [11]. The peak transmission season in the area was reported to occur between September and December. In the middle of

conducting this study it was known that 4 out of the 6 villages selected for the study were provided with MDT (mass drug therapy). In the MDT each individual was given full dose treatment for malaria, over 3 days.

STUDY POPULATION

From the total 44 villages 6 villages were randomly selected. Then 80 households were selected from each of the randomly drawn 6 villages using random numbers. In the 6 villages all the under 5 children and those 5 years and above in the selected 80 households were included in the study (Fig.1).

SAMPLE SIZE CALCULATION

To determine the size of the study population, sample size calculation was performed for the study of the relationship between symptomatic and asymptomatic malaria, and nutritional status.

Prevalence of symptomatic malaria:-

Well nourished children = 5% ----------> P1 = 0.05

Malnourished '' = 10% ----------> P2 = 0.10

Difference 5% ----------> Δ = 0.05

With, Alpha = 0.05 and Beta = 0.20

$$N = \left(\frac{Z_{\alpha}\sqrt{2P1(1-P1)} + Z_{\beta}\sqrt{P1(1-P1) + P2(1-P2)}}{\Delta} \right)^2$$

N = 435 in each group.

From the estimated prevalence of malnutrition (30%), to get the 435, determination of the size of children population from which we can get the required number of malnourished children was calculated, as follows.

$$\frac{435 \times 100}{30} = 1,450 < 5\text{yrs children.}$$

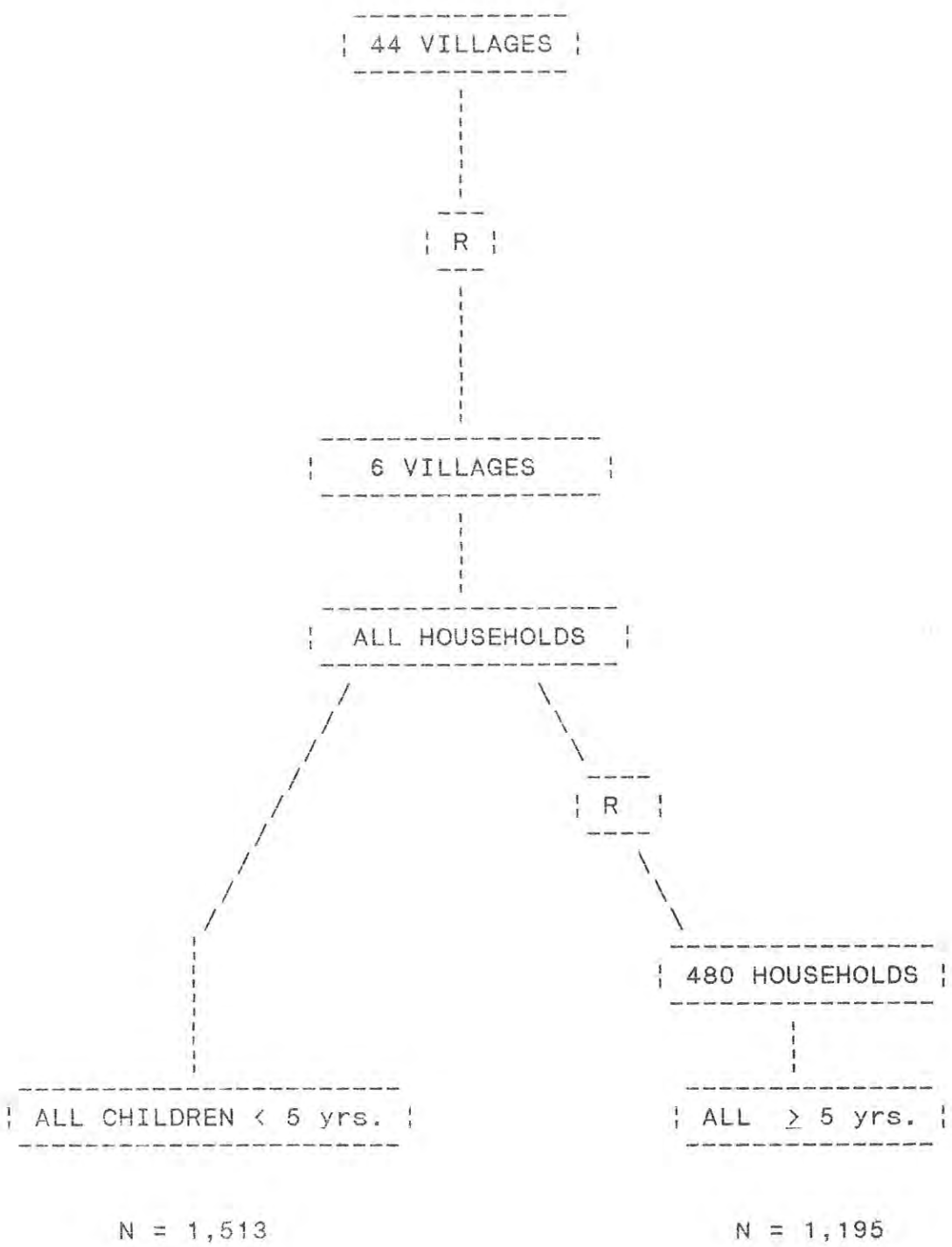


Fig. 1. Selection Hierarchy

QUESTIONNAIRE

A questionnaire was designed for collection of the necessary information from each individual. It was translated into Amharic, a language spoken by most people in the area. Very few individuals who did not speak Amharic were interviewed through a third person who spoke the language and Amharic very well.

The questionnaire had 3 parts. The first part is concerned with identification, the second with clinical history, and the third with laboratory findings.

During the interview, the mother or any immediate caretaker of the child under the age of 10 years was interviewed. For children above the age of 10 years and adults the actual person was interviewed.

The selection of symptoms was based on the commonest symptoms of malaria mentioned by people, from clinical experience in the area.

Asymptomatic malaria was defined as positive blood smear for malaria accompanied by no symptoms, and symptomatic malaria as positive smear for malaria parasite coupled with symptoms. In addition to symptoms, history of treatment in the last two weeks and any prophylactic drug intake was obtained from each individual. The questionnaire is attached as ANNEX.

WEIGHT AND HEIGHT MEASUREMENTS

Weight and height measurements were taken by trained ENI (Ethiopian Nutrition Institute) Workers.

Weight: A Salter spring balance with maximum capacity of 25 kilograms was used for weight measurement. The scale reading was checked and adjusted after every 10th child. Weight was measured to the nearest one decimal place with light clothing on.

Height/Length: A wooden length board was used for the height measurement. All children above 2 yrs of age had their height measured in the standing position. Children under the age of 2 years and those unable to stand had their height measured in the lying position using a special sliding board. In measuring weight and height, the procedures in the WHO manual were strictly followed.

BLOOD SMEAR

Blood was obtained by a pin prick with a sterile blood lancet from the tip of the middle finger or thumb in the case of small children. A thick and thin film was prepared for each patient on a single slide, and labeled. For staining the blood films the procedures as described by Bruce in 1980 were followed [26]. Then the smears were examined microscopically for malaria parasites by two experienced laboratory technicians. Each slide was examined thoroughly for 10 min. and the results recorded. All the positive slides and 5% of the negative slides were cross-

checked by another group of laboratory technicians for confirmation and comparable findings were obtained.

DATA COLLECTION:

The study was conducted in Pawi resettlement area between October 25th and November 15th 1988.

Eleven health assistants were recruited for data and smear collection. All were trained for one day on how to fill the questionnaire by the principal investigator, and for two days on how to prepare a blood smear by an experienced laboratory technician. A pretest was done on 120 individuals from 25 households and the necessary corrections were made. The corrections included rewording of questions and changing the method of data collection from house to house visit to the establishment of a temporary post in each village. Before starting data and smear collection in the villages, the leaders of each village were informed about the aim and purpose of the study. Then, the houses were numbered and 80 households were selected randomly.

The selected households and all those who had children < 5 years of age were informed about the study and persuaded to stay home on the day of data collection and were given a numbered card for identification. All members of the households who fulfilled the selection criteria for the study were registered. At the time of registration each interviewer was accompanied by a person from the village who knew very well all members of the households in the part of the village where the interviewer was assigned.

In each village a temporary post was established and people were persuaded to come to these posts for interview, weight and height measurement and for the blood smear. Those who failed to come to the posts were visited at home on the same day or the next day.

OPERATIONAL DEFINITIONS

Household : A unit of people living in the same house.

Malnutrition : Weight for height score of less than 80 % of the median in the NCHS reference, equivalent to less than -2 Z score .[27]

Symptomatic malaria : Symptoms of fever plus shivering or fever plus sweating coupled with positive smear for malaria parasite in the blood.

Asymptomatic malaria : None of the above symptoms but positive smear for malaria parasite in the blood.

CHAPTER IV

RESULTS

All those selected by the randomization process were interviewed giving a response rate of 100 %. The study population consists of 2,708 individuals of whom 1,513 were children under the age of 5 years and 1,195 were 5 years and above. Out of the total study population 2,663 (98.3%) had their smears examined by the laboratory. Among the under 5 children 1,478 (97.7 %) had their weight and height measured, of which 18.1% (268) were below the 80% standard for weight for height (Table 1).

From the 457 positive slides examined (17.2 % of all slides) species identification was not possible in 16 (3.5 %) of them. Determination of whether previous place of residence was malarious or not was successful in only 2,421 (89.4 %) of the study population. Among these 2,421 individuals 1,671 (69.0 %) were from malarious areas. From the total study population 43 % had received chloroquine in the MDT and out of those who gave a history of symptoms for malaria infection 95 % had received chloroquine treatment within the 2 weeks preceding the date of smear collection.

Table 1.

Nutritional Status (Wt/Ht) By Age in Under 5 Children

Age (in months)	> 80% No(%)	< 80% No(%)	Total
0-11	195(82.3)	42(17.7)	237
12-23	431(76.4)	133(23.6)	564
24-35	193(85.0)	34(15.0)	227
36-47	138(90.2)	15(9.8)	153
48-59	253(85.2)	44(14.8)	297
TOTAL	1210(81.9)	268(18.1)	1,478

P = 0.0002

Table 2.

Age and Sex Distribution of the Study Population

Age	Male No(%)	Female No(%)	Both sexes No(%)
0-11 mon.	115(47.1)	129(52.9)	244(9.0)
12-23 "	303(52.7)	272(47.3)	575(21.2)
2-4 years	336(48.4)	358(51.6)	694(25.6)
5-14 "	239(54.8)	197(45.2)	436(16.1)
15-29 "	108(38.6)	172(61.4)	280(10.3)
30+ "	240(50.1)	239(49.9)	479(17.7)
TOTAL	1,341(49.5)	1,367(50.5)	2,708(100.0)

The proportion of male and female population were comparable, constituting 49.5 % and 50.5 % and with mean ages of 12.7 years and 12.1 years respectively. The age and sex distribution of the study population is shown in Table 2. The extent of malnutrition differed significantly with age (Table 1). No significant sex difference was observed between the malnourished and well-nourished children (Table 3).

The overall malaria infection (both with and without symptom) declined with age, the lowest being in 0-11 months age group (8 %) and the highest in the age group 12-23 months (22 %). Chi-square test showed a highly significant association with, $P < 0.0001$ (Table 4 & Fig. 2). The prevalence of asymptomatic and symptomatic malaria was 7.0% (186) and 10.2% (271) respectively in the total population (Fig. 3).

For symptomatic malaria, the highest prevalence was 14.0%, in the age group 12-23 months OR = 4.20 (95% CI= 2.00,9.13), and the lowest 4.0 % ,in the age group 0-11 months OR = 0.40 (95% CI= 0.26,0.66), (Table 5). The association between the prevalence of symptomatic malaria and age was highly significant, $P < 0.001$. Generally the prevalence of symptomatic malaria was low during infancy, increased sharply in the second year of life and thereafter remained unchanged into adult life.

For asymptomatic malaria, the highest prevalence was 9.0 % in the age group 2-4 years, and the lowest prevalence was about 5.0 % in the under 1 years and 30 years and above age group (Table 6). Chi-square test revealed no significant association between the prevalence of asymptomatic malaria and age, P=0.36 (Table 6).

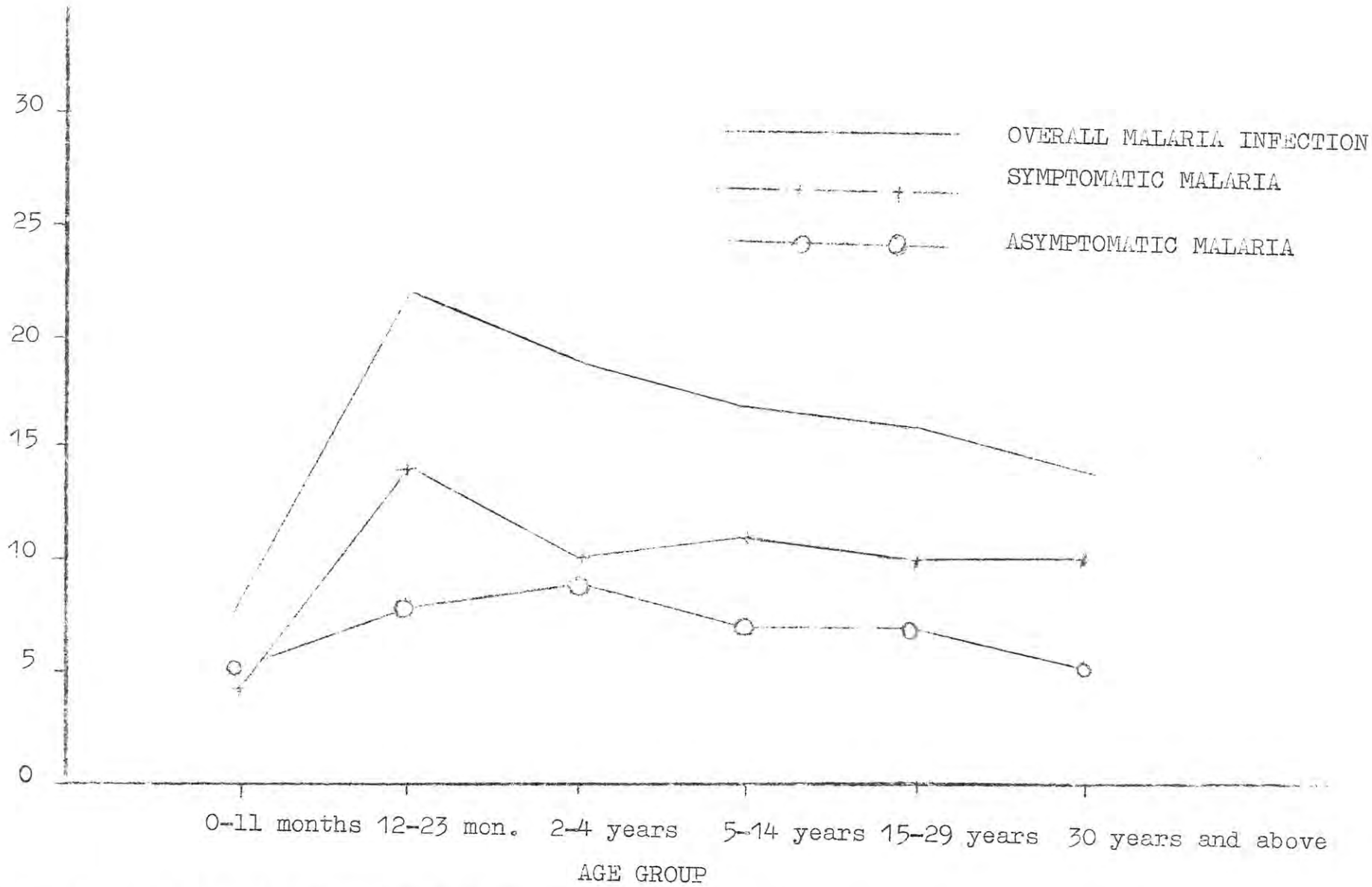
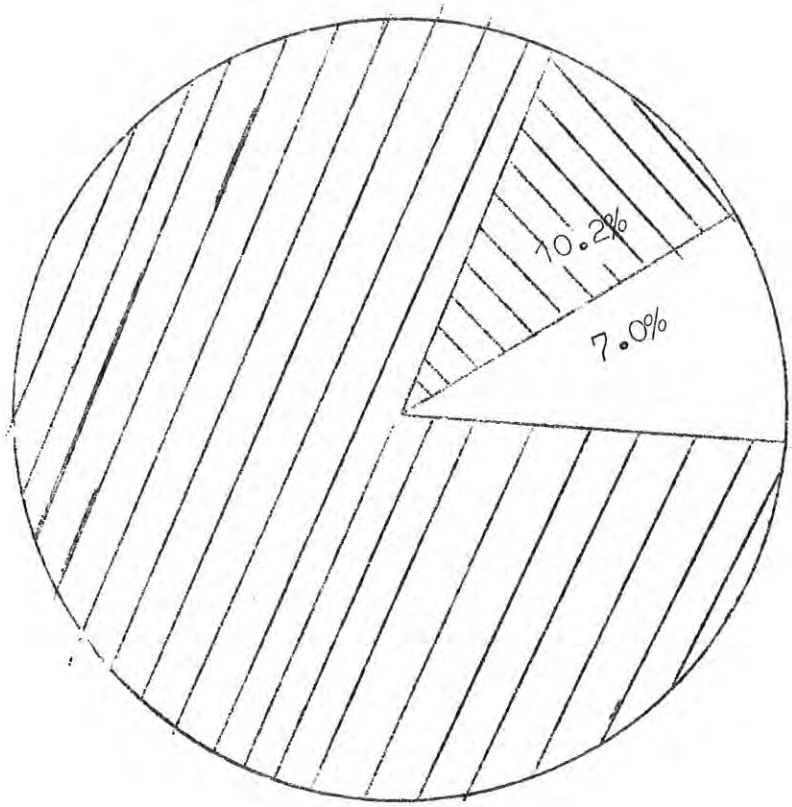


Fig. 2 PREVALENCE OF ASYMPTOMATIC AND SYMPTOMATIC MALARIA, ANI OVERALL MALARIA INFECTION BY AGE



SYMPTOMATIC MALARIA

ASYMPTOMATIC MALARIA

FIG.3 PREVALENCE OF SYMPTOMATIC AND ASYMPTOMATIC MALARIA

Table 3.

Nutritional Status (Wt/Ht) By Sex in Under 5 Children

Sex	> 80 % No(%)	< 80 % No(%)	Total No(%)
Male	606(50.1)	129(48.1)	735(49.7)
Female	604(49.9)	139(51.9)	743(50.3)
Total	1,210(100.0)	268(100.0)	1,478(100.0)

P = 0.6

Table 4

The Presence or Absence of Malaria Infection By Age

Age	Malaria		Rate	OR(95% CI)
	Yes	No		
0-11 mon.	20	222	0,08	
12-23 "	123	443	0.22	3.0(1.79,5.14)
2-4 yrs.	128	549	0.19	2.6(1.57,4.25)
5-14 "	73	355	0.17	2.3(1.32,3.99)
15-29 "	45	229	0.16	2.1(1.17,3.86)
30+ "	68	408	0.14	1.9(1.07,3.24)

$X(5)^2 = 25.12$

P = 0.0001

Table 5

Presence or Absence of Symptomatic Malaria By Age

Age	Symptomatic malaria			OR(95% CI)
	Yes	No	Rate	
0-11 mon.	9	233	0.04	
12-23 "	79	487	0.14	4.2(2.00,9.13)
2-4 yrs	66	611	0.10	2.8(1.32,6.12)
5-14 "	45	383	0.11	3.1(1.54,5.87)
15-29 "	26	248	0.10	2.7(1.18,6.38)
30+ "	46	430	0.10	2.8(1.28,6.19)

$X^2(5) = 20.36$

$P = 0.001$

Table 6

Presence or Absence of Asymptomatic Malaria by Age

Age	asymptomatic malaria		Rate	OR(95% CI)
	Yes	No		
0-11	11	231	0.05	
12-23	44	522	0.08	1.8(0.86,3.71)
2-4	62	615	0.09	2.1(1.08,4.06)*
5-14	28	400	0.07	1.47(0.68,3.21)
15-29	19	255	0.07	1.56(0.69,3.59)
30+	22	454	0.05	1.02(0.46,2.28)

$X(5)^2 = 7.83$

$P = 0.36$

To determine the association of age with the proportion of symptomatic and asymptomatic malaria, age was reduced into 6 groups. Chi-square test was performed to determine any association that exists. The test showed no significant association, P = 0.17 (Table 7)

The prevalence of symptomatic and asymptomatic malaria were 10.7 % & 6.8 % in males, and 9.4 % & 7.0 % in females respectively. No significant association was observed between sex and symptomatic and asymptomatic malaria, with chi-squared test, P = 0.29 and P = 0.93 respectively (Table 8).

To evaluate the influence of sex on the proportion of malaria that was asymptomatic, sex was cross tabulated with the two categories. Chi-square test was applied to determine any significant association. No significant association was observed, P = 0.39, (Table 8). Among those who gave history of symptoms smear positivity appeared to be low in infancy and increased markedly at the second year of life and thereafter declined with age gradually. In those who had no symptoms in the two weeks prior to the date of smear collection, the positivity was similarly low during infancy but remained fairly constant with increasing age thereafter (Fig.4).

The prevalence of asymptomatic and symptomatic malaria was 7.9% and 10.5% in the well nourished and 6.3% and 7.8% among the undernourished children respectively. Chi-square test showed no significant difference in the prevalence of symptomatic and asymptomatic malaria, P = 0.26 and P = 0.45 respectively.

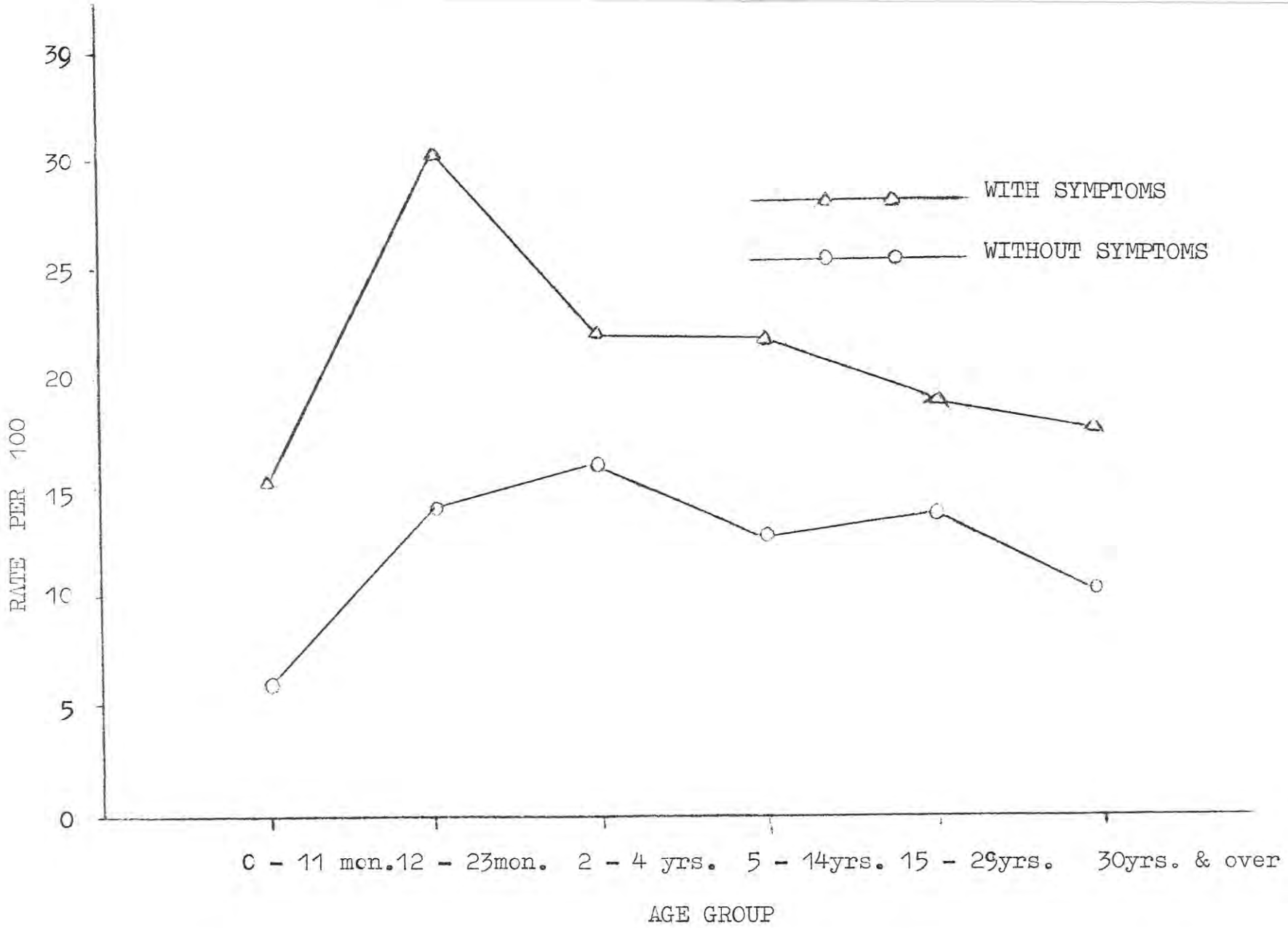


Fig. SMEAR POSITIVITY AMONG THOSE WITH SYMPTOMS ADD THOSE WITHOUT BY AGE

Table 7

Symptomatic and Asymptomatic Malaria By Age

Age	Malaria: Asymptomatic No	Malaria: Symptomatic No	N	OR(95% CI)
0-11mon.	11	9	242	
12-23 "	44	79	566	2.2(0.7,6.3)
2-4 yrs.	62	66	677	1.3(0.5,3.7)
5-14 "	28	45	428	2.0(0.6,6.0)
15-29 "	19	26	274	1.7(0.5,5.5)
30+ "	22	46	476	2.6(0.8,8.0)

$X^2(5) = 7.97$

$P = 0.17$

Table 8.

Prevalence of Symptomatic and Asymptomatic Malaria By Sex

Sex	Malaria: Asymptomatic No(%)	Malaria: Symptomatic No(%)	N	OR(95% CI)
Male	91(6.8)	143(10.7)	1,340	0.86(0.58,1.27)
Female	95(7.0)	128(9.4)	1,366	1.17(0.79,1.72)

$X^2(1) = 0.51$

$P = 0.48$

The two nutritional status categories were cross tabulated with the proportion of malaria that was asymptomatic. Chi-square test failed to show any significant association between the proportion of malaria that was asymptomatic and nutritional status, P = 0.96 (Table 9).

Since nutritional status of children in the study was found to be significantly associated with age (P = 0.0003) to avoid any confounding effect of age, age stratified analysis was performed using a Fisher's exact statistical test as the cells were small to carry out chi-square statistics. The test revealed no significant association.

Sex was cross tabulated with the proportion of malaria cases who were asymptomatic and asymptomatic, both in the well nourished and undernourished categories. In both cases chi-square test was used to determine whether any association existed. No significant association was detected in both situations, P = 0.93 and 0.89 in the well-nourished and malnourished children (Table 11).

The selected 6 villages were cross tabulated with the proportion of malaria that was symptomatic and asymptomatic. Chi-square test was applied to see whether any association existed. The test revealed a significant association, P = 0.0003 (Table 12) due mostly to villages 131 OR = 0.05 (95% CI 0.12,1.83) and 5 OR = 2.60 (95 % CI 1.15,3.52). When the villages which received and did not receive were separately

Table 9

Prevalence of Symptomatic and Asymptomatic Malaria By Nutritional Status in Under 5 Children

Nutritional status	Malaria		N	OR (95% CI)
	Asymp. No(%)	Symp. No(%)		
Wellnour.	96(7.9)	130(10.7)	1,210	0.96(0.46,2.00)
Malnour.	17(6.3)	22(8.2)	268	1.05(0.49,2.18)

$X^2(1) = 0.002$

P = 0.96

Table 10

Age Stratified Analysis of Symptomatic and Asymptomatic Malaria By Nutritional Status in Under 5 Children

Age(in months)	Nutritional status	Malaria		Fisher's exact test
		Symptom. No(%)	Asymp. No(%)	
0-11	Wellnour.	9(50)	9(50)	
	Malnour.	0(0)	2(100)	P = 0.5
12-23	Wellnour.	61(64)	33(36)	
	Malnour.	17(68)	8(32)	P = 0.8
24-35	Wellnour.	23(66)	12(34)	
	Malnour.	1(17)	5(83)	P = 0.1
36-47	Wellnour.	10(42)	14(58)	
	Malnour.	0(50)	0(50)	P = 1.0
48-59	Wellnour.	27(51)	26(49)	
	Malnour.	4(67)	2(33)	P = 0.7

Table 11

Symptomatic and Asymptomatic Malaria By Sex and Nutritional Status

Nutritional status	Sex	Malaria		OR(95% CI)
		Symp. No(%)	Asymp. N(%)	
Wellnour.	Male	67(58)	48(42)	0.93(0.54,1.65)
	Female	63(57)	48(43)	0.94(0.54,1.65)
Malnour.	Male	10(53)	9(47)	0.74(0.17,3.17)
	Female	12(60)	8(40)	1.35(0.32,5.84)
TOTAL	Male	77(57)	57(43)	1.01(0.60,1.69)
	Female	75(57)	56(43)	0.99(0.59,1.66)

Table 12

Prevalence of Symptomatic and Asymptomatic Malaria By Village

Villages	Malaria		N	OR(95% CI)
	Asymp. No(%)	Symp. No(%)		
1	30(6.8)	58(13.2)	441	0.70(0.34,1.37)
131	8(1.6)	22(4.4)	499	0.50(0.12,1.83)
24	25(6.8)	27(7.3)	368	1.30(0.52,3.52)
5	48(10.0)	33(6.9)	478	2.60(1.15,5.85)
17	44(10.3)	99(22.3)	445	0.60(0.30,1.09)
49	30(6.3)	31(6.5)	475	1.39(0.58,3.37)

$X^2(5) = 24.44$.

$P = 0.0002$

treated and the Chi-square test applied P values of 0.07, and 0.28 respectively were obtained, as village 131 had received MDT whereas village 5 did not.

When the villages which received MDT and those which did not were cross tabulated with the proportions of symptomatic and asymptomatic malaria, those who developed malaria in the villages which received MDT seem to be more likely to develop symptomatic malaria compared to the latter villages, P = 0.0001 (Table 13).

The villages which did not receive MDT were likely to develop a high proportion of asymptomatic malaria than symptomatic malaria, OR = 2.3, (95% CI=1.5,3.5). This association persisted even when the villages which did receive MDT and those who did not were cross tabulated with symptomatic and asymptomatic malaria; taking into account only those individuals who did not receive chloroquine in the MDT, (OR = 5.3, 95% CI= 2.7,10.9), (Table 14).

The two species of the plasmodium, *P.falciparum* and *P.vivax* were cross tabulated with the proportions of symptomatic and asymptomatic malaria. Chi-square test showed no significant association between the two, P = 0.18, (Table 15).

People who used to live in non-malarious and malarious areas prior to settling were cross tabulated with the proportions symptomatic and asymptomatic malaria to determine any association. Chi-square test revealed no significant association, P = 0.12 (Table 16).

Table 13

Asymptomatic and Symptomatic Malaria By Villages Which Did and Didn't Receive MDT

Villages with MDT	Malaria		OR(95% CI)
	Asymp.	Symp.	
No	73	60	2.28(1.48,3.52)
Yes	112	210	0.44(0.28,0.68)

$X^2(1) = 14.95$ N = 455

P = 0.0001

Table 14

Symptomatic and Asymptomatic Malaria By Villages Which Did and Did Not Received MDT

Villages with MDT	Malaria		OR(95% CI)
	Asymp.	Symp.	
No	73	60	5.2(2.50,11.16)
Yes	13	56	0.2(0.09,0.40)

$X^2(1) = 23.14$ N = 202

P = 0.000002

Table 15

Plasmodium Species by Symptomatic and Asymptomatic Malaria

Plasmodium species	Malaria		OR(95% CI)
	Asymp. No(%)	Symp. No(%)	
falciparum	94(52)	117(45)	1.32(0.89,1.97)
vivax	87(48)	143(55)	0.76(0.51,1.13)

$X^2(1) = 1.79$

$P = 0.18$

Table 16

Prevalence of Symptomatic and Asymptomatic Malaria By Place of Previous Residence

Previous residence	Malaria		N	OR(95% CI)
	Asymp. No(%)	Symp. No(%)		
Non-malar.	36(4.8)	71(9.5)	750	0.67(0.42,1.09)
Malarious	136(8.1)	181(10.8)	1,671	1.48(0.91,2.42)

$X^2(1) = 2.47$

$P = 0.12$

Among the symptomatic and asymptomatic malaria cases the proportion of people who received Chloroquine were 57.4% and 54% respectively (Fig.5).

To examine the effect of MDT on the outcome of malaria infection, the proportions of asymptomatic and symptomatic malaria were cross tabulated with those who received and did not receive chloroquine in the MDT program. The Chi-square test showed no significant association, P = 0.53, (Table 17).

Except children under the age of 3 years all the rest have stayed for 3 to 4 years in the resettlement area. And none of the individuals in the study were found to take any antimalarial drug in a form of chemoprophylaxis.

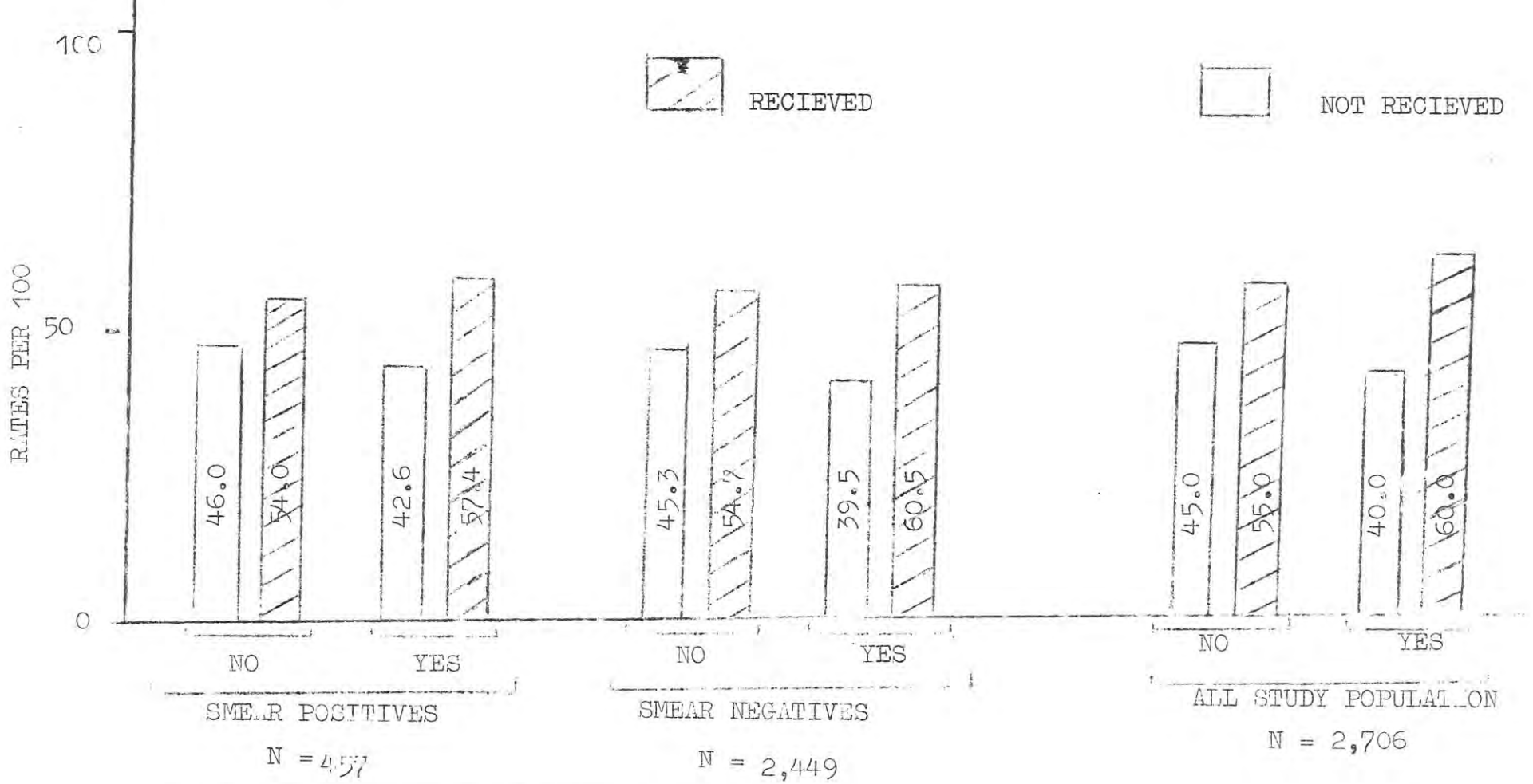


Fig. PROPORTION OF PEOPLE WHO DID & DID NOT RECIEVED DRUG IN THE MDT AMONG SMEAR POSITIVES, SMEAR NEGATIVES AND THE TOTAL STUDY POPULATION

Table 17

Individuals Who Received and Didn't Receive MDT By Symptomatic and Asymptomatic Malaria

MDT	Malaria		OR(95% CI)
	Asymptomatic No.(%)	Symptomatic No.(%)	
No	96(46)	115(43)	1.15(0.77,1.70)
Yes	101(54)	155(57)	0.87(0.59,1.29)

$X^2(1) = 0.39$ N = 457

P = 0.53

CHAPTER V

DISCUSSION

Although the prevalence of asymptomatic malaria has not been previously determined, the existence of malaria infection with out symptom is well known. This form of malaria requires intense and repeated infection for its development as it is mainly dependent on acquired immunity [9,12].

This study assessed the interrelationship of some factors such as age, sex, nutritional status etc. with both symptomatic and asymptomatic malaria.

The prevalence of symptomatic malaria and the overall malaria infection (both with and without symptom) were significantly associated with age, $P < 0.0001$, for both. Children in the age group 12-23 months were found to have the highest prevalence of symptomatic malaria compared to the youngest age group, OR = 4.20 (95 % CI = 2.00,9.13). This age group also had the highest rate of the overall malaria infection compared to 0-11 months age group, OR = 3.0 (95% CI= 1.79,4.14). In both cases no increased or reduced risk was noted beyond the age of the second year of life. This seems to support what has been reported by Fatih and Bruce where they reported increased risk of the disease at second year of life but no increased risk beyond this age [14,16].

No increased risk beyond the second year of life in the study population together with the short and common experience in

the malarious environment by the study population indicate that a relatively brief exposure is adequate to develop certain level of immunity against the disease. And the lower risk in infants suggests that the community in the area has developed immunity to this disease.

Age was not found to be a predictor of whether malaria infection was likely to be symptomatic or asymptomatic. This does not go with what one would expect considering the high intensity of malaria infection in the area. These findings could possibly be explained by the a relatively higher proportion of children and adult population who haven't yet lived long enough in an endemic environment to develop effective immunity and tolerate the effect of parasitemia and/or the MDT & treatment might have reduced the level of parasitemia to significantly lower level making it difficult to detect the parasite in the blood smear [9,26].

Similarly, sex was not a predictor of the type of malaria infection and it was not associated with the prevalence of either symptomatic or asymptomatic malaria, thus supporting the finding of Fatih [16].

The nutritional status of the child did not show any significant association with the proportions of malaria that were symptomatic or asymptomatic, O.R. 1.2 (0.6 - 2.2). Consistently lower prevalence of symptomatic malaria was noticed among the malnourished children in all age groups, but this was not statistically significant. The failure to detect any association

between nutritional status and symptomatic and asymptomatic malaria might have resulted from the inadequate sample size due to the lower than expected prevalence of malnutrition in the study population.

No influence of sex was noticed in both the malnourished and well nourished groups in determining the proportion of malaria that was asymptomatic or symptomatic, P = 0.48.

The proportion of malaria that is symptomatic or asymptomatic was not significantly associated with original place of residence (non-malarious or malarious areas) OR = 0.7 (95% CI = 0.4,1.1), for the those who used to live in malarious ares. This unusual finding may be due to the effect of MDT, or the high proportion of under 5 children among those who lived in malarious environment or due to people coming from malarious areas actually coming from areas with a wide variation in degree of endemicity some areas being so low or for the population to develop effective immunity and thus remain without symptoms despite a relatively higher level of parasitemia. [9]

LIMITATIONS OF THE STUDY

The establishment of the diagnosis of malaria infection relying solely on a single smear from each individual could obviously have markedly reduced the likelihood of finding the parasite in the blood, thereby missing the diagnosis in a considerable proportion of individuals . [26] Furthermore, the diagnosis of symptomatic and asymptomatic malaria was based on

the presence or absence of few subjective symptoms (fever, shivering and sweating). The symptoms selected were the most frequent symptoms patients with the disease present with when they appear in the health institutions for medical help. In the Sudan, Fatih et al used three common symptoms (Fever, shivering/rigor and arthralgia) in the locality, to make the diagnosis of malaria infection based on the clinical experience in the area [14].

The large proportion of the study population who had received chloroquine within the 2 weeks prior to smear collection might have modified the natural course of the disease and hence masked or distorted any interaction between the disease and the factors under investigation [26]. In addition the lack of accurate information on the exact date of treatment has made it impossible to assess the actual effect of chloroquine on the slide positivity.

Above all, the short experience of majority of the study population in malaria endemic environment and the different localities of residence prior to resettlement with widely varying endemicity of the disease have made it difficult to evaluate the impact of living in malarious and non-malarious area on the the development of symptoms following infection with the parasite. Chloroquine resistance has been reported in the area thus it might have affected the slide positivity and the clinical manifestations in those who were treated with chloroquine for malaria.

All the above mentioned factors could have resulted in miss-classification of symptomatic and asymptomatic malaria thereby affecting any association with the study variables.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

In this cross-sectional study age was found to be highly associated with prevalence of symptomatic malaria and the overall malaria infection (with and without symptoms). In particular those children in the second year of life were found to be at a higher risk compared to all others. Sex, nutritional status and living in malarious area were not found to be significantly associated with both the prevalence of either symptomatic and asymptomatic malaria. Age, sex, nutritional status (in under 5 children), living in malarious area and the species of plasmodium were not found to be predictors of whether malaria infection was likely to be symptomatic or asymptomatic.

Although this study has indicated age to be significantly associated with symptomatic malaria, and overall malaria infection, it has not shown age as a determinant of the proportion of malaria that is symptomatic or asymptomatic.

The lower risk in the age group 0-11 months suggests that the population has developed some level of immunity.

Since children in the age group 12-23 months were found to be at a higher risk of morbidity from malaria special attention should be given to children in the second year of life by providing facilities for early dignosis and treatment.

To determine the association of the above mentioned factors with symptomatic and asymptomatic malaria a longitudinal study would have provided a more conclusive evidence. Such a study is highly recommended.

It would also be important to determine the association of the above mentioned factors in a population where there is not so much drug pressure which definitely modifies the natural course of malaria infection.

Comparison of the association between different populations which reside in various levels of endemicity of the disease would have given more evidence on the influence of intensity of infection on the out come of malaria infection.

REFERENCES

1. David Hilton. February, 1987. *Malaria: A new battle plan.* Contact. 95:1-5.

2. World Health Organization. 1984. *World malaria situation 1983.* Malaria action program. 37:130-161.

3. Gebre-Mariam N. 1988. *Malaria.* The ecology of health and disease in Ethiopia. MOH ; Addis Ababa, 136-150.

4. Ahmed Z. 1988. *Health and health services in Ethiopia: A general survey.* The ecology of health and disease in Ethiopia. MOH, Addis Ababa. 1-17.

5. Gizaw B. 1988. *Drought and famine in Ethiopia.* The ecology of health and disease in Ethiopia. MOH, Addis Ababa. 75-81.

6. Alamaerew D. 1987. *Health Profile and Plan Of Action of Metekel Awraja.*

7. MacGregor, IA. 1982. *Malaria: Nutritional implication.* Review of Infectious Diseases. 4: 798.

8. Wenlock, RW. 1979. *The epidemiology of tropical parasitic diseases in rural Zambia.* Journal of Tropical Medicine and Hygiene; 82:90.

9. Trenton, k.,Ruebush, II., Breman, G. et al. 1986. *Selective primary health care. XXIV. Malaria.* Review of Infectious Diseases. 8;3:454-66.

10. World Health Organization. 1985. *World malaria situation 1982.* Malaria action program.;38:193-231.

11. Kidane, G., Teklehaimanot, A. 1988. *Surveillance and control of malaria in Pawi resettlement area.* Proceedings of the XXIV annual medical conference of the Ethiopian Medical Doctors Association (EMDA).

12. Mac Gregore, IA. 1960. *Demographic effects of malaria with special reference to the stable malaria of Africa.* West African Medical Journal. IX,No 6,260.

13. Gilles, HM., Lowson, J., Sibelas, M., et al. 1969. *Malaria anemia and pregnancy.* Annals of Tropical Medicine and Parasitology. 63,245

14. Bruce Chwatt, LJ. 1984. *Lessons learned from applied field research activities in Africa during the malaria eradication era.* Bull Wld Hlth Org ; 62(supp); 19-29

15. Beasoleil, EG. 1984. *A review of present antimalaria activities in Africa.* Bull Wld Hlth Org, 62(supp):13-17.

16. Fatih, Z. El Samani., Willett, WC., and Ware, JH. 1987. *Nutritional and socio demographic risk indicators of malaria in children under five: a cross-sectional study in Sudanese rural community.* Journal of Tropical Medicine and Hygiene. 90:69-78

17. Mausner, JS. 1985. *Introduction to epidemiology.* 119

18. ENI 1980. *Nutrition survey.*

19. Teshome, G. *Report on the nutritional status of children in Addis Ababa.* E.N.I, Addis Ababa July 1985.

20. Gerssu, T. 1988. *Risk factors in childhood malnutrition in Genale awraja South-east of Ethiopia.* Thesis submitted as partial fulfillment of the requirements for Masters of Science. Jimma Health Sciences Institute.

21. Murray, MJ., Murray, AB. 1977. *Starvation suppression and re-feeding activation of infection.* Lancet; i:123

22. Murray, MJ., Murray, MB., Murray, AB., Murray, CJ. 1975. *Refeeding, malaria and hyperferremia.* Lancet, ii:653

23. Murray, MJ., Murray, AB., Murray, MB., Murray, CJ. 1977. *Parotid enlargement, forehead edema and suppression of malaria as nutritional consequence of ascariasis.* American Journal of Clinical Nutrition. 30:2117

24. Murray, CJ., Murray, MJ., Murray, A., Murray, N. and Murray,C. 1978. *The biological suppression of malaria. An ecological and nutritional interrelationship of a host and two parasites.* Am J Clin Nut. 31:1363-1366

25. WHO. 1983. *Measuring change in nutritional status.*

26. Bruce-Chwatt, LJ. 1980. *Essential malariology.*

27. National Center for Child Health Statistics. 1977. *Growth chart for children.* DHEW publication No.(PHS)78-1650, Hyattsiville, MD.

28. Waterlow, JC., Buzia, R., Keller, W., Lane, JM., Niechaman,MZ. and Tanner, JM. 1977. *The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years.* Bull WHO. 55(4):489-98.

29. Awash Teklehimanot. 1986. *Chloroquine resistant plasmodium falciparum malaria in Ethiopia.* Lancet, 127-129.

ANNEX

FIELD DATA COLLECTION FORM

1. *Place of study*

   Woreda _____

   Village no. _____

   Ethnicity _____

2. *Identification.*

   Slide number _____

   Name _____

   Sex: *1=male* *2=female*

   Age: _____ *(in months in < 5 years, otherwise in years)*

   Weight in kilograms _____

   Height in centimeters _____

3. *Where was your place of residence before you started living here ?*

   Region _____

   Awraja _____

   Woreda _____

4. *Date blood film taken* _____/_____/_____

5. *Did the child/you have any symptom of disease, in the last two weeks, which was considered at home or at health institution as malaria ?*

   1=yes

   2=no

If yes, which of the following ?

Fever:	*1=yes*
	2=no
Shivering/rigor:	*1=yes*
	2=no
Sweating	*1=yes*
	2=no

6. *Have you taken any antimalarial drug for your illness in the last two weeks ?*

   [Only and only if the answer for the above question No,5 is yes]

   1=yes

   2=no

7. *How long did you stay in this area ? (in years)* _____

8. *Are you taking antimalarial drug to protect yourself from malaria ?*

   1=yes

   2=no

   If yes, 1=regularly (every week)

   2=irregularly

   For how long ? (in weeks) _____

9. Laboratory findings

Blood smear	1=positive
	2=negative
Pl. species	1=falciparum
	2=vivax
	3=both
	4=others
Stage of maturation	1=asexual
	2=gametocytes
	3= both

መረሻ መጎናፀፊያ ቅፅ

1. የጥናት ቦታ፡

ወረዳ——————— የሰላይት ቁጥር———————

ጣንደር———————

ጎሣ /ብሔረሰብ /———————

2. ስም ከነአባት፡———————

ፅታ ——————— ክብደት———————

ዕድሜ ——————— ቁመት———————

3. አሁን የሚኖሩበት ሰፍራ ከመመጣትዎ በፊት የት አገር ይኖሩ ነበር?

ከ /ሃገር ——————— ወረዳ ———————

አውራጃ ———————

4. የደም ናሙና የተወሰደበት ቀን———————

5. አርስዎ/ልጅዎ ባለፉት ሁለት ሣምንታት ጊዜ ውስጥ የወባ በሽታ ነው ተብሎ የተመረመረ /በቤተሰብዎ ሆነ በሕዝብና ሠራተኞች/የሕመም ምልክት ነበረያት/ነበረው/ነበራት?

1. አዎን 2. የለም

5. መልሱ አዎን ከሆነ፣ከሚከተሉት የትኛው መልክት ነበረው/ነበረያ/ነበራት?

ትኩሳት 1. አዎን 2. የለም

ሳንባ ምች ቀሃ 1. አዎን 2. የለም

ከመጠን ያለፈ ላብ 3. አዎን 2. የለም

6. በወባ ,በሽታ ታመው ባለፉት 2ሣምንታት ውስጥ የወባ ኪኒን ተመቅመዋል?

/በተራ ቁጥር 5 ለተመቀየቀው ጥያቄ የተሰጠው መልስ አዎን ከሆነ ብቻ የሚመየቅ /

1. አዎን 2. የለም / አልወሰድኩም /

7. በዚህ የሚፈራ ጣንድር ለምን ያህል ጊዜ ኖረ /ኖረ /ኖረች?———————

8. በወባ በሽታ ሳይያዙ የወባ በሽታን ለመከላከል መድሀኒት ይወስዳሉ?

1. አዎን 2. የለም / አልወሰድኩም /

መልስ አዎን ከሆነ አወሰሰዱያ አንዴት ነው?

1. ያለማቋረጥ

2. አልፍ አልፍ

ለምን ያህል ጊዜ ወስዱ? /በሣምንታት / ———————

DECLARATION

I the undersigned, declare that this thesis is my work and that all sources of material used for this thesis have been duly acknowledged.

Name Desta Alamerew, MD

Signature 

Place Addis Ababa, Ethiopia

Date of submission April, 1989