Factors associated with utilization of insecticide treated nets among pregnant women in northern regions of Namibia

By

Thomas Mbago

Student Number 557956

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DECLARATION

I, Thomas Mbago, hereby declare that, except for references to the works of others, which have been duly cited, this thesis is the true result of my own research work. It is being submitted for the degree of Master of Science in Epidemiology and Biostatistics at the University of the Witwatersrand, Johannesburg. I have never previously submitted it at this or any other University for examination or any degree award.

Signature:  31 January 2014

Full Name: Thomas Mbago

DEDICATION

I am pleased to dedicate this research work to my dear wife and children, for the encouragement and understanding you gave me to forge ahead and successfully complete the course. May Almighty God bless you.

ABSTRACT

Background: Malaria causes an overwhelmingly large number of cases and deaths around the globe every year, with over 90% of deaths occurring in sub-Saharan Africa. Namibia is among the sub Saharan countries that have malaria as a major public health problem, affecting most pregnant women and children in the northern regions. Insecticide treated net (ITN) distribution has been expanded in the northern regions since 2005, yet there is low ITN utilization. The associated factors for low ITN utilization are not well established.

Objective: This study aimed to determine factors affecting the utilization of ITN among pregnant women in northern regions of Namibia. Specific objectives were to: (1) describe coverage of ITNs among pregnant women in terms of possession; (2) describe the utilization rate of ITN among pregnant women in northern regions; and (3) determine the association between various factors and utilization of ITN among pregnant women. The first study outcome measure was utilization of ITN, defined as an individual pregnant woman who had used an ITN the night before the survey day. The second outcome measure was coverage of ITNs, defined as possession of at least one ITN in each household, irrespective of whether or not it was being used.

Methods: A cross sectional study design was used, using secondary data from a nationally representative survey which collected data on malaria interventions in regions of Namibia. The original survey collected data from a representative sample of 3000 households from 120 primary sampling units (PSUs) in nine regions country wide, using a stratified sampling method of two stages. This study targeted pregnant women in four northern regions, namely; Kavango,

Ohangwena, Oshana and Omusati, in both rural and urban areas; who participated in the 2009 Namibia Malaria Indicator Survey (NMIS) from 4 April to 10 June 2009. A total of 83 pregnant women were included in the analysis out of 194 pregnant women who were interviewed during the 2009 survey. In the descriptive analyses, we described the demographic characteristics of pregnant women. In the analytic analyses, univariable and multivariable analysis (logistic regression) were conducted. Logistic regression was used to determine risk factors associated with ITN utilization.

Results: The utilization of ITN was high (47%) for young women aged 15-24 years old. Overall, 67% of pregnant women aged 15-44 years old slept under bed nets the night prior the survey day. In the univariable analyses, being 35-44 years of age (OR 0.25; 95% CI: 0.07-0.89, $p<0.02$) and having information about malaria (OR 0.28, 95% CI: 0.09-0.85, $p<0.03$), were independently associated with ITN utilization. In the multivariate logistic regression model, none of the explanatory variables were significant at the 5% level. The study showed 98.8% overall coverage of ITNs among pregnant women in terms of possession.

Conclusion: These findings have implications for malaria interventions in Namibia. While almost all the pregnant women recruited in the study possessed ITNs, a significant proportion did not utilize them. Older women were more likely to utilize ITNs. Interventions to improve utilization among pregnant women should target younger women below the age of 35. Women that had information on malaria were more likely to utilize ITN. Sensitising women about the epidemiology of malaria across Namibia could lead to improved utilization of ITNs. A national malaria strategic plan needs to incorporate targeted reproductive women's education for malaria control in Namibia.

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LIST OF ACRONYMS AND ABBREVIATIONS

CI	Confidence Interval
HREC	Human Research Ethics Committee
ITN	Insecticide-Treated Net
LLIN	Long-Lasting Insecticide-treated Net
MDG	Millennium Development Goal
MoD	Ministry of Defence
MoHSS	Ministry of Health and Social Services
NMIS	Namibia Malaria Indicator Survey
NVDCP	National Vector-borne Disease Control Programme
NGO	Non Governmental Organization
OR	Odds Ratio
PCA	Principal Component Analysis
RBM	Roll Back Malaria
SES	Socio-Economic Status
WHO	World Health Organization

DEFINITION OF TERMS

1. Insecticide-Treated Net (ITN): A net that is a permanently treated "long lasting insecticide treated net" (LLIN) or a pre-treated net, but requires further treatment after a specified period of time.

2. Utilization of ITN: A pregnant woman who has used the net the night preceding the survey day; this was assured by direct observation of the bed net hanging over the sleeping area of the pregnant women.

3. Possession or ownership of ITN: A pregnant woman who had at least one ITN in her household during the time of the survey, irrespective of it being used.

4. Inappropriate ITN utilization: Using an ITN for a purpose other than for protection against mosquito bites.

CHAPTER ONE: INTRODUCTION

This chapter presents the rationale, problem statement and objectives of the study. Existing literature on factors affecting utilization of Insecticide Treated Nets (ITNs) among pregnant women is also presented.

Malaria is a major public health problem, particularly in sub-Saharan Africa. Each year, 300-500 million malaria cases lead to over one million deaths globally (1) of which 90% occur in sub-Saharan Africa (2). In southern Africa, malaria is a leading public health problem with over 90,000 deaths every year, of which pregnant women and children under five years old are the most vulnerable groups (3).

Malaria during pregnancy is a major contributor to maternal anaemia, infant mortality, spontaneous abortion and still birth. The consequences of malaria in pregnancy occur due to the sequestration of malaria parasites in the placenta, leading to impeded trans-placental nutrient transport. The trans-placental transport, combined with malaria- induced anaemia, impedes foetal growth leading to low birth weight (LBW). LBW is a known risk factor for infant and childhood mortality (4).

In Namibia, 68 % of the total population is living in malaria areas and therefore are at risk of malaria infection. The country experienced malaria epidemics from 1996 to 2004, with the largest epidemic recorded in 2001 (5). A malaria epidemic, as defined by the World Health Organization (WHO), is an occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time. A total of 500,000 malaria

cases and 1,000 deaths were reported in 2001 country wide, with pregnant women and children under five years old being most affected (6).

One of the methods for preventing malaria is to sleep under insecticide-treated mosquito nets (ITNs). ITN utilization has become an important intervention in the prevention of malaria infection (7). Several African countries have started scaling up free distribution of ITNs (3, 7). The national malaria policy in Namibia recommends the use of ITN as an effective intervention for preventing malaria (5). The policy advocates for free availability of ITN and for pregnant women and under 5 year olds to strictly use ITNs for prevention against malaria (8).

The persistence of high malaria prevalence among pregnant women in northern regions of Namibia (5), despite wide spread distribution of ITNs, could be an indication of poor utilization of the intervention. There is evidence of low utilization of ITN intervention among pregnant women (5). The Namibia Malaria Indicator Survey (NMIS) baseline conducted in 2009 in nine regions to assess the malaria interventions programme, found low utilization rate of bed nets among pregnant women of 30.3% (9). There is, however, little information on possible barriers to ITN utilization (9). Furthermore, there have been no studies conducted in Namibia specifically focusing on utilization of ITN among pregnant women.

Despite the knowledge that ITN utilization is an effective intervention for preventing malaria, many studies around the globe reported barriers to ITN utilization, particularly among pregnant women. There is a need to assess factors that affect utilization of ITN, so as to reinforce the strategy to control malaria among the Namibian population.

1.1 Literature review

1.1.1 ITN utilization as a malaria prevention strategy

The utilization of ITN has become a central element of international and national efforts against malaria (10). The World Health Organization (WHO) and Roll Back Malaria (RBM) partnership recommended ITN utilization as an effective preventive intervention for reducing malaria risk of transmission and mortality among pregnant women and children under five years old (7, 42).

Whilst ITN utilization is an effective intervention for preventing malaria, many studies conducted in East and West African countries reported barriers such as incorrect perceptions, inequity in malaria treatment and low socio-economic status preventing pregnant women from using ITNs and Intermittent Presumptive Therapy (IPT) (10, 29, 31, 32, 33, 37). Pregnant women and children under five years old are vulnerable groups to malaria infection, thus deserving special attention for the provision of free ITN for malaria protection (5).

1.1.2 Benefits of ITN use

Consistent and correct utilization of ITN decreases malaria-related morbidity and mortality among pregnant women and children (7, 11, 12). In Ethiopia, a study conducted to evaluate the use of freely distributed bed nets, showed that effective utilization among pregnant women and children resulted in nearly 100% reduction in malaria cases (13, 38). In Gambia, utilization of ITN was found to be routine in most households and was associated with low malaria incidence (14). In Rwanda, implementation of community-based malaria control programmes with

increased distribution and utilization of ITNs by pregnant women and children, brought down malaria sharply from 44% to 90% in the community (15).

A study in southern Tanzania showed that the protective efficacy of ITNs for parasitaemia in pregnancy was 38%. For multiparous women who used ITNs, there was a twofold decrease in parasite density compared with multiparous women who did not use ITNs (14). Kabanywanyi et al. (14) urged that efforts to increase ITN utilization coverage among pregnant women and children under five years old have potential benefits in preventing malaria during pregnancy.

1.1.3 Utilization rate of ITN

Studies reported by Noor et al. (16), revealed that the highest proportion of the population not protected by ITNs was pregnant women aged 15-19 years of age, at 38-42 %. A similar study in Ghana reported an ITN utilization rate of 16.5 % (17). In Sierra Leone the rate of ITN utilization was reportedly lower less than 17% (16, 17). A study using data from the Nigerian Demographic Health Survey (DHS) in 2008, targeting 34, 070 households to determine demographic factors associated with ITN utilization, revealed that 44% of pregnant women slept under treated bed nets (10, 18, 19). The rates of ITN utilization among pregnant women reported in all the above mentioned studies were below 40%, compared to over 50% utilization rates by women in Nigeria, Senegal, Uganda and Zambia general population (10, 18). A study in Kenya, conducted in December 2006 and January 2007, to evaluate barriers preventing pregnant women from using ITN, found that 68% of pregnant women used an ITN (11).

The Namibia Malaria Indicator Survey (NMIS) conducted to evaluate malaria interventions in nine regions of Namibia, found a 30.3% utilization rate of ITNs among pregnant women significantly lower, than the 84% utilization rates among similar age groups of women in Namibia general population (9). This utilization rate is far below the recommended Abuja Declaration by African Heads of States target of 80% universal coverage of ITNs use by pregnant women and children by 2010 (7, 9).

Similar to the 2009 Namibian Malaria Indicator Survey, Tsuang et al. (12) reported a study, which used data from a nationally representative survey in approximately 6,300 households in Tanzania, which found only 22% of households covered by nets. Baume et al. (20) reported a household survey conducted during the malaria season in 23 communities of Amhara and Oromia Region State of Ethiopia. The survey revealed that, of 857 household, 91% owned at least one ITN, but only 65% had been used the night prior to the survey day (20).

1.1.4 Factors associated with low usage of ITN

Studies reported by Steketee et al. (6) and Baume et al. (30), which showed low ITN utilization in a community, were due to lack of awareness among community members regarding the use of ITN as malaria prevention (6, 30). A study conducted in Nigeria on utilization of ITN by Oresanya et al. (21), found the rate of utilization to be 47% among pregnant women, compared to over 60% in the general population. According to Oresanya et al. (21), the most common factors that affect utilization of ITN, include: lack of awareness, cultural beliefs, low educational

levels and ignorance. Similar findings to Oresanya et al. study were also identified in many studies conducted in most African countries, such as, Burkina Faso, Ethiopia, Eritrea, Nigeria, Swaziland, Tanzania, Kenya, Uganda, Zambia (31, 33, 34, 35, 36, 39, 40, 41).

Studies reported by Mbonye et al. (22) and Pettifor et al. (23) both assessed malaria knowledge among pregnant women in Tanzania and Democratic Republic of Congo respectively, found that educational level was associated with low utilization of ITN (22, 23). According to Noor et al. (24) in a review that assessed malaria knowledge in 18 African countries, perceptions, awareness and ignorance were associated with low utilization of ITN, particularly among pregnant women. These findings are similar to those from NMIS which assessed knowledge of women who attended antenatal care and utilization of ITN, and revealed that mothers with lower levels of education were less likely to utilize ITN and seek anti-malaria treatment than mothers with high education levels (9).

All the above mentioned studies found that lower education level of mothers was associated with utilization of ITN, but these studies were conducted in countries with higher rates of malaria transmission and probably with higher vector densities than, which would influence ITN utilization. Although Namibia has a moderate malaria transmission rate, compared to West and East African countries environmental factors such as climate change and vector behaviours could influence ITN utilization.

Cultural factors, such as beliefs that adolescent girls and primagravidae are not at risk of getting malaria, found to influence the utilization of ITN in communities (15). The perceptions that the chemical used to treat nets have dangerous effects on pregnancy and the newborn child seems to

contribute to low usage of ITN (15, 16). Other factors commonly shown to limit ITN utilization among pregnant women include age, religion and cultural practices (15, 22, 26, 27, 28).

1.2 Aim and objectives

The aim of this study was to determine factors that affect utilization of ITN among pregnant women in northern regions of Namibia.

The study objectives were to describe coverage of ITNs among pregnant women in terms of possession, to describe the utilization rate of ITN among pregnant women, and to determine the association between various factors and utilization of ITN among pregnant women.

CHAPTER TWO: METHODS

This chapter describes the methods used in this study. Details of the study design, study population, data source, data management and analysis are provided.

2.1 Study Design

This was a cross sectional study using secondary data from a nationally representative survey which collected data on malaria interventions from 4 April to 10 June 2009 in malaria regions. The primary survey used a 2-stage stratified sampling method. The first stage was the selection of 120 Primary Sampling Units (PSUs) using a method of probability proportional to size. The second stage was the selection of 20 households within each PSU using a systematic approach. A representative probability sample of 3000 households in nine malaria regions was thus obtained.

2.2 Data Source

Data for this secondary analysis study were obtained from the Ministry of Health and Social Services, extracted from the Namibia Malaria Indicator Survey (NMIS) 2009 database (9). Information on demographic characteristics, socio-economic status (SES) and malaria knowledge were obtained from men and women through interview, using questionnaires which were programmed into personal digital assistants (PDAs) (HP 614).

2.3 Secondary Study Population

This secondary study targeted all pregnant women in four northern regions of Namibia namely; Omusati, Oshana, Ohangwena and Kavango, in both urban and rural areas. The four regions were chosen because they were known to have moderate and high malaria transmission risks. The inclusion criteria for this study were that pregnant women should live in one of the four northern regions under study. A total of 83 pregnant women were eligible for inclusion. The required study sample size was calculated using designed relative precision – sampling estimate (SE) of 10% with 80% power. STATA version 11.1 was used to determine the required sample size which was 78.

2.4 Data Management

The original malaria indicator survey database records were available in Microsoft Access format. To ensure integrity of data quality, data were transferred to STATA using STATA transfer software version 9. Variables of interest were extracted and data cleaning was done, including the deletion of duplicates. Categorical variables were coded.

2.5 Measurements and Definitions of variables

2.5.1 Outcome variable

The study had two outcomes measures. The first was utilization of ITNs, defined as an individual pregnant woman who had used an ITN the night before the survey day. The second outcome measure was coverage of ITN, defined as possession of at least one ITN in each household irrespective of being used. Binary variables for ITN utilization and possession were generated as 'Yes' (1) or 'No' (0).

2.5.2 Explanatory variables

The explanatory variables extracted from the dataset are listed in Table 2.1.

Table 2.1: Study variables and their definitions

Social and demographic variables		Definitions
a	Education level	Education level of participants was categorized as follows: No education, Primary level, Secondary level and Higher (tertiary) level
b	Age	Recorded in years
c	Residence	Residence type: rural or urban areas
d	Region	Administrative political region where study participant lived. Moderate malaria transmission regions were Ohangwena, Omusati, Oshana and Kavango high malaria transmission.
e	Knowledge of malaria	Measurement of respondent's knowledge about malaria information, what causes malaria, main signs of malaria, who is most affected, and protective measures. Variables were categorized.
f	Socio-economic status using wealth quintiles	Socio-economic status and asset-based wealth quintiles, applied at household level. Information on household possessions of drinking water, type of toilet facility, floor type, wall type, window type and household assets were computed using principal components analysis (PCA).
Net utilization/coverage variables		
g	Number of mosquito nets per household	The number of mosquito nets that a household had, and the interviewer observed, to confirm the actual number stated by the participant.
h	Source where net obtained	Source where participant obtained mosquito nets: Government clinic/hospital, distribution campaign, community health worker, retail shop, pharmacy, workplace, other
i	How long ago the net was obtained	Period since the net was purchased or obtained
j	Net purchased	Whether participant bought the net or not
k	Type of net	Type of net(s) that the household had: permanent ITN and any pre-treated net that requires further treatment after specified period of time (Interviewers were trained to identify the type of nets)

2.5.3 Confounding variables

Age of woman in years could be a potential confounder in the study, as it is known to be associated with both exposure and outcome (33). This was controlled in multivariable logistic regression model by adding explanatory variables at a time into the model, together with age.

2.6. Data Analysis

Data were analysed by using STATA software version 11.1. Explanatory variables included in the model were: age, education level, regions, residence (urban/rural), socio-economic status (wealth quintile), heard malaria information, how many bed nets there were in the household, and the source where net(s) was/were obtained.

In the multivariable analysis, a stepwise backward method and likelihood ratio model test were used to decide which variables to omit from the model. All factors with $p<0.05$ were considered significant independent risk factors affecting ITN utilization. The odds ratio, confidence interval and p value were calculated for each variable to determine the strength of the association between the explanatory variable and the outcome measure, using other variables as references for comparison. To determine coverage of ITN in terms of possession, chi square tests were conducted. Factors measured were: number of nets, source where net(s) was/were obtained, how long ago they were obtained, purchased, and type of net(s).

2.7 Ethical Considerations

The study was approved by the Human Research Ethics Committee – Medical (HREC-Medical) of the University of the Witwatersrand, Protocol number M120247 (Appendix 3). Permission to use the dataset (Reference: 17/3/3; Appendix 1) and Ethical Approval for the use of dataset (Reference: 17/3/3/AP; Appendix 2) were granted by the Ministry of Health and Social Services (MoHSS) of Namibia.

Confidentiality was ensured by using anonymous unlinked data. All personal identifiers were removed from the dataset and only identity codes were used. The data were used only for the purpose of this study.

CHAPTER THREE: RESULTS

In this chapter, the study sample is described and the results are presented per objective.

3.1 Descriptive Analyses

3.1.1 Demographic characteristics of the study population

In the descriptive analyses, the demographic characteristics of the pregnant women are presented using percentages as well as the overall utilization rate percentage. The demographic characteristics of pregnant women included in the study are presented in Table 3.2. Table 3.2 presents this information by ITN utilization.

The majority of the women (63.2%) who utilized ITNs had a secondary education; only 5.3% utilized ITN had no formal education. High proportion (83.3%) of women utilized ITN were age group 25-34 years old. Ohangwena and Kavango regions had high proportion of women utilized ITN (100% and 69.6%, respectively). The majority of women utilized ITN are in the medium quintile of socio-economic status (78.3%). Overall (73.8%) women who utilized ITNs, were informed about malaria.

3.1.2 Coverage of ITN in terms of possession in household

The first objective of the study was to describe coverage of ITNs among pregnant women in terms of possession of ITN. The study showed a 98% overall coverage of ITN in terms of possession in households. Coverage of ITN was better in households where the education of the women was higher (61%) (Table 3.1).

Coverage of ITN in rural households was high (71%) than in urban households. The coverage of ITN in all four regions was extremely higher in Kavango region (54.9%), only one household was found without possessed a net. Coverage of ITN was higher in households obtained nets from government distribution programmes (52.4%), as compared to those obtained ITN from other sources.

Of the total 83 households who possessed nets, 43% had two to three bed nets, while 41% of households had less than two ITN. Proportion of ITN coverage in terms of possession found to be high 39% in low socio-economic status households, and closely similar in medium and higher wealth quintile households, but no significant differences were found. Despite higher coverage of ITN among women in terms possession (98%), the utilization of ITN is lagging behind possession by quite a wide gap.

Table 3.1 ITN coverage in terms of possession in household

Characteristic	No of households with ITN	% of households	P value
Household Possessed ITN			
Yes	82	98.8	1.001
No	1	1.2	
Residence*			
Rural	58	71.0	0.713
Urban	24	29.0	
Region			
Kavango	46	54.9	
Ohangwena	6	7.3	1.002
Oshana	12	14.6	
Omusati	19	23.2	
Number of nets			
Fewer than two nets	34	40.9	
Two to three nets	36	43.4	0.571
More than three nets	13	15.7	
Source net obtained			
Government	43	52.4	
Retailer shops	19	23.2	0.194
Other	20	24.4	
Socio-economic status			
Low	33	39.0	
Medium	23	28.1	1.003
High	27	27.9	
School level			
None	7	7.3	
Primary	26	31.7	0.083
Secondary	50	61.0	

***Missing residence data (1)**

3.1.3 Utilization rate of ITNs

The second objective of the study was to describe the utilization rate of ITNs among pregnant women in northern regions of Namibia. There was a 67% overall ITN utilization rate among the pregnant women. ITN utilization rate was high among age group 25-34 years old (83.3%), and in age group 15-24 years old (69.2%). ITN utilization rate was relatively higher among women who had secondary education (63.2%), primary education (31.5%), and no education (5.3%). The utilization rate was high in Ohangwena (100%), Kavango (69.6%) and Omusati (66.7%). The ITN utilization rate was found to be high for women in the medium quintile of socio-economic status (78.3%), low (66.7%), and high (63.0%) (Table 3.2).

The ITN utilization rate was slightly higher in urban areas (70.8%), compared to rural areas (67.2%) ITN utilization among age group 15-24 years old in rural areas was 48.3%, compared to urban areas where it was 45.8%. A higher proportion of urban women who utilized ITNs had a secondary school education (62.5%), compared to those in rural areas (58.6%). The utilization rate among women with primary education was slightly higher (32.8%) in rural areas, compared to urban areas (29.2 %). ITN utilization in rural areas was found to be high in the low quintile of socio-economic status women (50.0%), compared to urban areas (16.7%). ITN utilization rate among urban women who heard about malaria was 85.7%, compared to that in rural areas of 75.4%. The ITN utilization in rural areas obtained through government health facilities were 58.6%, compared to urban areas (37.5%). The ITN utilization among rural women who recognised mosquito bites as causing malaria was 62.1%, compared to urban areas (41.7%). The majority who used ITNs/repellents to protect against malaria were in rural areas (86.2%), compared to urban areas (70.8%) (Table 3.3).

Table 3.2 Characteristics of pregnant women ITN utilization (n=83)

Characteristic	Frequency	% ITN use	% ITN not use	p-value
Utilize ITN	83	67.0	33.0	0.972
Age group				
15-24	39	69.2	30.8	
25-34	30	83.3	16.7	0.011
35-44	14	35.7	64.3	
School level				
None (reference)	7	5.3	3.1	
Primary	26	31.3	68.7	0.333
Secondary	50	63.2	36.8	
Region				
Kavango	46	69.6	30.4	
Ohangwena	6	100	00.0	0.294
Oshana	12	57.9	42.1	
Omusati	19	66.7	33.3	
Residence**				
Rural	56	69.6	30.4	0.714
Urban	26	73.1	26.9	
Socio-economic status				
Low (reference)	33	66.7	33.3	
Medium	23	78.3	21.7	0.483
High	27	63.0	37.0	

Heard malaria information*				
Yes (reference)	61	73.8	26.2	0.020
No	18	44.4	55.6	
Cause of malaria				
Mosquito bite	47	63.8	36.2	0.282
Not sure/other	36	75.0	25.0	
Main signs of malaria				
Correctly mentioned 3 signs	29	72.4	27.6	0.591
Mentioned two signs or less	54	66.7	33.3	
Danger signs				
Correctly identify one sign	47	63.8	36.2	0.283
Don't know/other	36	75.0	25.0	
Who most affected				
Pregnant women/children	69	68.1	31.9	0.817
Don't know/other	14	71.4	28.6	
Protect against malaria				
Use ITN/Repellent/Prophylaxis	68	70.6	29.4	0.420
Don't know/other	15	60.0	40.0	

***** Missing: Heard malaria information (4)

** Missing: Residence information (1)

Table 3.3 Comparison of ITN utilization among pregnant women in rural and urban areas (n=82)

Residence	**Rural (=58)**	**Urban (n=24)**	
Characteristic	n **(%)**	n **(%)**	P value
Age group			
15-24	28 (48.3)	11 (45.8)	
25-34	20 (34.5)	9 (37.5)	1.000
35-44	10 (17.2)	4 (16.7)	
School level			
None	5 (8.6)	2 (8.3)	
Primary	19 (32.8)	7 (29.2	0.954
Secondary	34 (58.6)	15 (62.5)	
Socio-economic status			
Low	29 (50.0)	4 (16.7)	
Medium	21 (36.2)	2 (8.3)	0.012
Higher	8 (13.8)	18 (75.0)	
Utilize ITN			
Yes	39 (67.2)	17 (70.8)	0.753
No	19 (32.8)	7 (29.2)	
Heard malaria information			
Yes	43 (75.4)	18 (85.7)	0.333
No	14 (24.6)	3 (14.3)	
Source where net obtained			
Government	34 (58.6)	9 (37.5)	
Retailer shops	11 (19.0)	8 (33.3)	0.194
Other	13 (22.4)	7 (29.2)	

Net purchased			
Yes	14 (24.1)	9 (39.1)	0.182
No	44 (75.9)	14 (60.9)	
Cause of malaria			
Mosquito bite	36 (62.1)	10 (41.7)	0.097
Not sure/other	22 (37.9)	14 (58.3)	
Main signs of malaria			
Correctly mentioned 3 signs	16 (27.6)	13 (54.2)	0.020
Mentioned 2 signs or less	42 (72.4)	11 (45.8	
Danger signs of malaria			
Correctly identify one sign`	34 (58.6)	12 (50.0)	0.470
Don't know/other	24 (41.4)	12 (50.0)	
Who most affected			
Pregnant women and children	50 (86.2)	18 (75.0)	0.220
Don't know/other	8 (13.8)	6 (25.0)	
Protect against malaria			
Use ITN/repellent/prophylaxis	50 (86.2)	17 (70.8)	0.103
Don't know/other	8 (13.8)	7 (29.2)	

3.2 Inferential analyses

3.2.1. Factors associated with ITN use

The third objective of study was to determine the association between various factors and ITN utilization among pregnant women. These results are presented in Table 3.4. We determined the risk factors associated with ITN utilization among pregnant women, by conducting univariable analysis, and multivariable analysis (logistic regression). The following risk factors: heard malaria information (OR 0.28, CI: 0.09-0.85, $p<0.02$); and age group 35-44 years old (OR 0.25, CI: 0.07-0.89, $p<0.03$), were positively associated with ITN utilization in the univariable analysis.

A statistically significant association was found between age group 35-44 years old and ITN utilization. Other risk factors, such as education level, number of bed net(s) in household, source from which net(s) was/were obtained, residence type (rural/urban) and socio-economic status, were not significant associated with ITN utilization in the univariable analysis. However, these risk factors were considered in the multivariable analysis based on evidence from other similar studies that reported an association between these factors and ITN utilization.

Explanatory variables, such as residence type (urban/rural) and regional setting, net purchased, type of nets and household sprayed in 12 months, were also found to be not significantly associated with ITN utilization. These variables were, however, not included in the multivariable model because they were not identified as risk factors in other studies.

3.2.2 Multivariable Analysis

In the multivariable logistic regression model, none of the variables was significantly associated with ITN utilization at the 95% level. When using the stepwise backward method, the model was not significant. A likelihood ratio tests for model fitness was used to decide which variable(s) to omit from the model.

Pregnant women who had a primary or secondary school education were more likely to utilize ITN, compared with those never went to school (OR 3.37, 3.53). Those who had heard about malaria information were 3 fold more likely to utilize ITNs, compared to those had never heard about malaria information. The model showed that women who obtained nets from retail shops and other sources were more likely to utilize ITNs, compared with those who obtained free bed nets from the government (OR 1.07, 3.76).

In rural areas, pregnant women were 3times more likely to utilize ITN, compared to women in urban areas. Pregnant women in households with two to three bed nets were 94% less likely to utilize ITN, compared to those in households with less than two bed nets. Those in the high socio-economic status group were 89% less likely to utilize ITNs, compared to those in low socio-economic status group. This model led us to conclude that no single risk factor alone was a good predictor for ITN utilization.

Table 3.4 Univariable and multivariable analysis: factors associated with ITN utilization

	Univariable model			Multivariable model		
Explanatory factor	OR	95% CI	P value	aOR	95% CI	P value
Age-group (years)						
15-24	1.00	Reference -	-	1.00	Reference	-
25-34	2.22	[0.69-7.22]	0.18	3.17	[0.67-3.54]	0.193
35-44	0.25	[0.07-0.89]	0.03	3.52	[0.06-0.90]	0.981
Residence						
Urban	1.00	Reference	-	1.00	Reference	-
Rural	1.18	[0.37-3.37]	0.75	3.04	[0.33-7.09]	0.170
School level						
None	1.00	Reference	-	1.00	Reference	-
Primary	3.0	[0.54-16.64]	0.21	3.37	[0.44-14.36	0.167
Secondary	3.4	[0.68-17.31]	0.14	3.53	[0.65-16.21	
Heard malaria information						
No	1.00	Reference	-	1.00	Reference	-
Yes	1.17	[0.07-0.99]	0.02	3.19	[0.17-1.62]	0.188
How many bed nets						
Fewer than two bed nets	1.00	Reference -	-	1.00	Reference	-
Two to three bed nets	0.94	[0.33-2.69]	0.90	0.99	[0.31-3.10]	0.984
More than three nets	0.31	[0.08-1.17]	0.08	0.35	[0.08-1.57]0.173	
Source net obtained						
Government facilities	1.00	Reference	-	1.00	Reference	-
Retail shops	1.10	[0.36-3.33]	0.87	1.07	[0.32-3.58]	0.912
Other	3.36	[0.85-13.17]	0.08	3.76	[0.85-16.61]	0.086
Socio-economic status						
Low	1.00	Reference	-	1.00	Reference	-
Medium	1.80	[0.46-3.33]	0.19	1.09	[0.42-3.77]	0.219
High	0.89	[0.89-1.03]	0.96	1.16	[0.99-1.07]	0.191

OR: odds ratio; aOR: adjusted odds ratio; CI: confidence interval

CHAPTER FOUR: DISCUSSION

This chapter discusses the major findings in line with the specific objectives. It concludes with study limitations with respect to study sample and strengths.

4.1. Coverage of ITN in terms of possession in household

The study showed that a high proportion (98.8%) of households possessed ITN, with only 1.2% reporting that they did not own a mosquito net. The findings that women in rural areas are more likely to own ITN may reflect the successful penetration of the massive community level distribution campaigns in rural areas. This is supported by our finding that the proportion of households that possessed ITN was higher in predominantly rural areas. Only 67% of pregnant women in households that possessed ITN actually slept under net the night before the survey. It is therefore acknowledged that increase in ITN household possession does not necessarily translate to increase in utilization. Higher coverage of ITN in terms of possession in rural areas could be explained by the possible increase in free distribution of ITN and possibly better comprehending mass media messages related to ITN with high educational levels.

Another possible explanation for this could be the possibility of earning a better income with higher educational which, in turn, may increase the likelihood of possessing a net in the household. Other similar studies also found income to be a major predictor of ITN possession which could be explained by an increase in purchasing ability with increase in income (41). While cost is often cited as a major reason for lack of possession of nets in rural areas, it could be also be a major constraint in urban areas. Based on the economic position of the urban

residents, one may not be able to afford to buy ITN, hence the coverage in urban area may be lower than in rural areas where ITN are distributed almost entirely freely (42).

4.2 ITN utilization

4.2.1. ITN utilization and knowledge of malaria

The overall utilization rate of ITNs found in this study was relatively lower than 87% utilization of ITNs by all age groups of women in the general Namibian population (9). This is indicative that pregnant women who are also a high malaria risk group are not using protective measures as would be expected. The Namibia Strategic plan should highlight this need to improve high utilisation by vulnerable groups, including the pregnant women.

However, the findings in the different age groups were inconsistent from those from recent published national household surveys from 18 malaria endemic countries in Africa. These studies found ITN use was high in those aged 15-24 years, low in those aged 25-34 years and gradually decreased in older ages groups (23). The study reported here found the difference could be due to the low participation of pregnant women aged 25-34 years in our study.

In our study, ITN utilization is lagging behind possession by quite a wide margin. The only indicator to explain ITN utilization is the knowledge that ITN prevent against malaria. However, 26% of pregnant women were not aware of malaria information, probably this would influence the utilization of ITNs among pregnant women. Interestingly, a high proportion of women who knew about causes and signs of malaria, 36.2% and 27.6% respectively, never used ITN.

This could be due to ignorance among pregnant women who perceived malaria to not be a health risk for them. Another notable observation in this study is that knowledge about cause of malaria and prevention of malaria was not significantly associated with utilization of ITN. Also apparent is that knowledge of the main signs of malaria was not associated with ITN utilization.

Knowledge of malaria assessed in our study, is consistent with similar observations by other studies (24-29). In a study conducted in rural Kenya to assess barriers to measures targeted to prevent malaria in pregnancy, Gikandi et al (11) reported using scores that knowledge of malaria predicted ITN use, but not the use of intermittent preventive treatment. A study involving pregnant women showed that lack of information about malaria, and ignorance that nets could not prevent malaria was associated with non-use of ITN and non-ownership (24, 28).

Findings from similar studies in Ethiopia showed no significant association between knowledge and the use of ITN (20, 25, 30). This suggests that the relationship between knowledge and health action may be influenced by other biosocial factor, such as cultural practices, negative perceptions and attitude towards ITN as a malaria intervention. Environmental factors, such as rainfall season and climate changes in northern parts of the country have an effect on malaria vector behaviour and survival. Malaria vector density, which is low in the northern regions of Namibia, would influence utilization of ITN.

While the aim of this study was to highlight the knowledge/information gaps as a predictor of non-utilization of ITN, it is important to note that this study identified other factors, which have been reported in other similar studies, as determinants of possession and use of ITN. Education,

residence type and SES have been reported to have an influence on the utilization of ITN and other malaria control interventions (31, 32).

We observed that educational level influenced the utilization of ITNs. The utilization of ITNs among pregnant women increased with increasing education level. A study in Nigeria by Edeluu et al. (28, 33) showed significant differences in terms of ITN awareness between educated mothers and those with low education, but, in terms of ITN utilization, there was no significant difference between the two groups.

A study conducted in Western Kenya to assess ITN ownership, usage and malaria transmission in the highlands (31, 34, 35), showed that, despite ITN ownership reaching more than 71%, usage was low, at 56 %. This study reported other risk factors, such as household education level, at least primary education level affecting the utilization of ITNs, similar to our study findings. The implications of these similar findings are that, education alone does not necessarily lead to ITN use and ownership. Both studies suggest the importance of health promotion programmes of pregnant women geared towards addressing misconceptions and positive behavioural change among pregnant women.

4.2.2 Socio-economic status using wealth quintiles

There were slight differences in wealth quintiles of SES among pregnant women. However, the observed differences could be due to the inclusion criteria, which resulted in a small sample sizes. Our findings are different from those from other studies, which found that use of

preventive measure were generally higher among those with a higher SES. Recent evidence from the Tanzanian DSS site indicates that 80% of the poorest socio-economic quintile owned nets compared to 51% of the least poor quintile (36, 37), which is different from the findings of this study.

4.2.3 Socio-demographic characteristics differences in ITN utilization

There were variations in ITN utilization between pregnant women living in rural/urban areas, reflecting discrepancies in all social and demographic characteristics evaluated. The proportion of pregnant women who utilized ITN the night preceding the survey was higher (67%), than the figure of 30.3% reported by NMIS 2009 for all pregnant women [which is far below the global and national expected coverage targets] (9). When these figure are interpreted with reference to the Abuja targets in which 50% of pregnant women were expected to sleep under ITNs by the year 2010 (38), the utilization of ITNs by these specific groups in this study is very low.

The difference from the NMIS findings could be explained by the differences in regions covered by the survey. The NMIS covered nine regions which are different with regard to their risk of malaria transmission. Contrary to findings of other studies (39), in this study, ITN utilization in rural areas was found to be higher than that in urban areas, though not statistically significant. One reason for the higher utilization of ITN in rural areas could be that net owners might have been provided with appropriate information about usage of ITN during the process of being given nets. The provision of community health outreach services in rural areas by health care workers, which is not a common practice in urban areas, could be an additional explanation. The

study found, mostly in rural areas, higher utilization of nets obtained through government health facilities than that from other sources. The majority of pregnant women in rural areas obtained nets freely, through the government health facilities.

4.2.4 Association between risk factors and utilization of ITN

In the final multivariable model, we did not find any significant associations between risk factors and ITN utilization. We conclude, based on our model, that no factor alone was a good predictor for ITN utilization among pregnant women.

4.3 Limitations

The primary study had a low participation of subjects in some regions which may not therefore fully represent pregnant women. This affected the extent of analysis that we were able to do, particularly in terms of comparisons of characteristics being measured between regions or rural/urban areas. The study sample size could have been increased by looking at the use of mosquito nets by all women of reproductive age or by women who gave birth in the last three years, but there was no information on the dataset that allowed us to do this. As a result, the study was limited to the use of mosquito nets by pregnant women.

We limited our study to four malarious regions out of the total nine regions. The four regions also concide with areas of focus in the mass distribution of ITN. The result is that the findings of this study may not apply to the whole of Namibia. We were not able to analyze the pregnant women's knowledge of malaria comprehensively because of the nature of responses in the

original data. This prompted the need for grouping (collapsing) knowledge of malaria variables into smaller groups. This might have affected the level of responses as some useful information might have been lost in the grouping.

Given that ITNs were distributed free in the study regions, the study did not obtain information on cost, a factor which might affect ITN ownership. The sample size was relatively smaller, which in turn might have affected the power of the study, thus limited the generalization of these study findings to all pregnant women in Namibia. It is also worth noting that the power of the study was high enough to identify any effect if it existed.

4.4 Conclusion and Recommendations

Raising public awareness of ITNs for malaria prevention intervention in Namibia is necessary to increase uptake and utilization of ITN and to reduce malaria among pregnant women. The primary study had a low participation of subjects in some regions which may not therefore fully represent pregnant women.

The impact of these study findings will be useful in reviewing the national malaria strategic plan to incorporate targeted reproductive women's education for malaria control in Namibia. Education of pregnant women should have a positive influence on possession and utilization of ITNs in one way or another. In terms of programming, efforts are needed to expand community level distribution campaigns to intensify appropriate behaviour change intervention that emphasize the efficacy of ITN in malaria prevention. As the distribution of ITNs is an ongoing

process, the proportion of pregnant women utilizing ITNs might have increased before the end of 2012. In view of these findings, we suggest the following recommendations:

1. For Namibia to achieve the Millennium Development Goal (MDG) to combat the menace of malaria among pregnant women, more efforts are required to increase the utilization of ITN.
2. Specific groups of pregnant women, particularly those aged 15-24 and 25-34, need to be targeted. Health promotion programmes should consider including messages that ask pregnant women to consider the actual risk reduction accruable from using ITNs to protect their unborn babies.
3. Programmes and partners that distribute ITN with affordable fair costs or for free by Government, Non-Governmental Organizations (NGOs), and other partners should prioritise pregnant women and children under five years old.
4. Appropriate Behaviour Communication Change (BCC) interventions are required to reduce the gap between possession of ITN by pregnant women and utilization of ITN; and to increase use of ITN by pregnant women.
5. Despite fair knowledge, there is a need to improve the availability of information through the preferred community channels. This recommendation emerges along with the WHO documented evidence that, as the level of transmission and disease decreases, so does the perception about the importance of malaria control activities.
6. Given that almost 99% households owned ITN, there is a need for future research to evaluate the effectiveness of distribution programme of ITNs and Indoor Residual Spraying (IRS) programme in malaria regions.

REFERENCES

1. Schantz-Dunn J, Nour NM. Malaria and pregnancy: a global health perspective. Rev Obstet Gynecol. 2009;2:186.

2. Lipa JJ. Twentieth report from the WHO Expert Commitee on Malaria. WHO technical report No. 892, Geneva, 2000, 71 pp.

3. World Health Organization, East and Southern Africa Malaria Control, 2008, Epidemiological Profile. Harare Zimbabwe: WHO.2008.

4. Roll Back Malaria/World Health Organization. Progress and Impacts Series. World Malaria Day 2010 : Africa Update 2010 Contract No.: ISBN 978-92-806-4516-3.

5. Government of Namibia. National Roll Back Malaria Strategic Plan. 2003 - 2007. Namibia MoHSS. In: Services MoHSS, editor. Windhoek, MoHSS. 2003.

6. Steketee RW, Nahlen BL, Parise ME, Menendez C. The burden of malaria in pregnancy in malaria-endemic areas. Am J Trop Med Hyg. 2001;64:28.

7. World Health Organisation/Roll Back Malaria. Global Strategic Plan 2005-2015;1:110-15.

8. Government of Namibia. National Malaria Policy. In: Services MoHSS, editor. Windhoek, Namibia. 2005.

9. Namibia MoHSS. Namibia Malaria Indicator Survey. Windhoek, MoHSS-NDVCP DSP. 2009.

10. Baume CA, Marin MC. Gains in awareness, ownership and use of insecticide-treated nets in Nigeria, Senegal, Uganda and Zambia. Malar J. 2008;7:153.

11. Gikandi PW, Noor AM, Gitonga CW, Ajanga AA, Snow RW. Access and barriers to measures targeted to prevent malaria in pregnancy in rural Kenya. Trop Med Int Health. 2008;13:208.

12. Tsuang A, Lines J, Hanson K. Which family members use the best nets? An analysis of the condition of mosquito nets and their distribution within households in Tanzania. Malar J. 2010;9:211.

13. Belay M, Deressa W. Use of insecticide treated nets by pregnant women and associated factors in a pre-dominantly rural population in northern Ethiopia. Trop Med Int Health. 2008;13:1303.

14. Kabanywanyi AM, Macarthur JR, Stolk WA, Habbema JD, Mshinda H, Bloland PB, et al. Malaria in pregnant women in an area with sustained high coverage of insecticide-treated bed nets. Malar J. 2008;7:133.

15. Otten M, Were W, Komatsu R, Karema C, Bekele AW, Snow RW, et al. Initial evidence of reduction of malaria cases and deaths in Rwanda and Ethiopia due to rapid scale-up of malaria ITN utilization, prevention and treatment. Mal Journal. 2009;8:14.

16. Noor AM, Kirui VC, Brooker SJ, Snow RW. The use of insecticide treated nets by age: implications for universal coverage in Africa. BMC Public Health. 2009;9:369.

17. Cruz ND, Dearden K, Gray B, Ivins N, Alder S, Davis R. Who sleeps under bed net in Ghana? A doer analysis of malaria prevention behaviours. Mal J. 2008;5: 61.

18. Onwujekwe UB, Eze S, Okoli EOC, Ochomma O. Improving equity in malaria treatment: relationship of socio-economic status with health seeking as well as with perceptions of case of using the services of different providers for the treatment of malaria in Nigeria. Mal J. 2008;7: 5.

19. Jombo GTA, Path FMC. Who sleeps under bed net in Olupko? impact of a decade-long anti-malaria crusade in a West African community. Advanced Scholars in Medicine. 2010;1:101.

20. Baume CA, Sewnet T, Zeleke B, Asefa G, Kenea M, Omer S and Dubiwak R. Ethiopia bednet study: Why some nets owned are not used. Net Mark. 2009; 9:11

21. Oresanya O, Hoshen M, Sofola O. Utilization of insecticide-treated nets by under-five children in Nigeria: Assessing progress towards the Abuja targets. Malaria J. 2008; 7:145.

22. Mbonye AK, Neema S, Magnussen P. Preventing malaria in pregnancy: a study of perception and policy implications. Health Policy and Planning. 2006; 21:17

23. Pettifor A, Taylor E, Eboni CK, Nkus D, Duvall S, Tabala M, Meshnick S, Behets F. Bed net ownership, use and perceptions among pregnant women seeking for antenatal care in Kinshasa. BMC Public Health. 2008; 8:9.

24. Noor AM, Kirui VC, Brooker JS, Snow RW. The use of insecticide treated nets by age: implications for universal coverage in Africa. BMC Public Health. 2009; 9:369.

25. Kacey C, Ernst MA, Stephen M. Ownership and disuse of bed nets in Kenyan children under five years of age. Kisumu,: Medical Research Institute, Kisumu, Kenya. 2011.

26. Hlongwana KW, Mabaso MLH, Kunene S. Community knowledge, attitudes and practices (KAP) on malaria in Swaziland. Mal J, BioMed Central. 2009; 8:29.

27. Isah AY, Nwobodo EI. Awareness and utilization of insecticide treated mosquito nets among pregnant mothers at a tertiary health institution in north-western Nigeria. Niger J Med. 2009;18:175.

28. Edelu BO, Ikefuna AN, Emodi JI, Adimora GN. Awareness and use of insecticide-treated bed nets among children attending outpatient clinic at UNTH, Enugu - the need for an effective mobilization process. Afr Health Sci. 2010;10:117.

29. Ogane G, Deressa W. Knowledge and utilization of insecticide treated mosquito nets among freely supplied households in Wonago Woreda, South Ethiopia. Ethiopia Journal of Health Development. 2008; 22:34.

30. Baume CA and Snow RW. Factors associated with use and non-use of mosquito nets owned in Oromia and Amhara Regional States, Ethiopia. Malaria Journal. [Malaria Journal]. 2009;8:145.

31. Atieli H, Zhou G, Afrane Y, Lee M-C, Mwanzo I, Githeko A. Insecticide-treated net ownership, usage, and malaria transmission in the highlands of western Kenya. Parasites & Vectors. 2011;4:113.

32. Yassin IM. Factors influencing the usage of insecticide-treated mosquito nets among pregnant women. International Journal of Health Research. [Journal Article]. 2010;3:139.

33. Auta A. Demographic factors associated with insecticide-treated net use among Nigerian pregnant women and children. North American Journal of Medical Sciences. 2012;4:19.

34. Aluko J, Oluwatosin A. Utilization of insecticide treated nets during pregnancy among postpartum women in Ibadan, Nigeria: a cross-sectional study. BMC Pregnancy and Childbirth. 2012;12:21.

35. Mutemi PM. Factors influencing utilization of insecticide treated nets in malaria prevention and control among women in Msambweni district, Kwale County, Kenya. University of Nairobi. Thesis. 2009; 1:65.

36. Matovu F, Goodman C, Wiseman V, Mwengee W. How equitable is bed net ownership and utilisation in Tanzania? A practical application of the principles of horizontal and vertical equity. Malar J. 2009;8:109.

37. Worrall E. Ensuring that malaria control interventions reach the poor. Mal J. 2003;2:36.

38. Negash K JD, Nafo-Traore F, Mukelabai K, Banda J, Snow RW, Medhin A, et al. Ethiopian Roll Back Malaria Consultative Mission: Essential Action to Support the Atainment of the Abuja Targets. Ethiopia Mal J. 2004; 1:101.

39. Okrah J, Traore C, Pale A, Sommerfeld J, Muller O. Community factors associated with malaria prevention by mosquito nets: an exploratory study in rural Burkina Faso. Trop Med Int Health. 2002;7:240.

40. Koreromp EL MJ, Cibulskis RE, Kabir Cham M, Alnwick D, Dye C. Monitoring mosquito net coverage for malaria control in Africa: possession versus use by children under 5 years. Trop Med Int Health. 2003;8:693.

41. Macintyre K KJ, Okbaldt YB, Zerom M, Soster S, GebreMeskel T. Rolling out insecticide treated nets in Eritrea: examining the determinant of possession and use in malarious zones during rainy seasons. Trop Med Int Health. 2006;11:824.

42. Roll Back Malaria/World Health Organization-Geneva. Roll Back Malaria Partership: The global malaria action plan (GMAP). WHO/RBM. 2008:1-271.

APPENDICES

APPENDIX 1: Permission to use NMIS 2009, dataset granted by MoHSS of Namibia.

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REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198	**Ministerial Building**	**Tel: (061) 2032510**
Windhoek	**Harvey Street**	**Fax: (061) 222885**
Namibia	**Windhoek**	**E-mail:**eshaama80@yahoo.com
Enquiries: Ms. E.N Shaama	**Ref:** 17/3/3	**Date:** 12 March 2012

OFFICE OF THE PERMANENT SECRETARY

Mr. Thomas Mbago
P.O. Box 24282
Windhoek

Dear Mr. Mbago

Request for permission to use Namibia Malaria Indicator Survey (MIS) 2009 dataset for research project purposes

1. The Ministry of Health and Social Services hereby acknowledge receipt of your request as stated above.

2. **Kindly be informed that permission to use the Namibia Malaria Indicator Survey (MIS) dataset has been granted under the following conditions:**

2.1 The dataset must **only** be used for your Master of Science (MSc) Degree in Epidemiology;
2.2 No other data should be accessed other than the data stated in the requesting letter submitted to the Ministry;
2.3 A quarterly report to be submitted to the Ministry's Research Unit;
2.4 Preliminary findings to be submitted upon completion of study;
2.5 Final report to be submitted upon completion of the study;
2.6 Separate permission should be sought from the Ministry for the publication of the findings.

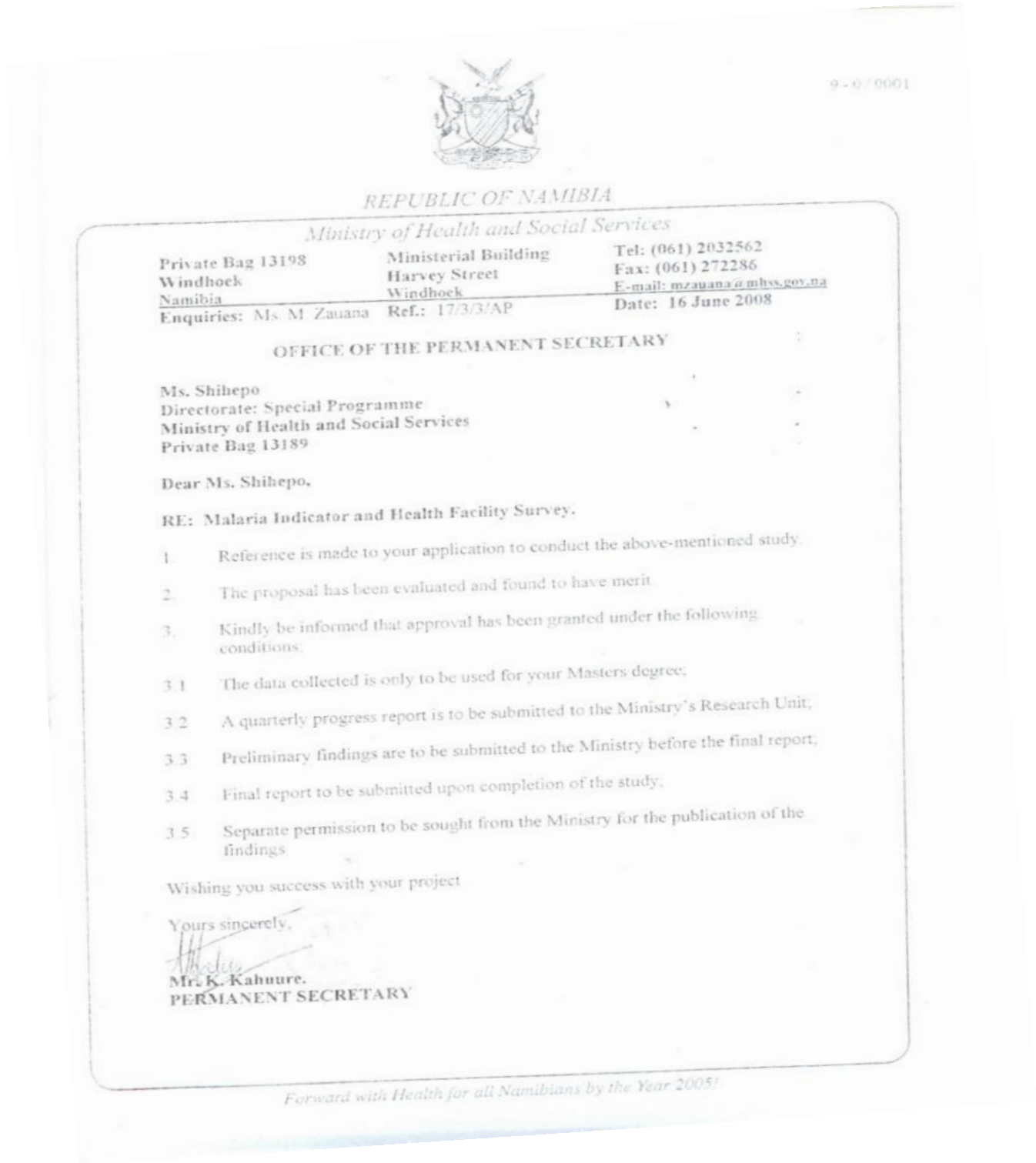
3. Attached find the ethical clearance letter for the dataset you have requested.

Yours sincerely,

MR. K. KAHUURE
PERMANENT SECRETARY

"Health for All"

APPENDIX 2: Ethical approval for the use of dataset granted by MoHSS of Namibia



REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198
Windhoek
Namibia

Ministerial Building
Harvey Street
Windhoek

Tel: (061) 2032562
Fax: (061) 272286
E-mail: mzauana@mhss.gov.na

Enquiries: Ms. M. Zauana Ref.: 17/3/3/AP Date: 16 June 2008

OFFICE OF THE PERMANENT SECRETARY

Ms. Shihepo
Directorate: Special Programme
Ministry of Health and Social Services
Private Bag 13189

Dear Ms. Shihepo,

RE: Malaria Indicator and Health Facility Survey.

1. Reference is made to your application to conduct the above-mentioned study.

2. The proposal has been evaluated and found to have merit.

3. Kindly be informed that approval has been granted under the following conditions:

3.1 The data collected is only to be used for your Masters degree;

3.2 A quarterly progress report is to be submitted to the Ministry's Research Unit;

3.3 Preliminary findings are to be submitted to the Ministry before the final report;

3.4 Final report to be submitted upon completion of the study;

3.5 Separate permission to be sought from the Ministry for the publication of the findings.

Wishing you success with your project.

Yours sincerely,

Mr. K. Kahuure.
PERMANENT SECRETARY

Forward with Health for all Namibians by the Year 2005!

Appendix 3: Human Research Ethics Clearance Certificate from the University of the Witwatersrand.

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mr Thomas Mbago

CLEARANCE CERTIFICATE	**M120247**
PROJECT	Factor Associated with Utilization Insecticide Treated Nets among Pregnant Womn in Northern Regions of Namibia
INVESTIGATORS	Mr Thomas Mbago.
DEPARTMENT	School of Public Health
DATE CONSIDERED	24/02/2012
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

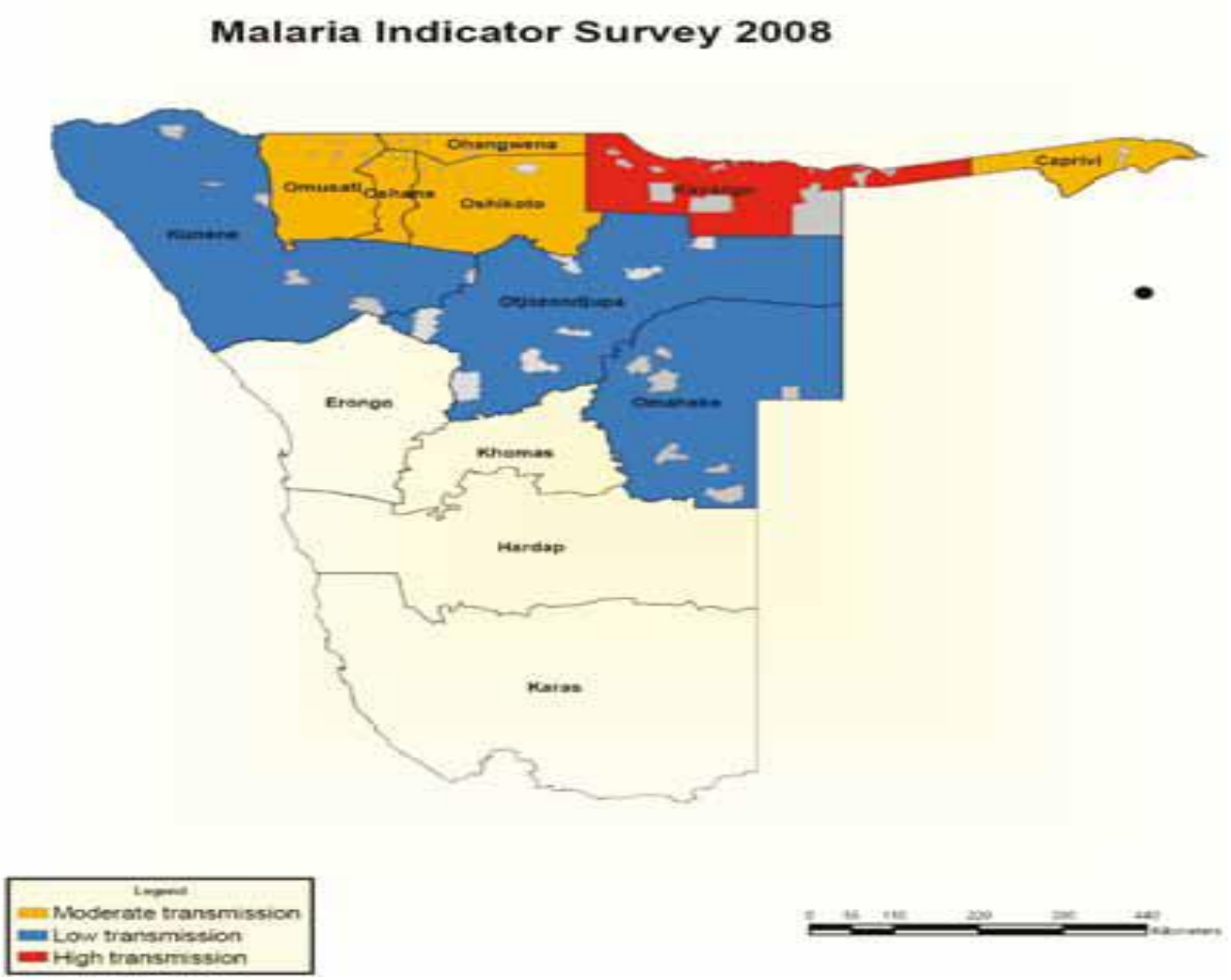
DATE 24/02/2012 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Dr Peter Nyasulu

DECLARATION OF INVESTIGATOR(S)
To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX 4: Map of Namibia showing nine Regions where NMIS 2009, was conducted and current study areas.



Source: Namibia National Planning Commission, GIS Section 2009.

Population: 2,176,840 (2007),

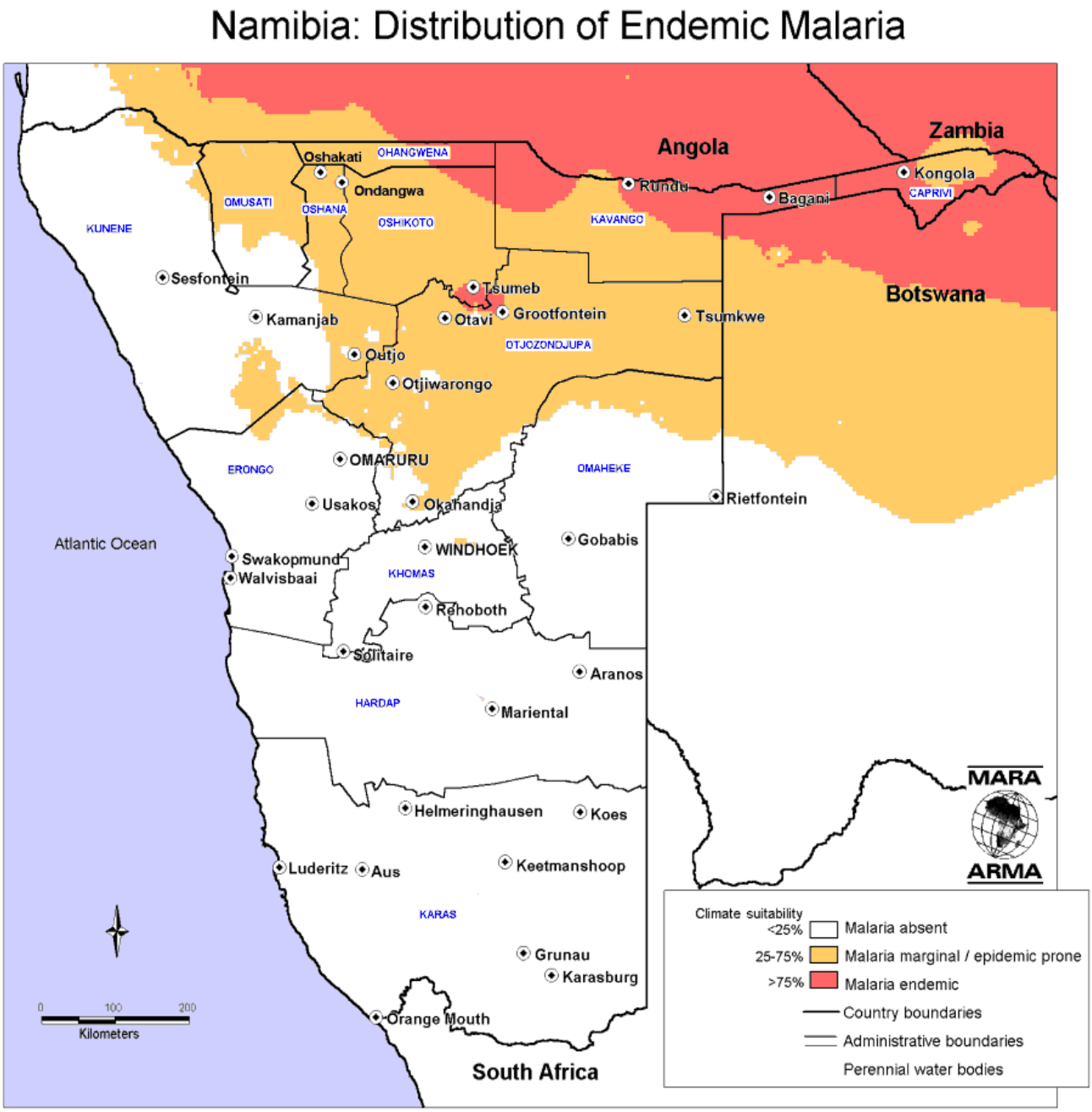
Surface Area: 852,295 km²,

Population living in malaria: >68%;

Number of malaria regions: 9 out of 13 (22/34 district)

Note: Malaria Indicator Survey was 2009, and not 2008 as shown in map.

APPENDIX 5: MARA map for Namibia showing distribution of endemic malaria



This map is a product of the MARA/ARMA collaboration (http://www.mara.org.za). July 2001, Medical Research Council, PO Box 17120, Congella, 4013, Durban, South Africa
CORE FUNDERS of MARA/ARMA: International Development Research Centre, Canada (IDRC); The Wellcome Trust UK; South African Medical Research Council (MRC); Swiss Tropical Institute, Multilateral Initiative on Malaria (MIM) / Special Programme for Research & Training in Tropical Diseases (TDR), Roll Back Malaria (RBM).
Malaria distribution model: Craig, M.H. et al. 1999. Parasitology Today 15: 105-111.
Topographical data: African Data Sampler, WRI, http://www.igc.org/wri/sdis/maps/ads/ads_idx.htm.