INSECTICIDE TREATED NETS DISTRIBUTION AND USE FOR MALARIA CONTROL IN OMUNTELE CONSTITUENCY, OSHIKOTO REGION, NAMIBIA

A mini-thesis submitted in partial fulfilment of the degree, Masters in Public Health (MPH)

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DECLARATION

I declare that "*Insecticide treated nets distribution and use for malaria control in Omuntele Constituency, Oshikoto Region, Namibia*" is my own independent work and it contains no material previously published by other researchers nor material which to a substantial extent has been acknowledged for the award of any other higher qualification degree or diploma of any other institution of higher learning or the University, except where due acknowledgement has been given in the text.

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
CI	Confidence Interval
DDT	Dichlorodiphenyltrichloroethane
GMCS	Global Malaria Control Strategy
HIS	Health Information System
HIV	Human Immunodeficiency Virus
HSSSP	Health and Social Services Support Programme
ITN	Insecticide treated (bed) nets
KAP	Knowledge, Attitude, Practice
MCH	Mother and Child Health
MIRHSP	Malaria Indoor Residual House Spray Programme
MOHSS	Namibian Ministry of Health and Social Services
N$	Namibian Dollar (Current Rate: 1 USD = 6 N$)
NVDCP	National Vector borne Disease Control Programme
PHC	Primary Health Care
PSU	Primary Sampling Unit
RMCS	Regional Malaria Control Strategy
RR	Relative Risk
TDR	Special Programme in Research and Training on Tropical Diseases (Co-sponsored by: UNICEF, UNDP, World Bank, WHO)
UK	United Kingdom of Great Britain
UNDP	United Nation's Development Programme
UNICEF	United Nation's Children's Fund
USD	US Dollar
WFP	World Food Programme
WHO	World Health Organization

DEFINITIONS

Anonymity – the identity of the subject is protected for the protection of the individual in the community.

Attitude - A tendency to possess certain feeling towards a specific aspect or stimuli.

Confidentiality - A kind of protection to personal information. It means that a discretionary few individuals have access to identifiable data.

Knowledge - an understanding about a subject being discussed

Practice - a way of doing something that is the usual or expected way in a particular organization or situation [32]

Perception - is a tendency to perceive something whether negative or positive, motivation, and interest in a subject.

Socioeconomic status - a descriptive classification of a person's position in society, e.g. income, educational level and occupation

Research design - the ultimate plan for gathering data in a research survey.

Cluster sample - a sampling method in which each unit selected comprise of a group of persons rather than an individual, e.g. households or village.

Sample - A subset of the population that is selected to represent the population of the selected study area.

Population - the total number of inhabitants of a given area.

Standardized questionnaire - The tool containing standard questions used by an interviewer to collect information needed to draw conclusions about a studied topic of research.

Household interview survey - the collection of information from a representative sample of households by trained interviewers.

ABSTRACT

Purpose: To assess and determine insecticide treated nets (ITNs) distribution and use for malaria intervention in Omuntele Constituency.

Study Design: Cross-sectional analytical household KAP survey.

Sample: 6 out of 35 villages in Omuntele Constituency in Oshikoto Region (Northwest Namibia) were selected. 10 households each were selected randomly from 6 villages as the primary sample unit (PSU).

Respondents: A random sample of 60 male and 60 female adults above 15 years of age.

Data collection and analysis: A standardized questionnaire was administered to a sample of 120 respondents of 60 households of selected villages. Data was analyzed by using CSAMPLE in Epi Info 2002 for the estimation of frequencies.

Results: The results showed a proportion of 50% of households surveyed owned more than one net and 23.3% had at least one net, leaving 26.7% that did not have a net at all. A mean of 1.8 nets per household was observed. More than one third (36.6 %) of people living in the investigated households were sleeping under a net with 31.3% of them having been children less than five years of age. Availability of money, educational status and close distance of households to net sales points were the main contributing factors for net ownership. The generally high willingness to pay for ITNs was often not compatible with the ability to pay. Respondents were much more knowledgeable than expected about malaria in general but could often not answer more specific questions regarding prevention and individual protection. 85.2% of net owners used their nets regularly at least during malaria season while inconvenience and discomfort caused by heat and

stuffiness were the main reasons given by those for not, or not regularly, using their ITNs.

***Conclusion**:* Financial constraints remain the main barrier of increasing ITN coverage. Providing ITNs free of charge would be a viable way to maintain equity and guarantee an immediate increase in access.

1. INTRODUCTION

1.1. Background

The changing epidemiology of malaria in Namibia, and indeed the whole world, expresses the need to enhance control strategies with non-traditional interventions. The use of insecticide treated nets (ITNs), as a means of recruiting community participation into malaria control, has been tried elsewhere [1]. However, very little is currently operational in Namibia, where active community participation in malaria control has been widely implemented and assessed. Therefore, this study assessed the level of ITN distribution and use as a participative means of malaria control in the community of Omuntele. With approximately 400 000 clinical cases of malaria and between 300-500 deaths every year, malaria ranks first in terms of morbidity in Namibia, and third in mortality, following HIV/AIDS and tuberculosis [2]. The majority of these cases occur in the northern parts of the country. Plasmodium *falciparum*, the most dangerous and fatal of the four malaria parasite species, accounts for 97% of all malaria infections in Namibia [2]. The country experiences seasonal unstable malaria transmission characterized by sporadic epidemics of severe disease whose incidence are greatly influenced by the rainfall patterns. The peak transmission period is usually from February to April. Malaria is endemic in the northern regions of the country [3].

The bulk of the national resources allocated to malaria control is spent on providing expensive curative care and on funding the very costly malaria indoor residual house spray control programme. Furthermore, the calculations of the programme are only based on a government managed programme that uses insecticide that lasts 6 months. This programme is implemented in the absence of up-to-date evidence on its health impact.

Meanwhile, little emphasis is placed on other effective interventions like the use of ITNs to reduce the malaria problem.

1.2. The Namibian National Programme for Malaria Control

In Namibia, the spraying programme for malaria vector control was first launched in 1965 in the Oshakati District, in the far north of the country, using 75% of DDT ($2g/m^2$) [3]. Since then, all malaria endemic regions in the northern parts of Namibia are sprayed on an annual basis. The programme is still running with only some villages occasionally being left unsprayed in the absence of dwellers. The objective of the programme is to prevent and reduce morbidity and mortality from malaria to its lowest possible levels by controlling the adult mosquito population. So far, the distribution of ITNs is not yet part of the national programme for malaria control. Even though health education on malaria is provided, personal protection still remains an area that has been thinly promoted. It is intended that the results of this study would help the community to commit themselves to personal protective resources and the National government to divert the resources spent on the expensive technique for malaria control in practice to the new technique for malaria control.

1.3. Significance of the Problem

At least 400 000 clinical cases of malaria and between 300-500 deaths from the disease are reported in the country every year. Malaria ranks first in terms of morbidity in Namibia, and third in mortality, following HIV/AIDS and tuberculosis [2]. Out of the yearly reported clinical malaria cases, 40 000 clinical malaria cases are counted for

Oshikoto region. Meanwhile close to 20 - 45 malaria deaths per year are reported in Oshikoto region. The Omuntele Constituency health facility records 1800 - 2000 malaria cases every year, which accounts for 5% of all malaria cases in Oshikoto region, as extracted from the Health information System (HIS) Oshikoto Region. With no immediate outlook of reducing malaria significantly and improving bed net exploitation, community participation in prevention is the only way of affecting the course of the pandemic. Furthermore, studying the current distribution and use, knowledge, perception, socioeconomic status of the community, practice and attitude regarding malaria and bednets of the community, may encourage them to make a strong commitment in order to sustain these malaria intervention programme efforts and take charge of their own health. The study results will further enhance service provision, policy formulation, research, interventions and sustainable community-based programmes at large.

1.4. Statement of the Problem

The residual spraying with pyrethroids is the current method used to interrupt malaria transmission in Oshikoto region with alternative methods still being widely ignored. But despite an annual house spraying coverage of 80%-90%, transmission has increased steadily over the past few years [18]. This makes malaria a persistent health problem and raises doubts about the choice of method in the attempt to control malaria in Oshikoto region. Use of ITNs represents an alternative or complementary intervention to reduce malaria incidence. However, information on the current prevalence, distribution and use of ITNs together with the community's perception and attitude regarding ITNs is not available.

1.5. Significance of this Study

Internationally, the use of ITNs has been increasingly recommended over house spraying as a means of controlling malaria vectors over the last 15 years [4]. It might be expected that insecticide treated nets would be more effective than house spraying for the following reasons: Most anophelines bite indoors late at night and bed-nets intercept mosquitoes as they approach sleepers in search of blood. Thus, the nets may be considered insecticidal traps baited with the odour of the sleeper inside. In contrast, walls and ceilings sprayed with some Anopheles irritating insecticides, such as DDT, may only shorten the resting time on the sprayed surfaces [4].

For insecticide treated nets to be fully effective, active involvement of community members is required to make sure that nets are always used. Even during warm seasons when their use is uncomfortable and when there may not be enough biting by nuisance insects to motivate for the uninterrupted use. This is important, since there may still be enough vectors to be dangerous [5].

1.6. Context

Omuntele Constituency belongs to Oshikoto Region, a vast semi arid territory in the north west of Namibia. It is sparsely populated with approximately 17200 people of which about 55% = 9400 people are aged 15+ years [6]. The majority of these people depend on subsistence farming, which is dependent on seasonal rainfall. The constituency is largely under-developed and has poor infrastructure. Health services are rendered by three clinics, but no health centre exists to admit patients. Outreach teams from neighbouring constituencies reach the peripheries of Omuntele only on an irregular basis.

The distance to the district hospital is very far (about 100 km) with no public transport being available and no proper roads existing in an extremely sandy area.

The study was located in Omuntele because this is the only one, out of ten constituencies in the region, not benefiting from the Malaria Indoor Residual House Spray Programme (MIRHSP) [3]. This exclusion was justified on the basis that Omuntele has had a bed net project running for the last seven years. Materials for those nets used to be provided by WHO with the netting and selling having been done within the community. After having run successfully over many years, the project recently experienced supply problems with netting materials.

1.7. Justification for the Study

Namibia has adopted the Primary Health Care (PHC) approach after its independence in 1990. The Primary Health Care Services include the National Vector-born Disease Control Programme (NVDP), which in turn houses the Malaria Indoor Residual House Spraying Programme (MIRHSP) [19]. This is in line with the Regional Malaria Control Strategy (RMCS), which formed the basis for the development of the Global Malaria Control Strategy (GMCS), endorsed some six years ago at the ministerial conference on Malaria Control in Amsterdam [20]. The strategy provided the framework and context for the re-orientation of Malaria Action Plans. The Ministry of Health and Social Services in Namibia has recently endorsed a malaria policy and strategy document, which outlines objectives and strategies for malaria control, and a draft action plan (without budget) has been prepared [2].

The WHO Regional Plan of Action for malaria control places particular emphasis on the importance of community based activities [21]. In contrast, the Namibia national malaria programme has not been community focused. However, in collaboration with the WHO, it is developing community-based programmes. This integrates the findings of operational research on household practices relating to malaria management with health education and communication activities. Community based projects for the production and distribution of ITNs is also planned but little resources are allocated for this intervention programme.

2. LITERATURE REVIEW

2.1. Malaria

WHO statistics show that 40% of the world population lives in areas considered to be malarious with 90% of all malaria cases occurring in Sub-Saharan Africa. 300-500 million new cases are reported annually with more than 1 million people being killed by malaria every year. Young children are at highest risk and malaria accounts for almost 25% of child mortality in Africa. In addition, the disease drains Africa's economies with direct and indirect cost of malaria control and treatment exceeding US$ 2 billion per year in this continent alone. Increasing parasite resistance against insecticides and antimalarial drugs is seen as the greatest challenges in the worldwide fight against malaria. [7, 8].

2.2. Insecticide Treated Nets (ITNs)

Based on experiences over the past 20 years, WHO considers ITNs to be a promising intervention for reducing the risk of malaria infection in areas of both stable and unstable

transmission. The widespread use of ITNs could be expected to reduce all-cause child mortality in malaria endemic areas by about 20%. However, very few countries have more than 20% of children at risk from malaria sleeping under ITNs. [9]. Based on experiences with ITNs in previous years, the 1999/2000 progress report of the Special Programme in Research and Training on Tropical Diseases (TDR) calls on the need to improve existing strategies, especially with regard to optimizing the use of ITNs and increasing accessibility. Community participation in ITN activities and social marketing techniques are seen as promising in that respect. [10]

2.3. Experiences with ITNs

Abdulla S. et al. (2001) assessed the impact of a social marketing programme on distributing nets treated with insecticides on malarial parasitaemia and anaemia in very young children in an area of high malaria transmission in Tanzania [11]. The findings showed that ownership of nets increased rapidly (treated and untreated nets: from 58% to 83%; treated nets: from 10% to 61%). The study reported that treated nets had a protective efficacy of 62%. The results from the study showed that ITNs have a substantial impact on morbidity when distributed in a public health setting.

D'Alessandro U. et al. (1995) measured the effectiveness of the Gambian National Insecticide Impregnated Bednet Programme and found a reduction of 25% in all-cause mortality in children aged 1-9 years living in treated villages. However, small-scale trials, which had been carried out prior to introducing the national programme showed much more promising results with a 60% reduction in mortality in children 1-4 years old sleeping under treated nets. One of the explanations given by the authors for the much

lower outcome of the national programme was based on the close link between usage and efficiency of bednets. When planning for the national programme, it was wrongly assumed that the level of bed net use throughout the country would be similar to that found in the area of the controlled trial, which was 96%. But a nationwide survey on bed net usage found that only some 70% of 1-4-year-old children regularly slept under a bed net. [12].

The high efficiency and acceptance of ITNs as an important method for malaria control worldwide has been frequently discussed in the literature as is summarized by *Takken W.* (2002) [13]: "In the absence of resistance, most studies on ITN effects report a reduced survival of adult mosquitoes as well as mass killing." Takken describes three different ways in which ITNs work: first, the insecticide acts as a killing agent when the insect makes contact by landing on the net; secondly, the insect rests only briefly on the treated fabric being irritated by the insecticide; and thirdly, fewer mosquitoes enter rooms where ITNs are present due to the deterrence caused by the insecticides. In addition, Takken also describes a range of side effects of ITNs with both positive and negative impacts. The latter includes changes in biting behaviour of mosquitoes expressed by outdoor biting and/or shifts in time of biting. In contrast, the possible change in host preference with the favourite host being unreachable under the ITN would be a positive side effect.

In their Final Report No. 5 on malaria from 1998, the *WHO Special Programme for Research and Training in Tropical Diseases (TDR)* [14] emphasizes, "ITNs are likely to be effective for malaria prevention even in areas where pyrethroid resistance is present. In addition, the use of ITNs is unlikely to induce resistance in areas where malaria

vectors are free of resistance genes." These encouraging findings were based on field trials carried out in Benin and Côte d'Ivoire, which showed that the presence of ITNs strongly deterred entry of malaria vector mosquitoes into a room, whether or not they were resistant. Resistant vectors were killed almost as efficiently as susceptible mosquitoes since they had longer contacts with the treated nets after they had partly lost their response to the irritant effect of pyrethroids.

Browne E.N.L. et al. (2001) assessed the impact of insecticide-treated bed net use on malaria and anaemia in pregnancy as a supplementary study in a major WHO/TDR-supported bednets trial in northern Ghana [5]. Effective net use by parity varied from 42% in primigravidae to 63% in multigravidae, in spite of free nets and insecticide impregnation. Overall, 80% of the women studied had access to nets, with the difference in access by parity having been highly significant. However, only 70% of those with access to nets were actually using them. The main reasons given for not using a net were warm weather, perceived absence of mosquito biting, and lack of public education on insecticide-treated bednets for malaria control.

Guyatt H. et al. (2003) assessed the use of bednets that were distributed free to pregnant women in Kenya [15]. The study revealed that in a district with high malaria transmission, 93 of 111 women (84%) who had not previously been sleeping under a bed net had used the net while pregnant, and 97 of the 107 surviving babies (91%) were also protected. The findings showed that free bednets are valued and used by recipients and should be seen as a feasible and effective means to increase access to and use of ITNs in vulnerable groups.

Clarke S.E. et al., (2001) investigated whether untreated bednets had any protective benefit in Gambia where nets, although widely used, are mostly untreated [16]. The results showed that the use of an untreated bed net in good condition was associated with significantly lower prevalence of Plasmodium *falciparum* infection with a protection of 51%. Children in the poorest households benefited most from sleeping under an untreated net with a 62% protection. This was explained by greater exposure amongst the poor due to poor housing structures (e.g. mud-brick walls, thatched roofs) whilst increasing socio-economic status was associated with lower infection rates. The findings suggested that an untreated net, provided it is in relatively good condition, can protect against malaria with the poor having most to gain from the use of a net.

Guyatt H.L. & Snow R.W. (2002) do not only provide evidence for a protective effect of untreated bednets against malaria, but also compare relative costs and cost-effectiveness of treated and untreated nets [17]. Based on the results of a meta-analysis they suggest that the net alone could be responsible for half of the protective efficacy of ITNs, which means that untreated nets are at least half as effective as treated nets. Considering relative costs of untreated and treated nets, it is obvious that untreated nets could be as cost-effective as treated nets.

*Möller O. et al. (*1994) evaluated the cost recovery trial of a National Impregnated Bednets Programme (NIBP) in Gambia, which was introduced in 1992. The study measured coverage by distribution channel, as well as the knowledge, attitudes and practice of the health workers and villagers during the intervention. The results from the study showed that only 16% of bednets were impregnated in 1994, compared to 80% when the insecticide was offered free of charge in previous years. The use of impregnated

bednets was higher in areas where the sale of permethrin emulsion by village health workers was supplemented by the sale of insecticide in individual packages through shops [24].

Onwujekwe O. et al. (2003) conducted surveys in Nigeria to assess the determinants of purchase of ITNs. They found that increased distance of respondents to ITN sales points decreased net purchase and suggested distribution strategies that would decrease time and travel costs to households [25].

Mushi A.K. et al. (2003) evaluated a voucher system designed to provide a targeted subsidy for treated nets to young children and pregnant women in two rural districts of Southern Tanzania. The evaluation found some evidence of an extreme high rate of voucher return. Increased voucher use among least poor households was observed, compared with the poorest households that could not afford the remaining cash required when using vouchers as part-payment. Thus, the conclusion of the study was that, within a poor society, vouchers may not necessarily increase health equity unless they cover a high proportion of the total cost [26].

Guyatt H.L. et al. (2002) conducted a survey on the cost to a household of protecting themselves with ITNs compared with current household expenditure in rural highland Kenya. The survey results showed that homesteads expressed a willingness to pay for ITNs, but the amounts offered were not sufficient to cover the costs of providing this service without donor support to meet the difference. Most of the households' expenditure was allocated to basic needs and their aspiration to protect themselves with ITNs was not compatible with their ability to pay [27].

Korenromp E.L. et al. (2003) reviewed data from household surveys in sub-Saharan African countries to investigate the strengths and weaknesses of the indicators "proportion of households possessing mosquito net(s)" and "proportion of children under 5 years of age who slept under a net". In-depth surveys suggested that use was lower than possession because: (i) nets were scarce (mean 1.8 per possessing household); (ii) nets were not always used for children and (iii) use was lower during hot, dry months than during cool rainy months, and many surveys had been conducted in dry seasons [28].

Alaii J.A. et al. (2003) conducted a randomised controlled trial in Western Kenya on factors affecting use of permethrin-treated bed nets. Adherence to permethrin-treated bed net (ITN) use and their proper deployment was directly observed in 784 households in western Kenya. The study showed approximately 30% of ITNs distributed free of charge, were unused. Also, an overall percentage of 72.3% of adherence to continuous use was also observed. The most important reason for non-adherence was disruption of sleeping arrangements. The probability of adherence by individuals was strongly depended on age. Children less than five years of age were less likely to use ITNs than older individuals. Excessive heat was often cited as a reason for not deploying the child's ITN, and was more likely to be used during cooler weather [29].

Fred Nuwaha (2001) conducted a survey on factors influencing the use of bednets based on demographic characteristics, socio-economic conditions, causes and transmission of malaria, perceived control of malaria prevention, beliefs about utility of bednets and whether they use bednets or not. Factors such as employment, income, living in permanent house structures, being a skilled worker or professional, and believing that

bednets prevent malaria were observed as the strong independent factors that favoured bednets use in Mbarara Municipality of Uganda [30].

3. STUDY PROCEDURES

3.1. Research Question:

To what extent are insecticide treated nets distributed and used in Omuntele Constituency, Oshikoto Region, Namibia?

3.2. Aim of the Study

The aim of this study was to assess the current distribution and use of ITNs. In addition, the study explored reasons for the findings by exploring the knowledge, attitudes, practices, and perceptions of ITNs as well as socio-economic factors of the communities in the Omuntele Constituency.

3.3. Objectives of the Study:

The specific objectives of this study were as follows:

- To assess the proportion of households having bednets in Omuntele Constituency.
- To determine the socio-economic status of those who do have and those who do not have ITNs or bednets.
- To assess the level of knowledge and the perceptions of the community with regard to malaria and ITNs/bednets.
- To assess the attitude of the community towards ITNs.
- To assess practices applied in the use of bednets.

- To make recommendations to the National Vector born Disease Control Programme Division and donors to increase investments in the promotion of ITNs.

4. METHODOLOGY

This section deals with the study design, study area, sampling, data collection and ethical considerations.

4.1. Study Design

The study conducted is a cross-sectional analytical household KAP survey. Information collected during this survey illustrated the current distribution and use of bednets, the knowledge, attitude, practice, and perception about ITNs as well as socio-economic factors within the community of Omuntele Constituency.

The methodology comprised a quantitative research approach. This approach was used to collect information relating to socio-demography, for example phenomena like age, sex, educational level, employment status, and marital status), and on socio-economic status of households involved in the survey, attitude and perceptions towards ITNs, knowledge, and practices applied in the use of ITNs.

A cross-sectional study design was selected since it could provide a snapshot-view of the current situation, is relatively inexpensive to perform, and could satisfy all objectives of the study in a limited period of time.

4.2. Study Area

Omuntele Constituency has a total number of 35 villages, each village with an average of 25 - 30 households. However it is noted that Omuntele Constituency represent 10.2% of

Oshikoto Region's population. It is a very remote and difficult to access rural area that is located in Northwest Namibia. Malaria incidence is much higher here than in the semi-arid and arid parts of central and southern Namibia. ITN coverage was predicted to be fairly good due to the existence of a local bed net project.

4.3. Sampling

4.3.1. Sample size

The sample size consisted of 120 respondents from 60 households (60women and 60 men). A 50% bednets use rate (most conservative) was assumed so that the sample size would yield a 95% confidence interval of +/- 10% for descriptive analysis. Comparative analyses considered exploratory aspects only, since this sample size had limited power. Nevertheless, the findings could be useful to guide future research on predictors of correct bed net use in the region.

4.3.2. Sampling procedures

The constituency has a total population of approximately 17200 (55% 15 years old and over = 9460 adults) and a total of 35 villages, with an average of 25 – 30 households per village. Multi-stage cluster random sampling of 6 out of 35 villages was selected for the Primary Sampling Unit (PSU) by using simple random sampling with the villages being of approximately the same size population [22]. In each village 10 households (out of 25-30) were randomly selected, and then within each household 2 adults (16 years and older) of opposite sex were then selected (stratified random sampling) residing and present in the household at the time of the interview. If a household did not have both gender groups available for interview, those available were interviewed and additional

households were selected and visited until the desired sample size in both genders was reached. (Stratified sampling by gender was used to ensure both genders were included in the sample for analysis, as there was a concern that men were less likely to be available for interviews compared to women). 60 households were selected from 6 villages (i.e. Ambende, Onamavo, Omuntele, Okaluwa, Opembe and Okandombo villages). The household numbers were written down on small pieces of paper, which were put into a box, then shuffled and after that, numbers representing a household were picked by means of simple random sampling. The sample size consisted of 120 adult respondents aged 16 and above. The total number of respondents was made up of 60 males and 60 females. The constituency counsellor informed the selected villages and household's inhabitants about the purpose of the study. Ethical procedures were followed and are discussed in detail later.

4.3.3. Inclusion criterion:

The survey was conducted only to people aged 16 years and above. Adults of opposite sex residing and present in households at the time of the study were included in the survey.

4.3.4. Exclusion criterion:

Persons whose age was below 16 years were excluded. Asking each representative person his/her age ensured the exclusion.

4.4. Data Collection

4.4.1. Pre-testing of the questionnaire

The questionnaire was pre-tested in one of the constituencies with similar characteristics, e.g. language and cultural norms and values, to those of Omuntele Constituency. This was done to see whether the tools provided the information required. Final coding was developed after the pre-test exercise, to see whether questions were clear, unambiguous and whether it could be clearly understood by the respondents. Time to complete the questionnaire was determined after the testing exercise. An approximate time of 25 to 35 minutes was estimated per respondent. The testing led to adjustment of the questionnaire. Unclear statements were identified, revised and reformatted. Alternatively, the questions were erased.

4.4.2. Measurements

Reliability of the tools

This tested whether measurements made were consistent. Respondents who were used in piloting the questionnaire could answer most of the questions. Problematic questions that did not provide the desired information were erased. After all alterations were made, the questionnaire was considered a reliable tool based on the quality of information received from the piloted respondents. The questionnaires was administered by trained enumerators and supervised by the principal investigator.

Validity of the tool

Sensitivity of variables was also tested to find out which ones were influential to positive results. The existence of the bed net project in the constituency was the predictive value of a test, which depended upon ITNs presence in the constituency.

Content validity was tested to determine whether the words, statements and questions in the questionnaire offered the purpose and valid intention of the study. This tested whether measurements were correct, i.e. instrument measure what it was intended to measure, and that it measured it correctly. The content of the questionnaire was revised for different meanings for different respondents and whether the tool was capable of answering the question. Final alterations were made to the tool and it was ready for the field to collect data. The questionnaire is attached as Annexure 1.

4.4.3. Data collection procedures

The principal investigator and two trained enumerators collected information using standardized questionnaires at households selected for the survey. Interviews were conducted to collect detailed information from key informants on demographic characteristics, socio-economic status, knowledge and perception about malaria and bednets, practice, attitude and bednets ownership from key informants of the respective households who were present at the time of the study. During the survey the investigator recorded the number of people as well as the number of children under 5 years old who were living in the households, the number and age group of individuals either using or not using bednets, number of ITNs in a household, and sleeping arrangements of children. Interviews were held in English and Oshiwambo as the predominant local languages. The questionnaire itself was originally in English but was translated into Oshiwambo for standardisation. The principal investigator supervised the research enumerators to ensure correct procedures. For quantitative variables, the allocated numbers were entered in the questionnaire. For categorical variables, code-numbers were allocated to describe their quality. In case of limited options, the coding was done in

advance (e.g. gender: 1=male; 2=female). For open-ended questions with a wider range of possible answers, codes were only allocated after having categorized the answers (e.g. reasons for not using bed nets), this was done to avoid manipulation of responses by the researcher. In those households where two adult informants were present, interviews were conducted separately to avoid intentional duplication of information by the respondents.

4.5. Ethical Considerations

The study was carried out in households. Anonymity and confidentiality was ensured. The participants were informed about the aim of the study, the method of how the study was going to be conducted and about the possible benefits from the study. Informed consent was obtained prior to interviews. Participants were informed that they were free to withdraw from the study at any time without giving reasons and that their rights and welfare were safeguarded. Approval from the Higher Degrees Committee of the University of the Western Cape to go ahead with the research study was obtained prior to commencement of the study. Ethical clearance was requested from the Ethical Committee as well as permission from the Ministry of Health and Social Services Research Committee (Namibia) and from the Constituency Counsellor as well as from the community headmen. The participants were registered on the questionnaire with numbers rather than names to ensure anonymity. Confidentiality of the information collected is maintained and shall remain. All data and results gathered would only be shared with the UWC, Ministry of Health and Social Service's National Vector born Disease Control (Namibia), and the Omuntele Constituency Counsellor. The information that subjects gave may benefit other constituencies with similar situations or problems.

5. DATA ANALYSIS

5.1. Statistical Methods

Data were entered and validated and cleaned by the survey investigator using CSAMPLE in the EpiInfo 2002 software. CSAMPLE in EpiInfo was used for estimating relative frequencies, relative risks and 95% confidence intervals. This program is specifically designed to analyze complex survey data (i.e. cluster sampled survey data) and takes into account the necessary adjustments in standard error and confidence intervals due to the cluster sampling method [23]. Data was analyzed according to the five sections of the questionnaire as mentioned earlier in the content of the questionnaire section.

6. RESULTS

6.1. General

6.1.1. Biographical data

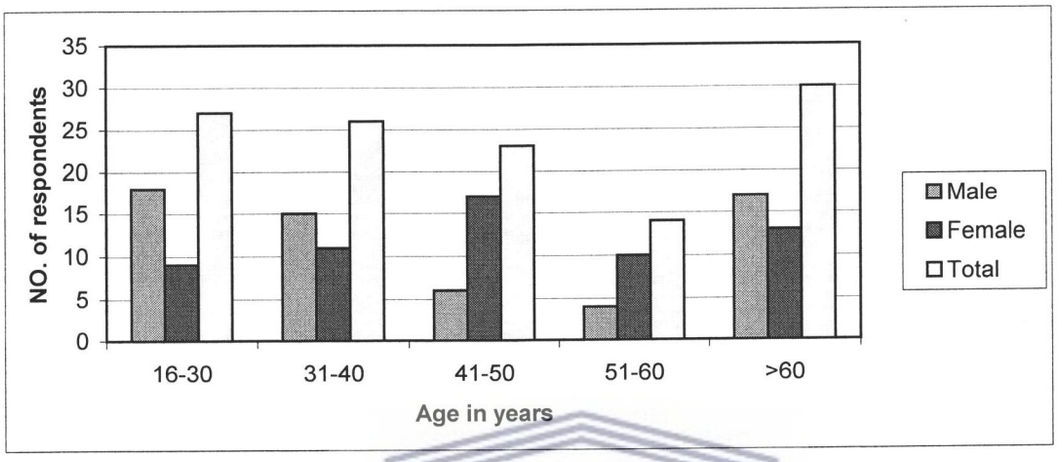
The study sample consisted of 120 people with an equal gender distribution of 60 females and 60 males. Ages ranged from 16 to 87 years (mean = 46 years) and were also fairly equally distributed with only the age group of the 51-60-year old ones having been slightly underrepresented (Table 1).

Table 1: Age distribution of sample

	Age groups (years)					Total
	16-30	31-40	41-50	51-60	>60	
Numbers	27	26	23	14	30	120
Percent	22.5	21.7	19.2	11.7	25.0	100.0

However, analysis of age distribution according to sexes showed that middle-aged men (41-60 years) were the least represented (Figure 1).

Figure 1: Age distribution of respondents by gender



More than two thirds of all respondents (82/120 = 68.3%; 95% CI 60.5, 76.2) were married, 56.7% (34/60; 95% CI 43.6, 69.7) of males and 80.0% (48/60; 95% CI 72.8, 87.2) of the women.

6.1.2. Household data

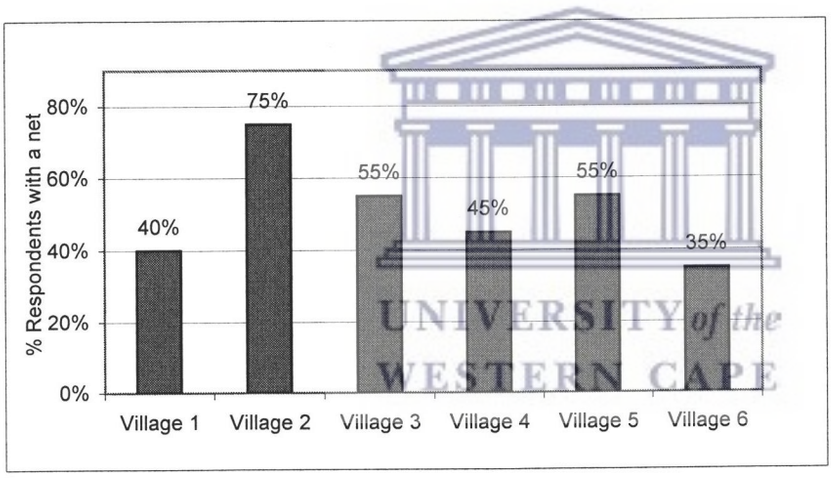
A total of 576 people including 168 (29.2%) children under the age of five years were living in the investigated 60 households. Numbers of inhabitants per household ranged from three to 18 with a mean of 9.3 people including a minimum of one and a maximum of seven (mean = 2.8) children less than five years of age.

6.2. Bed Net Distribution

6.2.1. Village level

In three out of six villages, about half of the respondents had a bed net (between 9 and 11 out of 20 = 45-55%). In two other villages, about one third of respondents had a net (7 and 8 out of 20 = 35 and 40%). The last village (Village No 2 = Omuntele Village), was quite outstanding with 75% (15/20; 95% CI 75.0, 75.0) of respondents possessing a bed net. Thus, this village was home to one quarter of all net owners (15/61=24.6%; 95% CI 19.1, 68.3).

Figure 2: Net ownership by villages

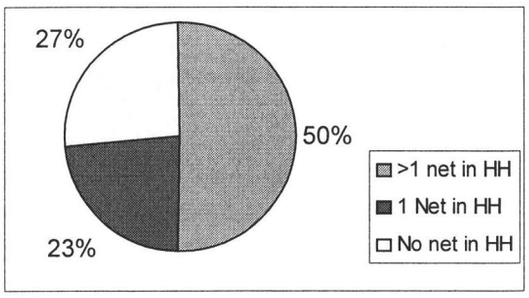


6.2.2. Household level

Out of the 60 households investigated, 16 (26.7%) did not have any bed net at all in the household, whilst 14 (23.3%) had one net and the remaining 30 households (50%) more than that. In total, there were 106 bed nets resulting in a mean of 1.8 nets per household while the maximum of six bed nets was found in two households. However, when only

considering those households, which do have nets (n=44), it results in a mean of 2.4 nets per possessing household.

Figure 3: Households with and without bed nets:



6.2.3. Individual level

About half of all respondents (61/120=50.8%) were in possession of a bed net. Meanwhile, more than one third (211/576 = 36.6%) of all people (n = 576) living in the investigated 60 households slept under a bed net with almost every third of them (66/211 = 31.3%) having been a child less than five years of age. Thus, two out of five children under five years (66/168 = 39.3%) were sleeping under a bed net.

However, big differences between the various age groups could be observed regarding net ownership. Following inverse proportion, net ownership became less likely with increasing age for those above 30 years of age: Whilst 69.2% (95% CI 52.0, 86.5) of those aged 31-40 years and 65.2% (95% CI 40.1, 90.4) of the 41-50 year-old ones had a bed net, only 42.9% (95% CI 17.7, 68.0) of the 51-60-year-old ones and 36.7% (95% CI 29.8, 43.6) of those aged 60 years and above owned a net. As for the youngest group, aged 16-30 years, only 40.7% (95% CI 24.2, 57.1) were in possession of a bed net (Figure 4).

Figure 4: Age and gender of bed net owners

Figure 4 also illustrates differences in net ownership by gender: 34 out of 60 males (56.7%; 95% CI 45.5, 66.0) and 27 out of 60 females (45%; 95% CI 34.0, 54.5) owned a bed net. Only in the youngest group, aged 16-31 years, women surpassed men. At the other end of the age scale, however, not even one quarter of females above 60 years of age had a bed net while almost half of the men in the same age group were in possession of a net. Amongst men aged 31-50 years, even more than 80% owned a bed net.

6.3. Socio-Economic Status

6.3.1. Educational level

Amongst the 61 respondents possessing a bed net, 13 (21.3%; 95% CI 15.9, 26.7) never went to school or only attended primary school whilst 48 (78.7%; 95% CI 73.3, 84.1) completed a secondary or tertiary education. 64.4% (38/59; 95% CI 46.9, 81.9) of the people without a bed net had not exceeded primary education while 35.6% (21/59; 95% CI 18.1, 53.1) completed secondary or tertiary education. People with a secondary or tertiary education were 2.7 times more likely to own a bed net than people with primary or no education [Relative Risk (RR) = 2.7; 95% CI = 1.42, 5.23].

Table 2: Socio-economic status versus bed net ownership

SOCIO-ECONOMIC FACTORS		BED NETS		TOTAL
		Yes	No	
EDUCATION:	None / Primary	13	38	51
	Row %	25.5	74.5	100.0
	Col. %	21.3	64.4	42.5
	Second. / Tert.	48	21	69
	Row %	69.6	30.4	100.0
	Col. %	78.7	35.6	57.5
	Total	61	59	120
	Row %	50.8	49.2	100.0
	Col. %	100.0	100.0	100.0
INCOME:	Any income	56	40	96
	Row %	58.3	41.7	100.0
	Col. %	91.8	67.8	80.0
	No income	5	19	24
	Row %	20.8	79.2	100.0
	Col. %	8.2	32.2	20.0
	Total	61	59	120
	Row %	50.8	49.2	100.0
	Col. %	100.0	100.0	100.0

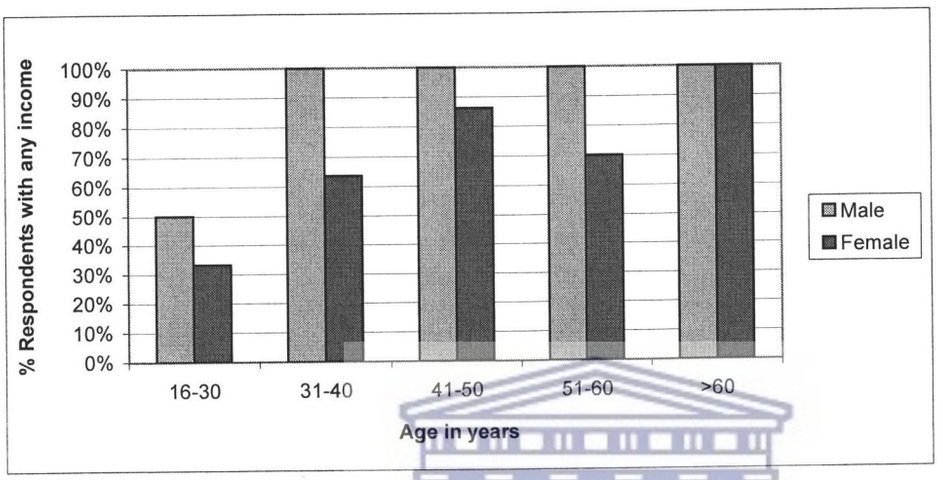
6.3.2. Income

91.8% (56/61; 95% CI 87.2, 101.4) of the respondents possessing a bed net had some kind of income source, e.g. through (self-) employment, farming or from receiving a pension. Only 8.2% (5/61; 95% CI -1.4, 4.9) did not have any income source (e.g. students). Amongst those people without a bed net, about two thirds (40/59 = 67.8%; 95% CI 1.1, 74.5) did have an income and the other third (19/59 = 32.2%; 95% CI 25.5, 38.9) did not have an income (Table 2). Having an income made it 2.8 times more likely to have a bed net than without an income (RR = 2.8; 95% CI = 1.27, 6.17).

When looking at incomes against a gender background, males are clearly better off than females with 85% (51/60; 95% CI 70.0, 100.0) of them having indicated that they had some source of income compared to 75% (45/60; 95% CI 66.6, 83.4) of women with an income (Figure 5). Further analysis according to age groups showed for men that all but

the youngest group (16-30 years) reached 100% for having some source of income. Amongst women, only the last group consisting of females aged 60 years and more reached 100% for income (Figure 5).

Figure 5: Income versus age and gender



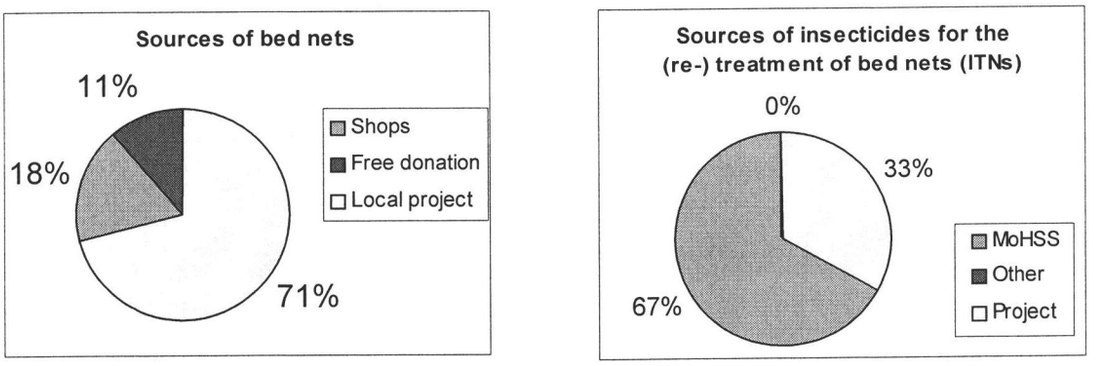
A more detailed age analysis of those without any income (results not illustrated in figure 5) even showed that all men without income were aged 25 years and younger. On the other hand, women without income were found up to an age of 57 years. Above that age, most of them received a pension as income.

6.4. Availability

6.4.1. Sources of bed nets and insecticides

Only 11.5% (7/61, 95% CI 7.4, 15.6) of those people who had a bed net (N = 61) got it as a free donation. 70.5% (43/61; 95% CI 57.8, 83.2) bought it at the local bed-netting project and 18% (11/61; 95% CI 6.4, 29.6) in shops, which are far away from the area and require transport. (Figure 6)

Figure 6: Sources of bed nets and insecticides



54 of the existing 61 nets (= 88.5%; 95% CI 82.0, 95.0) were treated with insecticides. In two thirds of the cases (36/54 = 66.6%), the nets were treated free of charge by the Environmental Health Services (Ministry of Health and Social Services) who visit the area for this purpose every year before the beginning of the main malaria season. The other 18 nets (33.3%) were treated at the cost of the respective owners who took their nets to the bed-netting project for treatment. The insecticides were provided free of charge to the project by the Ministry of Health and the dipping of nets was done for an amount of N$ 5.00 (= U$ 0.85 at an exchange rate of U$ 1 = N$6.00).

6.4.2. Willingness to pay for bed nets

All 120 respondents (100%) answered positively when asked whether they would be willing to pay money for a bed net. Indicated amounts ranged from N$10 to N$55 (Table 3), which equals 1.65 USD up to 9.15 USD. On the other hand, 59.3% (35/59; 95% CI 42.7, 72.6) of those who did not own a bed net indicated lack of money as the reason.

Table 3: Amounts respondents are willing to pay for a bed net

Amount in N$	55	50	45	40	35	30	25	20	15	10	Total
Frequency	1	4	0	16	14	26	21	22	11	5	120
Percent	0.8	3.3	0	13.3	11.7	21.7	17.5	18.3	9.2	4.2	100.0
Cum. %	0.8	4.1	4.1	17.4	29.1	50.8	68.3	86.6	95.8	100.0	100.0

The prices charged at the local bed net project ranged from N$35 (= 5.85 USD) for a single up to N$80 (= 13.35 USD) for bigger nets with prices in commercial shops being even higher. However, only 29.1% (35/120) of respondents were willing to pay N$35 or more with the maximum indicated not exceeding N$55. The remaining 70.9% (85/120) were only willing to pay N$ 30 (= 5.00 USD) or even less.

6.5. Knowledge of the Community

6.5.1. Knowledge on malaria

All 120 people interviewed considered malaria to be a major problem. Most of them knew the ways of transmission (115/120 = 95.8%; 95% CI 90.5, 101.2) and that everybody is vulnerable to malaria (116/120 = 96.7%; 95% CI 93.4, 99.9). However, significantly less people were knowledgeable in more specific areas like prevention and individual protection: Every third respondent (41/120 = 34.2%; 95% CI 16.7, 51.6) was not aware that malaria can be prevented and 40% (48/120; 95% CI 20.9, 59.1) did not know how to protect themselves from malaria. (Table 4).

Table 4: Knowledge on malaria and bed nets

	Yes/Correct		No / Incorrect		Total	
	No.	%	No.	%	No.	%
MALARIA						
Malaria considered a major problem?	120	(100.0)	0	(0.0)	120	(100.0)
Ways of transmission	115	(95.8)	5	(4.2)	120	(100.0)
Who is vulnerable against malaria?	116	(96.7)	4	(3.3)	120	(100.0)
Is malaria preventable?	79	(65.8)	41	(34.2)	120	(100.0)
Individual protection	72	(60.0)	48	(40.0)	120	(100.0)
BED NETS						
Heard about ITNs?	84	(70.0)	36	(30.0)	120	(100.0)
Difference ITN / Normal net	55	(65.5)	29	(34.5)	84	(100.0)
Should bed nets be treated?	72	(60.0)	48	(40.0)	120	(100.0)
Why should they be treated?	54	(75.0)	18	(25.0)	72	(100.0)
How often should they be (re-) treated?	11	(15.3)	61	(84.7)	72	(100.0)

6.5.2. Knowledge on ITNs

Even though quite high levels of net treatment already existed (88.5%), not more than 70% (84/120; 95% CI 55.5, 84.5) of all respondents had ever heard about ITNs with only two thirds of them (55/84=65.5%; 95% CI 52.3, 78.6) having been able to explain the difference between ITNs and untreated nets. A similar picture was created regarding the question as to whether bed nets should be treated, which was agreed to by 60% of all respondents (72/120; 95% CI 45.0, 75.0). However, not even three quarter of the respondents (53/72=73.6%; 95% CI 56.6, 90.6) could say why they would want a net to be treated and only 15.3% (11/72; 95% CI 1.6, 29.0) knew how often a net needs to be re-treated to be efficient.

6.5.3. Educational level versus knowledge

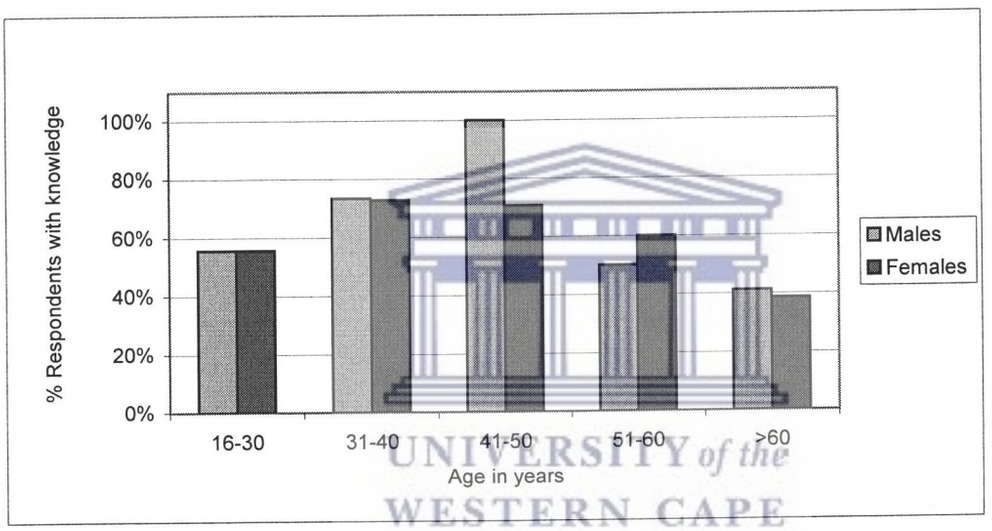
More than 70% of those with knowledge on malaria prevention and individual protection had completed secondary or tertiary education (56/79 = 70.9%; 95% CI 58.8, 83.0 and 51/72 = 70.8%; 95% CI 60.1, 81.6 for prevention and protection respectively). Meanwhile, 68.3% (28/41; 95% CI 51.2, 85.4) of those not knowing about malaria prevention in general and 62.5% (30/48; 95% CI 50.6, 74.4) of those not knowing about individual protection against malaria never went to school or had primary education only. Respondents with a secondary or tertiary education were 1.8 times more likely to have a knowledge on both, malaria prevention and individual protection than those with none or primary education only. (RR = 1.8; 95% CI = 0.97, 3.329 and RR=1.795; 95% CI = 1.08, 2.99 for the likelihood to have knowledge on prevention and protection respectively).

Table 5: Association between educational level and knowledge on prevention and protection

KNOWLEDGE ON:		EDUCATIONAL LEVEL		TOTAL
		Sec./Tert.	None/Prim.	
Prevention from malaria:	Yes	56	23	79
	Row %	70.9	29.1	100.0
	Col. %	81.2	45.1	65.8
	No	13	28	41
	Row %	31.7	68.3	100.0
	Col. %	18.8	54.9	34.2
	Total	69	51	120
	Row %	65.8	34.2	100.0
	Col. %	100.0	100.0	100.0
Protection against malaria:	Yes	51	21	72
	Row %	70.8	29.1	100.0
	Col. %	73.9	41.2	60.0
	No	18	30	48
	Row %	37.5	62.5	100.0
	Col. %	26.1	58.8	40.0
	Total	69	51	120
	Row %	50.8	49.2	10.0
	Col. %	100.0	100.0	100.0

Since knowledge on individual protection against malaria is a crucial factor for the promotion of ITNs, this variable was further analyzed considering age and gender of respondents (Figure 7). Results showed that 60% of men (95% CI 42.5, 77.5) as well as 60% of women (95% CI 37.4, 82.6) knew how to protect themselves from malaria. In both sexes, those aged 60 years and more had the least knowledge (7/17 = 41.2% and 5/13 = 38.5% for males and females, respectively),

Figure 7: Knowledge on individual protection versus age and gender

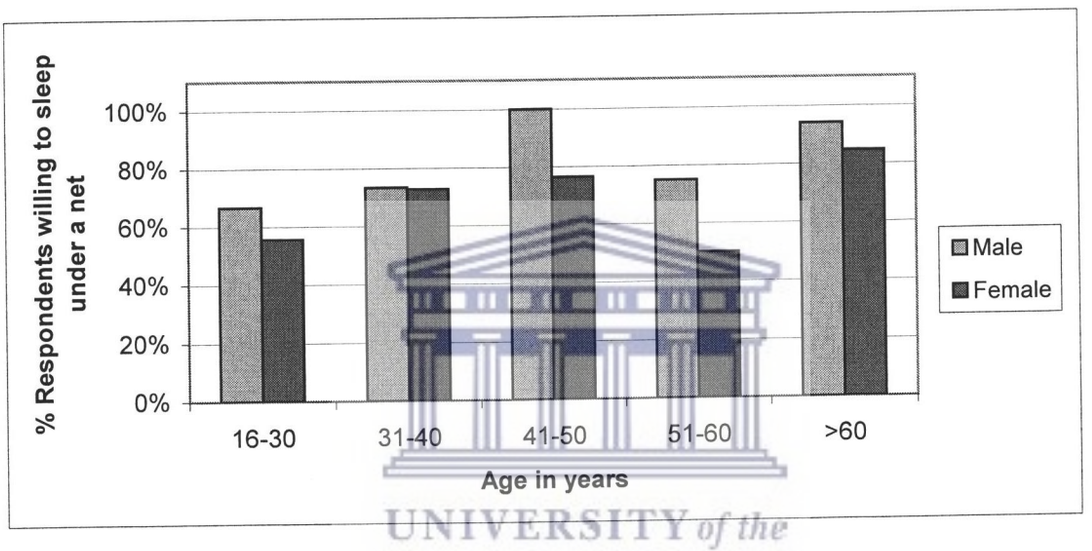


6.6. Attitude and Perception of the Community towards ITNs

Three quarters of all respondents (90/120 = 75%; 95% CI 67.0, 83.0) were willing to sleep under a bed net. Both age and gender of respondents seemed to contribute to their willingness to use a net (Figure 8). With 80% (48/60; 95% CI 71.2, 88.8) of men and 70% (42/60; 95% CI 61.2, 78.8) of women having indicated that they would be willing to sleep under a net, it was 1.143 times more likely for men than for women to be willing to sleep under a net (RR = 1.143; 95% CI 1.04, 1.259). The elder people aged above 60

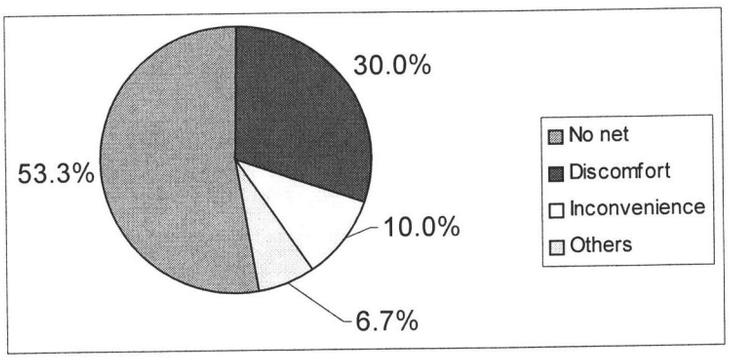
years were most willing to sleep under a net amongst women (11/13 = 84.6%) and second amongst men (16/17 = 94.1%). For the latter, the 41-50-year-old ones were leading with 100% (6/6). The reasons given for willingness to sleep under a net included protection from malaria (30/90 = 33.3%), protection from mosquito bites (59/90 = 65.6%) and protection from insects in general (1/90 = 1.1%).

Figure 8: Willingness to sleep under a net versus age and gender



More than half (16/30 = 53.3%; 95% CI 26.2, 80.5) of those indicating that they would not be willing to sleep under a bed net could simply not imagine to do so since they did not have a net. Reasons given by the other 14 respondents not been willing to sleep under a net included discomfort (9/30 = 30%) caused by heat and stuffiness created under a net, inconvenience (3/30 = 10%) of putting up a net as well as entering and leaving a bed covered by a net. The remaining two respondents (2/30 = 6.7%) explained their lack of willingness to sleep under a net with irritation caused by the chemical used to treat the nets and with the existing bed net being too old, respectively (Figure 9)

Figure 9: Reasons not to be willing to sleep under a bednet:



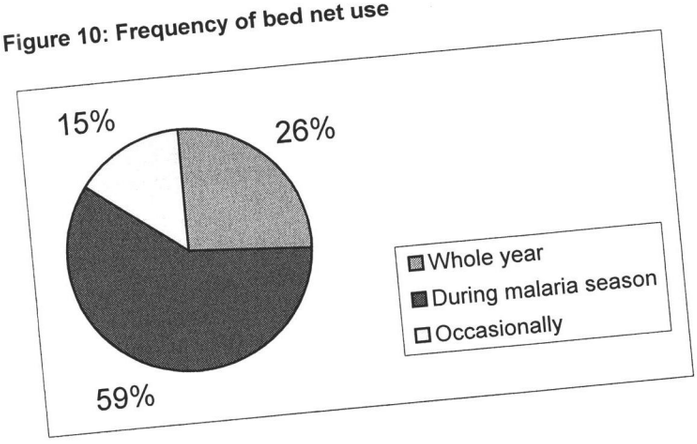
In addition, the educational level of respondents was put into relation with their willingness to sleep under a bed net. However, hardly any difference could be observed: 75.4% (52/69; 95% CI 64.0, 86.7) of those with secondary or tertiary education were willing to sleep under a net and 74.5% (38/51; 95% CI 59.5, 89.5) of those without or with primary education only. Therefore, the risk ratio is very close to 1 (RR = 1.01; 95% CI = 0.77, 1.34).

6.7. Practice / Use

6.7.1. Frequencies of bed net use

About one quarter (16/61 = 26.2%; 95% CI 17.7, 34.8) of the 61 respondents owning a bed net were using their net throughout the year whilst 59% (36/61; 52.0, 66.0) were using their nets only during malaria season, and the remaining 14.8% (9/61; 95% CI 9.6, 19.9) only occasionally.

Figure 10: Frequency of bed net use



6.7.2. Ways of using bed nets

The majority of net owners (57/61 = 93.4%; 95% CI 90.0, 96.9) used their nets in the correct way whilst 4.9% (3/61; 95% CI 0.4, 9.4) used it partly correctly and only 1.6% (1/61; 95% CI –1.3, 4.6) incorrectly.

6.7.3. Frequencies of washing and treating bed nets

88.5% (54/61; 95% CI 82.0, 95.0) of nets were treated with insecticides with 64.8% (35/54; 95% CI 55.9, 73.7) of them having been retreated once per year and the other 35.2% (19/54; 95% CI 26.3, 44.1) twice per year. All of these 54 nets were washed prior to (re-) treatment, but not at other occasions. On the other hand, the seven nets (7/61 = 11.5%; 95% CI 5.0, 18.0), which were never treated with insecticides, were washed whenever necessary (i.e. when dirty).

7. DISCUSSION

7.1. Gender and Age

The sampling method ensured an equal gender distribution within the study sample, which was considered important by the researcher since gender related differences in outcomes were predicted. Results showed this to be true. Significantly more men than women indicated to have an income. Consequently, with lack of money having been the strongest single factor for not owning a net, more men than women were in possession of a bed net. Understandably, only the eldest and the youngest age groups diverted from this pattern. Since both, women and men above 60 years of age received a pension; this was the only group without differences in having an income. However, this is not reflected in net ownership with half of the men, but only every fourth woman, owning a net. Thus, this is the group with the largest relative differences in net ownership by gender. Further investigations would be needed to assess the reasons. Meanwhile, assumptions based on the existing social structures might suggest that women feel more responsible to fulfil basic needs of family members from the little they get before purchasing a net. The only age group with a higher percentage of women than men owning a bed net was the one of the youngest respondents, aged 16-30 years. Many young males stated that it was simply not a priority for them to purchase a bed net, even if they would or did have the money to do so. Young females, on the other hand, were very eager to have bed nets as protection. But with financial constraints being even more severe amongst the young, many could not afford to buy nets. These are missed opportunities, especially since pregnancies and the presence of small children under the age of five years are most common amongst women of this age group. Therefore, ways of introducing a sustainable subsidy to

minimize costs of ITNs should be considered. The question of whether ITNs should be free to the most vulnerable groups is widely discussed in the literature and often dismissed as not feasible due to concerns that, apart from high costs to donors, such free nets would be sold or not used by the target people. But Helen Guyatt and Sam Ochola consider the free provision of ITNs to pregnant women as an important delivery system in increasing access to and use of ITNs in vulnerable groups. In a Kenya based study, they showed that 91% of 294 women interviewed were still using the free net from antenatal clinic after a year [15].

7.2. Bed Net Distribution

The results show a higher bed net coverage than predicted considering the remoteness of the investigated area. The distribution shows considerable variation across the villages though. This is clearly influenced by the respective distances to the source, which, in most cases, was the local bed net project. Thus, Village 2, which hosts the project, shows the highest level of net ownership followed by Village 5, the previous location of the project, and then by Village 3, which is in very near proximity to Village 2. Lowest net coverage was found in Village 6, the furthest distanced place from the project. These findings suggest a good overall impact of the locally based bed net project on distribution outcomes in the community. It should be considered to extend the project by establishing branches in other villages for closer proximity of ITN sales points to the households. The problem of long distances as a barrier for the purchase of ITNs was also determined by O. Onwujekwe et al in Nigeria who recommended ITN distribution strategies that would decrease time and travel costs for households to increase net coverage [25].

7.3. Socio-Economic Status

The results from the study clearly showed an association between bed net ownership, educational level and income. Most of the respondents possessing a net had at least completed secondary school. On the other hand, two thirds of those without a net did not complete or exceed primary education. In conclusion, respondents with a secondary- or tertiary education were almost three times more likely to own a bed net than those with primary or no education (RR = 2.7). Assessments as to why and how lower educational levels limit people in owning bed nets (e.g. limited income possibilities because of lower qualification, reduced understanding of health education and other information due to language problems) could assist in adapting interventions like health education and promotional activities to local conditions.

More than nine out of every ten respondents possessing a net indicated that they had some source of income compared to only two thirds of those without a net. However, the impact of income was expected to be much stronger, i.e. more people without a net as expected to have no income either. The explanation comes with the finding of more than 80% of all respondents having indicated that they had some source of income, which was quite surprising considering the poor rural setting. However, the information could not be unpacked since income was not defined in any comprehensive manner. Further investigation would be needed to explain this finding, which was deliberately avoided in this study because of concerns that respondents might not like to disclose such personal information in full.

7.4. Availability of Nets and Insecticides

The availability of both bed nets and insecticides for treatment depends largely on economic (affordability) and geographical (access) factors. The latter was already discussed within the context of bed net distribution under 7.2. Further analysis regarding the sources of bed nets and insecticides confirmed the advantage of local distribution systems. Most net owners got their nets either from the local bed net project or as a free donation whilst only every tenth net was bought from shops outside Omuntele Constituency. Meanwhile, all insecticides were brought into the area free of charge by the Ministry of Health and Social Services. Whilst most nets were already treated before being distributed, re-treatment was either done directly by the ministry through re-treatment campaigns or indirectly, by supplying the local bed net project with free insecticides. This resulted in a treatment rate of almost 90%. But despite this high coverage, there are some concerns regarding the lack of understanding of the usefulness of ITNs within the community. Knowledge as to why, how, and how frequently nets should be treated was very limited. At the same time, the practical exercise of actually dipping the nets was not carried out by the net owners themselves. These findings together suggest that the treatment coverage would be much lower without provision of both free insecticides and re-treatment services. Therefore, it might drop drastically whenever this external support is reduced or withdrawn. Similar developments have been described by U. D'Alessandro for Gambia [32] where insecticides were distributed for free in the first year of the national insecticide treated bed net programme resulting in an 80% treatment rate. But when a fee for the insecticides was introduced in the second year, the coverage dropped rapidly to 14%.

An ultimate solution to the always problematic re-treatment challenges would be the introduction of permanently treated nets. At the same time, community participation needs to be improved to increase sustainability.

7.5. Willingness to Pay (WTP)

A willingness to pay (WTP) for a bed net was confirmed by all respondents. However, most amounts indicated were not sufficient to cover the cost of a single net. Meanwhile, the study showed that an average of two people was sleeping under each net. This requires bigger nets of much higher cost (up to N$ 80 = 13.30 USD at the current rate of 6:1) than the mean WTP of N$ 28 (4.65 USD). This is even greater than the maximum WTP of N$ 55 (9.15 USD), recorded in the study. Thus, the aspiration of poor households to protect themselves with ITNs was not compatible with their ability to pay. In addition, some words of caution need to be expressed as to the reliability of the WTP responses, which have a hypothetical character. This concern was also taken up by Helen Guyatt et al [27] who criticised most research done on cost recovery would treat WTP as synonymous with ability to pay. In the absence of guidelines for defining affordability, Guyatt et al compared the costs to a household of protecting themselves with ITNs with current household expenditure including basic needs like food, education and health care. Similar assessments should be conducted in Omuntele Constituency to ascertain the levels of subsidy that may be needed to increase ITN coverage to satisfying levels. However, it needs to be considered that even highly subsidised ITNs might still be unaffordable for the poorest. Thus, the only solution to achieve equity in access and increase in coverage would be to provide ITNs free of charge. Possibilities to fund such

an intervention need to be explored. One option might be to re-consider the allocation of funds within the national malaria program, i.e. diverting funds from the very expensive spraying programme to the free provision of ITNs.

7.6. Knowledge of the Community

The results of this study reflect a very good general knowledge on malaria amongst all respondents regardless of gender, age and educational level. But often this knowledge could neither be specified nor be applied to practical situations. Consequently, significantly fewer respondents have been knowledgeable about ways of prevention from, and individual protection against, malaria. In contrast to the general knowledge, both age and educational level had an impact on the knowledge about ways of preventing and protection while gender did not seem to play any role. Respondents with completed secondary- or higher education were almost double as likely to have more specific knowledge compared to less educated respondents (RR=1.8). The older respondents above 60 years of age were the least knowledgeable in this regard.

These findings illustrate the vital need to craft health education with more practical relevance according to local conditions and demands. In addition, active community participation needs to be strengthened to create a feeling of own responsibility for personal health and, thus, protection against disease. During the interviews, some respondents gave the impression of rather recalling than truly understand some of the information given in their answers. For example, about 70% of all respondents had heard about ITNs (regardless of whether or not they owned a bed net) but not even half of them knew the difference between treated and non-treated nets.

7.7. Attitude of the Community towards Bed Nets

The main variable used in this study to verify people's attitudes towards ITNs was their willingness to sleep under a net. It needs to be considered though that the nature of this question is hypothetical, similar to the willingness to pay. This caused some problems for respondents who sometimes struggled to give answers referring to an abstract context. As a result, almost all respondents without a bed net who indicated that they were not willing to sleep under a net explained this by not being able to imagine sleeping under a net. Main reasons given for a lack of willingness to sleep under a net by net owners included discomfort and inconvenience. Disruption of sleeping arrangements, the most important factor for non-adherence in a study carried out by Jane A. Alaii et al in Western Kenya [29], was not mentioned at all.

It was a bit surprising to find the elderly people aged 60 years and above to be the ones most willing to sleep under a bed net. At the same time, they were not only the age group with the lowest percentage of net owners (which, in turn might raise the willingness and desire to own one) but also the ones with the least knowledge about prevention from and protection against malaria. Another surprise was the gender distribution with females of all age groups having been less willing to sleep under a net than males of the same age groups. This raises thoughts whether the still strongly patriarchal society might have an influence on the willingness in a way that men are thought to have the priority in getting a net within a household. Further investigation would be needed for verification of this point.

7.8. Practice / Use

Analysis of the more practical side as to how and how often bed net owners actually do use their nets showed that apart from a few exceptions, all of them used their nets in the correct way. The majority of them slept under their nets regularly every night at least during malaria season. Similar behaviour was also assessed in Burkina Faso by Jane Okrah et al [33]. Even though this habit is reasonable and understandable, advice should be given to the community that malaria is becoming less seasonal and more constant.

Some problems were predicted regarding the washing and re-treatment of ITNs. But it was found that only those nets, which were never treated with insecticides, were washed regularly. Owners of ITNs hesitated to wash their nets and reduced this activity to times prior to re-treatment only. Under these conditions, it should not be of a big disadvantage that one third of ITNs were retreated once per year only instead of six monthly as been recommended and done with the other two thirds of ITNs.

8. RECOMMENDATIONS

The findings of this study provide strong arguments for subsidisation of bednets, since it demonstrated the barrier of existing high prices on bed net coverage in a poor rural community. In addition, results proved the importance of easy access to ITNs and, thus, support the strategy of locally based bed net projects. Community knowledge also needs to be deepened to support the positive attitudes of community members towards ITNs and improve their correct use.

This leads to the following recommendations to be considered to increase bed net coverage and treatment rates:

- Strengthening and extending the local bed net project.
- Provision of sustainable subsidies. To achieve this, the re-allocation of existing funds, which are spent on the expensive spraying programme, might be considered.
- Introduction of long-lasting insecticides for the treatment of bed nets should be considered to curb the major re-treatment challenge.
- Extensive health education crafted according to local needs should be provided.
- Community participation should be intensified by encouraging active involvement of community members at all stages, e.g. in the netting, (re-) treatment, marketing and distribution of ITNs.

9. CONCLUSION

The study shows that the communities of Omuntele Constituency are well aware of the malaria problem in their area with generally positive attitudes towards ITNs and good adherence in the use of existing ITNs. Meanwhile, socio-economic and geographical factors have a substantial impact on the access to ITNs. The socio-economic status is low throughout the constituency. Prevailing incompatibilities between willingness and ability to pay for ITNs demonstrate the barrier of existing high prices of bed nets on their coverage in poor communities. This serves as strong argument for further subsidy of bed net purchase and treatment. Providing ITNs free of charge would be the simplest way to maintain equity and guarantee immediate increase in access.

In addition, the proximity to the source of ITNs is essential as shown by the proportional relation between bed net distribution per village and its distance from the project place. Local promotion and marketing seem to encourage individual decisions to allocate some of the little money available for the purchase of bed nets.

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ANNEXURE 1

Subject No._____

UNIVERSITY OF THE WESTERN CAPE – R.S.A:
SCHOOL OF PUBLIC HEALTH

QUESTIONNAIRE FOR HOUSEHOLD INTERVIEWS IN OMUNTELE CONSTITUENCY, OSHIKOTO REGION, NAMIBIA:

FACTORS INFLUENCING THE DISTRIBUTION AND USE OF ITNs

VILLAGE NO. _____

HOUSEHOLD NO. _____

SUBJECT NO. _____

INTERVIEWER _____

DATE OF INTERVIEW _____

LENGTH OF INTERVIEW _____

Question No.	Description	Code	Response
1. Personal Details			
1.1.	Age (years)		
1.2.	Sex	1 = Male 2 = Female	
1.3.	Marital status	1 = Married 2 = Not married	
2. Socio-economic status questions			
2.1.	How many people live in this household?		

2.2.	How many children under the age of 5 years are living in this HH?		
2.3.	Educational level	1 = Primary level 2 = Secondary level 3 = Tertiary education 4 = None	
2.4.	Employment status	1 = Unemployed 2 = Employed 3 = Self-employed 4 = Pension 5 = Other, specify	
2.5.	What is your additional source of income? (Farming, supported by relative, aid,…)		
2.6.	What do you sleep on?	1 = Bed 2 = Mattress on the floor 3 = Traditional floor mat	
2.7.	Do you have a net?	1 = Yes 2 = No	
2.7. (a)	**If yes**, where did you get your net?	1 = Free donation 2 = Purchased/local project 3 = Purchased from shop 4 = Other, specify	
2.7. (b)	**If yes,** since when do you have a net?	1 = Less than 6 months 2 = 6 – 12 months 3 = More than 1 year	
2.7. (c)	**If no,** How much money are you willing to pay for a bed-net?		N$
2.8.	Is your bed net treated with insecticides?	1 = Yes 2 = No 3 = Don't know	
2.8. (a)	**If yes**, who treated it?	1 = Got it already treated 2 = Health Services 3 = Self 4 = Other, specify	

2.9.	**If you treated it yourself,** where did you get the insecticide?	1 = Shop 2 = Health Services 3 = Other, specify	
2.10.	Did you have to pay for the insecticide?	1 = Yes 2 = No	
3. Knowledge / Perception Questions			
3.1.	Do you consider malaria as a major problem?	1 = Yes 2 = No 3 = Not sure	
3.2.	How do you get malaria?	1 = Correct 2 = Incorrect 3 = Not sure	
3.3.	Who is vulnerable to malaria?	1 = Correct 2 = Incorrect 3 = Not sure	
3.4.	Can malaria be prevented?	1 = Yes 2 = No 3 = Not sure	
3.4. (a)	**If yes,** how can you protect yourself from getting malaria?	1 = Correct 2 = Incorrect 3 = Not sure	
3.5.	Have you heard about ITNs?	1 = Yes 2 = No	
3.5. (a)	**If yes,** what is the difference between ITNs and a normal bed-net?	1 = Correct 2 = Partly correct 3 = Incorrect	
3.6.	Should nets be treated and re-treated with insecticides?	1 = Yes 2 = No	
3.6. (a)	**If yes,** Please give reasons.	1 = Correct 2 = Partly correct 3 = Incorrect	
3.6. (b)	How often should a net be re-treated?	1 = Monthly 2 = Every 6 months 3 = Every year 4 = Other	

4. Attitude questions			
4.1.	Are you willing to sleep under a bed net every night?	1 = Yes 2 = No	
4.1. (a)	**If yes,** why? Specify the reasons.		
4.1. (b)	**If no,** why not? Specify the reason.		
4.2.	Do you think every person should sleep under a net?	1 = Yes 2 = No 3 = Don't know	
5. Practice questions			
5.1.	What time do you go to sleep?		
5.2.	What time children go to sleep?		
5.3.	How are the sleeping arrangements?	1 = Children <5 sleep together with mother/parents 2 = Children <5 sleep alone (separate from parents) 3 = Other, specify	
5.4.	How many people in your HH sleep under a bed net? Please specify respective numbers.	1. No. of males >5 years 2. No. of females >5 years 3. No. of children <5 years	

Subject No._____

5.5.	Do you have a bed net?	1 = Yes 2 = No	
5.5. (a)	**If yes,** How often do you use your net`?	1 = Every night throughout the year 2 = Every night during malaria season 3 = Occasionally 4 = Not at all	
5.6.	How do you use your net?	1 = Correct 2 = Partly correct 3 = Incorrect	
5.7.	Do you treat/re-treat your net?	1 = Yes 2 = No	
5.7. (a)	**If yes,** How many times in a year do you re-treat your net?	1 = At least twice per year 2 = Once per year 3 = Less than that	
5.8.	Do you wash your treated net?	1 = Yes 2 = No	
5.8. (a)	**If yes,** How many times do you wash your net it in a year?	1 = At least twice per year 2 = Once per year 3 = Less than that	
5.8. (b)	Do you re-treat your net immediately after it has been washed?	1 = Yes 2 = No	

Do you still have anything to add or any questions?

Thank you very much for your time and assistance.