Factors associated with ownership and use of bed nets in Purulia district, West Bengal, India, 2005

By

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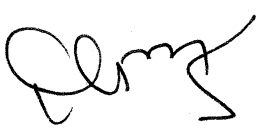
CERTIFICATION

This is to certify that this dissertation, entitled 'Factors associated with ownership and use of bed nets in Purulia district, West Bengal, India, 2005', submitted by Dr. Asit Kumar Biswas, in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology, is the original work done by him and has not been submitted earlier, in part or whole, for any other (Publication or degree) purpose.



Date

DIRECTOR

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Abbreviations

AIDS	Acquired Immuno Deficiency Syndrome
DALY	Disability adjusted life year
DDT	Dichloro-diphenyl-trichloro ethane
FETP	Field Epidemiology Training Programme
KAP	Knowledge, attitude and practice
ITN	Insecticide treated bed net
MAE	Master of Applied Epidemiology
mg	Milligram
NAMP	National anti malaria programme
NIE	National Institute of Epidemiology
SPSS	Statistical package for social scientist
Sq.m.	Square meter
wdp	Water disposable powder
WHO	World Health Organization

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Abstract

Introduction

Bed net is effective to reduce malaria transmission and mortality, when ownership and use of it is acceptable, feasible and affordable. An understanding on factors influencing ownership and use of bed net is, therefore, a prerequisite to design malaria control strategies based on bed net in malaria endemic Purulia district, West Bengal, India.

Methods

Our analytical cross sectional study surveyed 561 household heads in randomly selected 33 clusters for ownership and all individuals within the owners' households for bed net use, through structured questionnaires. We compared prevalence of ownership and use between exposed and unexposed, to variables on demographic, socioeconomic and bed net related knowledge, belief and practices. We generated a multivariate logistic regression analysis model to test variables that were significantly associated with outcome in univariate analysis.

Results

Of responded 540 households, 247 (46%) owned bed net. Of 1681 individuals within owners' households, 1359 (81%) used bed net. Strongest factor associated with ownership was households' monthly income ≥ Rs. 2000 (prevalence ratio 12.0, 95% CI 7.8-82.0). Multivariate analysis indicated age <35 years ($p < 0.0001$), sleeping inside ($p < 0.0001$), know mosquito bite causes malaria ($p = 0.002$), know malaria is severe in children ($p < 0.0001$) and use of mosquito repellent ($p = 0.029$) associated with bed net use.

Conclusions

Households' monthly income associated with ownership, while bed net related knowledge and belief associated with use. There is need to reduce price of bed net to make it affordable. Health education messages focus on positive Knowledge and belief requires for improving bed net use.

Key words: Prevalence, malaria, bed net ownership, bed net use.

1. Introduction

Globally, every year 300-500 million people acquired malaria and more than one million people die[1]. In concert with pneumonia, tuberculosis, diarrhoea, measles and HIV /AIDS, malaria causes 90% of the deaths from infectious diseases[1]. Over 90% of the disease burden including deaths is in Sub- Saharan Africa[2]. Bed nets, especially insecticide-treated one are amongst the most effective tools available to reduce malaria transmission and mortality[3]. As a result, promotion of ownership and use of bed net has become a central element of international efforts against malaria. Trials in Africa indicated that proper use of mosquito net reduces malaria incidence by 14 to 63 percent[4]. However, effectiveness of bed net in control of malaria depends on acceptability, feasibility and affordability. The acceptability of bed net as vector control interventions varies in relation to the perceived benefits by the population, the degree of inconvenience caused and the investment of time, effort and money[5]. The affordability varies in relation to the distribution of the financial costs between the public sector, community and the end users.

Malaria transmission occurs in eight out of ten countries in South East Asia WHO region. WHO estimates that 1,200 million of the total population of 1,400 million people (85%) live in areas with moderate to high risk of malaria and 90% of this population live in India, Myanmar and Thailand[6]. In 2000, India reported a total 2.1 million cases of malaria with 946 deaths[7]. This low case fatality rate from malaria suggested under reporting of deaths. Plasmodium falciparum contributed to the majority of these deaths. The Malaria Research Center, New Delhi conducted studies in India in that indicating the efficacy of bed net against malaria transmitted by local vectors[8]. As a result the national anti malaria programme incorporated use of bed net (especially insecticide treated) through different states as a part of global roll back malaria strategy. However the status of implementation of these recommendations is unclear and little information is available regarding who owns a bed net and who use one.

The Purulia district, located in the western part of the state of West Bengal, India is highly endemic for malaria. Analysis of malaria epidemiological situation, 2004 indicated perennial transmission[9]. Six community blocks accounting for 25% of the population of the district contributed to 70% of the case load and to 90% of plasmodium falciparum infection. In addition, there is a potential for outbreaks, with at least two outbreaks in recent years that resulted in a few deaths from malaria: – one in Neturia block in 1999 and the other in Bandwan block in 2002. The evaluation of the national anti malaria programme in Purulia district, West Bengal, 2005 indicated that 46% of households owned a bed net. Of the bed net owners only 46% (20% of total households) were using bed net to sleep[10]. An understanding of the factors influencing ownership and uses of bed net is a prerequisite to design strategies aimed at using bed net for prevention. We conducted a study to

(1) identify factors associated with ownership of a mosquito net in rural area of Purulia district, West Bengal, India,

(2) identify factors associated with use of mosquito nets among owners of mosquito nets in rural area of Purulia district, West Bengal, India

(3) formulate recommendations to improve access and use of mosquito nets in Purulia district, West Bengal.

(a) Introduction

One of the major innovations in the field of malariology during the past two decades is the development of the technology of insecticide-treated mosquito nets (ITNs) [11]. Mosquito nets or curtains have been in use since long in many civilizations including India. The Italian traveler Marco Polo had mentioned in his travelogue that nobles in southern India used the mosquito curtains made of light cane work in the 13th century AD. Although deliberate treatment on nettings with repellents and even DDT were tried to provide additional protection to individuals against blood sucking insects like mosquitoes, development of pyrethroids during the 1980s led to evaluation of pyrethroid-treated netting and clothing materials against mosquito vectors. Until 1990, several small-scale trials in various countries demonstrated the effectiveness of nets treated with pyrethroids in reducing malaria and vector populations. In China, nets treated with deltamethrin were in large-scale use around this period[12]. As was being done in Africa and other endemic countries, contemporary laboratory and field trials with untreated and treated mosquito nets were carried out in endemic states of India as well.

Trials all over the world indicates efficacy of bed nets undoubtedly, but the effectiveness of it in control of malaria depends on acceptability, feasibility and affordability of both in individual and in community. The acceptability of bed nets as vector control interventions varies in relation to the perceived benefits by the population, the degree of inconvenience caused and the investment of time, effort, and money. The affordability varies in relation to the distribution of the financial costs between the public sector, the community and the end users.

To identify the articles related to factors associated with ownership and use of bed nets, we used Medline 1990-2005 databases with key words vector control, vector control and bed net, vector control and bed nets - factors associated with ownership and use.

(b) Bionomics of vector control

The bionomics of about 60 different species of malaria vectors including 30 of major importance varies considerably[13]. Knowledge of the larval habitats and adult behaviour will be necessary in order to select the appropriate line of attack, not only for source reduction, but also the more general chemical methods, including both larviciding and adulticiding. Potential water habitats include both permanent and temporary bodies of water, fresh and brackish water, standing water and canals and open streams, in bright sun light or deep shade. Larvae can thrive even in indoor containers, in shallow pools and deep wells, in clean drinking water and in water highly polluted with organic matter, in large open marshes and in the tiny pools of water that collect in plant axils, in tree holes, in rock or crab holes, in cattle footprints or in discarded tins or other artificial containers. Although some species have the ability to adapt to a fairly wide range of breeding places, most are much less adaptable, providing a number of useful targets for larval control. The time of feeding is also very important, both for vector efficiency and for the effectiveness of control. The most efficient vectors tend to bite mainly in the middle hours of the night, when people are in deep sleep, while vectors biting at dusk or dawn are more likely to be an obvious nuisance, thereby causing people to defend themselves more effectively against them[12].

The following terms are used to define the more important characteristics of vectors' feeding and resting habits in relation to human habitations:

i) Anthropophily and zoophily indicate the vector's preference for human or animal blood.

ii) Endophily and exophily indicate the tendency of vectors to rest indoors or outdoors during the whole or part of the period of blood digestion and egg development

(c) Vector control

i) Methods

Vector control methods are classified as:

Methods of reducing human-vector contact -

This category covers all methods in which a barrier is established between vectors and humans, and includes the following:

(1) Mosquito nets and insecticide treated mosquito nets - Although untreated mosquito nets have a long history of use in controlling malaria transmission, the introduction of net treatment with insecticides of residual action has considerably increased their effectiveness by adding to the barrier effect of the net the repellent and killing action of the insecticide. Unlike indoor house spraying, this method also has the advantage of being effective for individual protection[14]. The mass effect, as with any other method of control, depends on high coverage but, when coverage is low, individuals using the nets are protected[13]. The main limitation is the potential for transmission by early biting vectors before people retire to sleep.

(2) House protection with screening of windows, doors - This is an effective method if properly implemented and maintained. It remains almost exclusively a method of individual and family protection, since it requires a high investment and has high care and maintenance costs.

(3) Use of repellents - These may be applied either directly on the skin (as a cream, lotion or aerosol) or on clothes. The use of repellents is also only a measure of individual protection that can be recommended as a complement to the use of bed nets and house protection methods, to be used after dark before retiring under the mosquito net.

(4) Fumigant insecticide dispensers - These are widely used throughout the tropics for individual protection, particularly in the form of mosquito coils and, in urban areas, electrically heated dispensers.

Methods aimed mainly at reducing vector density -

Most practical methods aiming at the reduction of vector densities require the treatment of vector breeding places, leading to their elimination or to a considerable reduction of breeding in the treated sites. The main limitation of these methods is the difficulty of locating and treating all breeding places essential for the maintenance of malaria transmission. These methods include all forms of larval control, as described below:

(1) Source reduction by environmental management - This includes drainage, flushing, filling, and rendering river and lake margins unsuitable for anopheline breeding. In general, these methods have relatively high investment costs and may be cost-effective only in urban areas or some types of development projects.

(2) Larviciding - This includes the use both of chemical insecticides and those of biological origin, such as the toxin of *Bacilus thuringiensis israelensis* and insect growth regulators. It requires the treatment of all breeding places and has little residual effect, and requires regular and frequent applications.

(3) Biological control - For anophelines, this is practically limited to the use of larvivorous fish, which are most effective in man-made breeding sites (e.g. ponds, cisterns or irrigation systems).

(4) Space spraying of insecticides - Space spraying has been extensively used for controlling epidemics of mosquito-borne diseases such as dengue and some types of encephalitis. It has only occasionally been used in malaria epidemic control and as a complementary measure against exophilic vectors. Its main limitation is the difficulty of applying them at night, when vectors are flying, and the poor penetration of insecticide fogs into the day time resting places of the vectors.

Methods aimed mainly at increasing adult vector mortality

Increasing adult vector mortality reduces their expectation of life and therefore the probability that the parasite will complete its development. The two methods available for increasing adult vector mortality are described below.

(1) Indoor residual spraying - This includes all methods of indoor spraying with residual insecticides, thus targeting the killing effect to house resting vectors and constituting a most efficient way of using the insecticide to kill vectors likely to transmit malaria. Its main limitation is that exophilic vectors may exist and may not come into contact with sprayed surfaces.

(2) Community wide use of insecticide treated nets - When a large proportion of the population in a community is protected by insecticide-treated nets there may be a significant reduction of vector survival, density and sporozoite rate ("mass impact") and hence of malaria transmission[13].

ii) Acceptability

The acceptability of vector control interventions varies in relation to the perceived benefits by the population, the degree of inconvenience caused and the investment of time, effort, and money. In addition, perceived dangers may lead to refusal. Whereas continuous acceptability and user participation are prerequisites for effective use of insecticide-treated mosquito nets, other vector control methods may demand only occasional participation, cooperation or simply passive acceptance by the majority of beneficiaries. Nevertheless, complete spraying needs the active cooperation of householders in order to prepare the houses for spraying and subsequently to maintain the insecticide residue without major disturbance (e.g. re-plastering of walls). The perceived or real benefits of chemical control may change over time, e.g., indoor residual spraying and insecticide-treated mosquito nets sometimes initially motivate users because of their spectacular effect on nuisance insects, such as bedbugs, lice, flies and mosquitoes, but over time these effects may diminish or become less evident. Inconveniences which can limit acceptability include (1) the obvious residue left by insecticides formulations for indoor residual spraying on wooden or painted walls and furniture, (2) unpleasant odour of some insecticide products,

(2) the interference of mosquito nets with air circulation in hot humid climates and (4) the contamination of crops kept in the houses, which may affect their acceptance in the market.

iii) Affordability

Affordability is also an essential factor in determining the suitability of a potential insecticide product and choice of application method. The determination of cost should be based on the cost of the product as applied and not strictly on its purchase price. This includes consideration of the amount of active ingredient in the formulation, cost of shipment and handling (including local transport and storage), as well as dosage, frequency and cost of application. Affordability and the potential for its improvement will vary in relation to the distribution of the financial costs between the public sector, the community and the end users. The current tendency to establish cost sharing mechanisms and to privatize services brings the question of affordability directly to each of these levels. The improvement of affordability by individual users may require the regulation (or subsidizing) of the trade of certain basic commodities such as mosquito nets and insecticides, the public support of certain activities, such as the re-treatment of mosquito nets, and the setting up of mechanisms for care of the poor.

iv) Information, education and communication

Information, education and communication are of the greatest importance in the guidance and support of both communities and individuals, and in ensuring their participation in the planning and execution of local operations. Messages should be clear, informative and concise, supported by training, and always followed by appropriate logistical support in the form of equipment and materials, as well as supervision aimed at solving operational problems. In addition it requires coordinated involvement of government services and community organizations with the support of non-governmental organizations and the private sector. The mobilization of all these forces requires information and education at many levels in order to involve all the possible participants in a working programme.

(d) Bed nets as personal protection method

I) Untreated bed net

The use of untreated bed nets as a personal protection method from mosquito bites during night has been practiced from early times. They still remain one of the most important of all measures of personal protection, not only from mosquito but also from flies, beetles and other insects. The size of the mesh of net is determined not only by the number of hole in square unit of material, but also by the thickness and the type of thread of which the netting is made. Netting suitable for protection against most vectors Anopheles is one of 25/26 meshes[15]. The number of hole in square inch would be about 150. A band of cloth about 300 mm wide should form the lower part of mosquito net at the mattress level to protect arms and legs in contact with the net during sleep, as this will make it more difficult for the mosquito to bite through it. Nowadays mosquito nets are made of cotton, nylon, a mixture of nylon and polyester or some other synthetic material, which are lighter, easy to wash and preferably forms a bond with some chemicals when applied with insecticides or insect repellants. The mean size of holes of nylon nets is usually 1.2-1.5 mm; there should be six to eight holes in 10 mm length. The preferred and traditional pattern is the rectangular net with a reinforced lower end and no opening in the side for the purpose of entering the net. There should be no tears or holes; if they are, they should be repaired immediately. When in use, the net should be tucked all round under the mattress or sleeping mat. It should be let down before dark in the evening and when going to bed, a thorough search should be made for any mosquito that may be inside it, preferably using a torch. A useful precaution is to spray the inside and outside of the net with an aerosol dispenser or a hand sprayer using an appropriate insecticide preparation. Attempts are now being made to produce cheap and effective mosquito nets for wider use by the population in developing countries. Also, different sizes and different types are being made, such as round nets that suspend from a single point and even special nets to use when sleeping in a hammock. In some countries, such as the People Republic of China mosquito netting is permanently nailed to four posts attached to the bed, with a cross over opening in the front to allow entry. The top of the net is made of fine linen and the sides are made from mosquito netting or even coarsely woven muslin. The

member of the community sprays the nets twice a year with a pyrethroid solution, using a plastic knapsack sprayer. This has formed part of a successful strategy for malaria control, with many millions of nets being used by the at risk population.

ii) *Insecticide treated bed nets*

Nets have long been used to protect against mosquitoes, including malaria vectors. However, they are often torn or hung in such a way that mosquitoes can enter or bite through them. It is mainly to prevent this that the treatment of nets with an insecticide and/or repellent was developed. Pyrethroid treatment of nets gives greater personal protection than untreated nets by irritating, repelling or killing mosquitoes before they can find a place to bite through the net or, if the net is damaged, before they can find a hole through which to enter and bite once inside.

Insecticide-treated nets are, in principle, suitable for any transmission situation, provided that they are accessible, acceptable and used by the population in such a way (in place and time) as to interrupt human – vector contact effectively. As mentioned above, they are an effective means of individual protection. As coverage increases, therefore, the effect on the community becomes the addition of the protected individuals, and as total coverage is approached, the "mass killing effect" on the vector population may become sufficient to interrupt transmission before total coverage reached. Apart from the improvement in personal protection resulting from the addition of a chemical barrier to the net, a mosquito net is a rational place to put a residual insecticide. Mosquitoes are attracted to the net by the odour and carbon dioxide emitted by the sleeper inside it, essentially turning the treated net into a baited trap[15].

As insecticide-treated mosquito nets may be progressively introduced into a community in the expectation that their effectiveness in individual protection will help to promote the continuous spread of their use. Similarly, from the point of view of cost, because it provides individual protection, it is the vector control method most suitable for cost recovery. In fact in most current programmes, the aim is commercial distribution, public funds being devoted to only promotion, information and social marketing. There is not yet enough information to be able

to assess how far these programmes will cover the most peripheral and impoverished sectors of the population, which are likely to be those that will suffer most severely from the burden of malaria. Ways should be found of compensating for "market failures" and methods of increasing the accessibility of insecticide-treated mosquito nets to marginalized populations.

Although malaria control programmes will promote and support the procurement, distribution and use of insecticide-treated mosquito nets with the objective of controlling malaria, it is often found that people accept and use them because they protect against nuisance mosquitoes (*Culex, Aedes* and *Mansonia)* and other nuisances, such as bedbugs and lice. In The Gambia, in a national bed net programme for malaria control, it was found that the extent of the use and re-treatment of bed nets was directly related to the density of nuisance mosquitoes, and only indirectly to the malaria incidence.

Since the acceptability of insecticide-treated mosquito nets is related, as indicated above, to their obvious effect on nuisance pests, this factor will usually also have been responsible for the demand for them and for the establishment of a market for untreated bed nets. Sometimes, however, although the conditions for acceptability are present, no trade has developed because there has been no commercially available product that matches the habits and purchasing capacity of the population. In addition, the use of bed nets may not be acceptable because of unfavourable climatic conditions, such as high humidity and temperature with little wind, where any slight reduction in ventilation may become unbearable. It is therefore very important, when the use of insecticide-treated mosquito nets is being considered as a malaria control method, to find out whether they will be acceptable and, if not, whether the objections to them can be overcome with information, education and communication.

The protection provided by insecticide-treated mosquito nets is limited mainly to the people under the nets and the time that they are under them, although people staying or sleeping in a room where a treated net is being used will also be protected to some extent. This means that people staying outdoors during part of the night or in other rooms will not be protected.

If nets are sold commercially and individuals are responsible for treatment, the end user should be informed that, if they wash their nets more often than recommended, they should also retreat them more frequently.

Insecticide treated bed net in India[17]

ITN Trials in Assam

To evaluate effectiveness of mosquito nets in malaria control, the first field trial was carried out in Sonapur PHC, Assam during 1987 to 1991 in areas where *An. minimus* was the main malaria vector (Jana-Kara *et al.*, 1995 & Sharma *et al.*, 1996). Cotton nets treated with deltamethrin WP at 25 mg/ sq.m were found effective in reducing *An. minimus* population and malaria incidence. In villages with untreated cotton nets malaria situation remained unchanged, whereas in villages without nets malaria incidence rose significantly during the trial period. General acceptance of nets by the communities was satisfactory.

ITN Trials in Orissa

In tribal villages of Sundergarh district, nylon nets treated with deltamethrin or lambdacyhalothrin at 25 mg/ sq.m reduced indoor densities of malaria vectors, *An. culicifacies* and *An. fluviatilis*, their biting rate and the malaria incidence significantly (Sampath *et al.*, 1998 & Yadav *et al.*, 1998, 2001). In the mining areas, where malaria caused tremendous economic loss due to loss in man-days, use of cyfluthrin-treated nets resulted in considerable reduction in *An. fluviatilis,* and incidence of malaria, as well as anaemia and spleen rates in protected children (Sharma and Yadav, 1995). Hospital occupancy due to malaria in two mining hospitals decreased. Minor communities accepted the treated nets very well and perceived that such nets even reduced other household insect pests besides mosquitoes.

ITN Trials in Madhya Pradesh

A trial conducted during 1989–91 in some tribal villages of Mandla district where *An. culicifacies* and *An. fluviatilis* are malaria vectors, showed a low impact of treated nets. The reasons for low impact were poor compliance by inhabitants due to their varied socioeconomic status and means of livelihood.

ITN Trials in Uttar Pradesh

In a trial to evaluate relative efficacy of insecticide-treated mosquito nets in Dehra village of Dhaulana PHC, District Ghaziabad during 1996 nylon nets were impregnated with deltamethrin at 25 mg/ sq.m by standard methods. Repellency, killing and airborne actions were monitored from dusk to dawn by hourly collection of mosquitoes that entered and rested in rooms and also females that landed on treated and untreated mosquito nets. Results indicated 15.3–22.9% repellent action, 98.3–99.3% excito-repellency action and 100% mortality of females that landed on treated fabrics (Ansari and Razdan, 2000).

ITN Trials in Haryana

A field trial was carried out in the year 2000 in villages of District Sonepat to assess the efficacy of bifenthrin as an impregnant on mosquito nets. Phase II trial was conducted to assess the comparative efficacy between two formulations namely suspension concentrate and micro-emulsion. Efficacy was studied for both the formulations at three doses of impregnation, 10, 25 and 50 mg/sq m. Net bioassays to assess the persistence indicated bio-availability up to 11 fortnights (~ 5 months) at all the doses of the two formulations. There was an estimated 50% reduction in the entry of the mosquitoes into the houses with intervention of treated nets compared to the houses without treated nets indicating the impact of the insecticide.

Studies on ownership and use of bed nets

A study on assessment of malaria related knowledge, attitude and practices among primary care giver of under five years children to identify association between caregivers characteristics and positive KAP towards malaria in an urban setting of Uganda during 1999 indicated though 90% of respondents reported mosquito and /or malaria as the cause of fever, but only 25% reported using bed net. Higher level of education for the caregivers were associated with positive malaria related KAP[18].

Malaria related knowledge, attitudes and practices (KAP) were examined in a rural and partly urban multiethnic population of Kossi in north-western Burkina Faso to the establishment of a local insecticide treated bed net programme during 2000. To a randomly selected 210 head of households a structured questionnaire was administered. Results indicated mosquito nets were mainly used during rainy season and the adults, particularly the head of households, used most of the existing nets. People were willing to treat existing nets and buy it, but only if such services would be offered at reduced prices and in closure proximity to the households[19].

In north Shan State, Myanmar a simple health promotion message administered by village midwives during raised bed net usage over 60% in trail hamlets. Most villagers were prepared to buy their nets at market prices and willing to pay cost of re-treatment, but poor, members of the Wa ethnic group required half subsidy for them to afford a net[20].

In 1994 Medical Research Council Laboratries, Banjul, Gambia, West Africa evaluated the Gambian National Impregnated Bed net Programme with objectives to introduce impregnated bed nets in all primary health care villages and to establish a system of cost recovery over a three year period. The bed net uses was improved from 16% to 80% when the insecticides for treatment of bed net offered at free of cost. Lack of money was the main reason for not owning and impregnation of bed nets[21].

A research infrastructure was established in two ecological zones in southern Ghana to study the variables of malaria transmission and provide information to support the country's Malaria Action Plan launched in 1992. Residents' beliefs and practices about causes, recognition, treatment and prevention of malaria were explored in two ecological zones in southern Ghana using epidemiological and social research methods. In both communities females constituted more than 80% of caretakers of children 1-9 years and illiteracy was high. There is a need for a strong educational component to be incorporated into Malaria Action Plan to correct misconception about malaria transmission, appropriate treatment and protection of households[22].

To find out the acceptability of the use of insecticide treated bed nets they were distributed in 4 communities with in the Kassena Nankana district of the Upper East Region of Ghana in 1994. The nets were readily accepted by community. The major benefit perceived by the users was the reduction of the nuisance effect of mosquitoes and other insects. The people in the study area normally sleep on mats in either an open courtyard or a sleeping room depending on the weather but this did not determine them from using the nets. After having used the nets for a year, the community members expressed willingness to buy the nets if they were made available after the harvest season when they had sold their crops and had enough money to pay them. The results of this study have been used to plan and conduct a large intervention trial[23].

The effect of untreated bed net use was investigated, without undertaking a specific intervention, in four cross-sectional community bases surveys in 10 villages of a highly endemic area of Papua New Guinea during 1990. Over half (55%) of villagers interviewed reported that they had used a bed net in previous night. In general and after adjusting for age, village and housing characteristics, bed net users, particularly the children had low parasite prevalence and spleen rate than the non-users[24].

A comparative study on attitude to malaria, traditional practices and bed net as vector control measures in five West African countries during 1992 indicated bed nets were used to a varying extend from 44% in Ghana to 86% in Gambia, in each community to protect against mosquito bites but also for other purposes such as privacy, decoration and protection from roof debris dropping on the bed[25].

A survey in a Pakistan based Afghan refugee camps during 2000 on knowledge, attitude and practice indicated subsidized sales of insecticide treated bed nets was improved by 50% with effective sustainability in control of malaria[26].

Study area

We defined the study population as the rural area of Purulia district (91% of total population of the district: – 2.5 million as per 2001 census). The Purulia district, in the west of West Bengal, India is characterized by rugged hilly terrains. It has a sub tropical hot climate with low precipitation. There are 20 community administrative blocks. The average population density is 409 per sq. km. with 14% decennial growth rate[27]. The proportion of literate people is 56%[27]. About half of the total populations of the district are main or marginal workers by occupation[27].

Study design

We conducted an analytical cross sectional study.

Inclusion criteria

We included all permanent residents of the area giving consent to participate in this study.

Sampling strategy

We took a cluster sample technique of the rural area of all blocks of the district. Our sampling unit was households. We selected villages (clusters) using the probability proportional to population size method. In each cluster, we selected fifteen households. First, in each household we selected the head of household for interview to assess bed net ownership. Second, we included all individuals among households where beds net were owned.

Sample size

We calculated the sample size for household using the Right Size software. With an estimated prevalence of ownership 46%[10], 15 households in each cluster, a

confidence coefficient interval of 95%, an α error of 5% and a rate of homogeneity in cluster 0.02, we needed 495 households in 33 clusters. We anticipated a proportion of non-response of 10% and the sample size increased accordingly.

Selection and definition of variables

Our outcome variables were bed net ownership and bed net use. We defined a bed net ownership at the level of household as the presence of at least one bed net, no matter whether it was on use or not. We defined bed net use at the individual level as the use of bed net during sleeping. Our exposure variables included demographic characteristics, socioeconomic status and knowledge, belief and practices with respect to malaria.

Data collection

A five member team including a field epidemiologist (the principal investigator) and four trained field workers collected information in September 2005 using two structured questionnaires. First we interviewed the head of households with respect to bed net ownership. Second, we interviewed other family members (or the guardian in the case of minors) about bed net use when the head of the household reported ownership of bed nets.

Data entry and analysis

We calculated the theoretical requirement of bed nets in household using the number of beds used by the household to sleep as denominator. We calculated prevalence ratio and the 95% confidence interval by dividing the prevalence rates of ownership and use of bed net among person with exposure by that of person without exposure to selected variables. We examined variables that we expected as confounding factors or effect modifiers in stratified analysis. We generated a multivariate logistic regression analysis model to test the variables that were significantly associated with outcomes in univariate analysis. We calculated adjusted odds ratio after multivariate analysis. We used Microsoft Excel, Epi-Info 2005 version and SPSS version 13 software for data analysis.

Quality assurance

We drafted questionnaires and conducted rapid in-depth interviews of community members and programme managers to explore potential independent factors for bed net ownership and use in the population. We pilot tested the questionnaires. The principal investigator validated a tenth of interviews through observations of field procedures of data collection for quality assurance and consistency.

Human subject protection

The study participants had to spend 10 minutes of their time with the field investigators to participate in the study. We made the participants, parents/ guardians fully aware of the fact that their participation was voluntary and that they were free to withdraw at any time. We explained the benefit of the study and took written informed consent. We did not write any identifiers on the data collection instrument and used a code instead to ensure confidentiality. The ethics committee of National Institute of Epidemiology, Chennai approved the project. We took permission from the district health administration, Purulia to conduct the study.

Bed net ownership

We surveyed 561 households of which 540 households' heads (96%) participated. Among the 21 (4%) households heads who did not participate, 16 (76%) were not present in house on the day of the survey and 5 (24%) in resided houses that were locked. The median age of the head of households was 38 years (range 22-91, standard deviation: 13.3). The median family size was six (range 1-24, standard deviation: 3.4) and monthly income of family was $ 45 (range $ 5 - $625, standard deviation $40). Of the total households, 135 households (25%) resided in forest and hilly areas. 117 households (22%) heads were female, 286 households (53%) had at least one child less than five years of age and 13 households (2%) had a pregnant woman in their family. Household heads having primary education was 327 (61%). Main occupation was agriculture 276 (51%) followed by labour 135 (25%).

Of the 540 household heads who participated 247 [46%, 95% confidence interval (CI): 42-50] had owned at least one bed net in their house. Of the 247 households owned bed net(s) 56 (23%) had more than one fourth, 67 (27%) had more than half, 18 (7%) had more than three fourth and 97 (39%) had hundred percent bed nets to the requirement in their family (Figure 1). Ownership of bed net was more common among those who resided in forest and hilly areas and among households for which the head was younger than 35 years of age. Other demographic variables were not significantly associated with ownership of bed net (Table 1). Wealthier households were more likely to own a bed net. Household's monthly income ≥ $ 45, ownership of a radio or of a television, living in a permanent house and employment for the head of the households were associated with bed net ownership (Table 1). The frequency of bed net ownership increased with household's income (chi square for trend = 330, p value <0.0001, Table 2). Knowledge that bed net prevented malaria and

knowledge that malaria is severe in children was associated significantly with ownership of bed nets. In contrast, those who found bed net inconvenient were less likely to own them (prevalence ratio 0.6, 95% CI 0.5-0.8, Table 1).

Ownership of bed net was more common in the household where the head was educated (prevalence ratio 2.5, 95% confidence interval 1.9-3.2). After taking in to account of the confounding effect of household's monthly income, there was no longer any association between educations of head of households and bed nets ownership (adjusted prevalence ratio 1.2, 95% CI 1.0-1.4). Multivariate analysis on bed net ownership indicated that household income, belief that bed net prevented malaria, perception that bed net is costly and inconvenient to use contributed to the model. The strongest factor was the household's monthly income ≥ $ 45 (model chi-square 449, adjusted odds ratio 93, $p < 0.0001$) (Table 4). In contrast, those who found bed net inconvenient were less likely to own them.

Bed net use

We surveyed 1,760 individuals with in bed net owners' households. Of those, we were able to interview 1,681 individuals (96%). Among the 79 individuals who did not respond, 63 (80%) were not available in house, 13 (16%) refused to response and 3 (4%) were sick. The non respondents had similar demographic characteristics as that of respondents. Individuals who responded among owners' households and those of Purulia district (study population) were similar with respect to general characteristics (data not shown). Overall, 1,359 members in owners' households (81%) engaged in practices of bed net use and 839 members aged more than 18 years (85%) [n=772] believed that bed nets prevent malaria.

Among the 1,359 users of bed nets, 331 used bed net (24%) for 1 to 3 days in a week, 253 used bed net (19%) for 4 to 6 days a week and 775 always used bed

net(57%). Individuals sleeping inside the house were more likely to use a bed net than those sleeping outside (84% versus 43%, prevalence ratio 19.6, 95% CI 6.5-59). Bed net use varied according to age. Selected elements of knowledge about malaria were associated with bed net use. These included knowledge that mosquito bite caused malaria, that bed net prevented malaria and that malaria was severe among children and pregnant woman (Table 1).

Those who believed that bed net were inconvenient were less lively to use them (prevalence ratio 0.5, 95% CI 0.4-0.6). This effect was more marked among those without primary education than those with primary education (prevalence ratio: 0.4, 95% CI 0.3-0.6 and 0.8, 95% CI 0.7-0.9 respectively, Woolf's test for effect modification: 10.8, $p = 0.001$). Multivariate analysis for bed net use among owners' households indicated that age < 35 yrs, sleeping inside the house, Knowledge that mosquito bite caused malaria, that bed net prevented it and malaria was more severe among children were associated with bed net use. The strongest factor was sleeping inside house (adjusted odds ratio 527, $p < 0.0001$) (Table 4). In contrast, those who used mosquito repellent were less likely to use bed net.

7. Discussion

Bed net ownership and use is still low in Purulia. Factor influencing the ownership was the indicators of high socioeconomic class particularly households' monthly income. On the other hand, bed net and malaria related knowledge and belief were associated with the use of bed net. The information available not only give input on designing a bed net (especially insecticide treated one) implementation strategy in Purulia district but also can be replicated in part of the country where similar socioeconomic and geographical condition prevail.

Wealthier households particularly those with monthly income ≥ $ 45 were more likely to own a bed net. This was well supported by the fact that proportion of ownership increased with increase in income. The cost of one bed net in Purulia district was $ 2.5. Given that the average monthly income of a family in rural Purulia is around $ 45, there was not much saving to invest in the purchase of bed net(s) in household with income below that amount. On the other hand, people of high socio economic class were likely to have more disposable income that can be used for purchase of bed nets. The Gambian national impregnated bed net programme also indicated lack of money was the major reason for not owning a bed net [21]. Furthermore a study in Pakistan indicated improvement in bed net ownership in Afghan refugee camps by subsidizing it [26]. So far as the ownership of bed net concerned, our study did not indicate any association with the education of head of household. Thus efforts should be concentrated towards increasing financial accessibility to improve ownership.

Malaria related knowledge, attitude and practices played an important role in the use of a bed net. Users were more likely to believe that mosquito bite caused malaria, that bed net prevented it and knowledge that malaria was severe among children and pregnant woman than the non user of bed nets. They were also more likely to believe that bed net were worth the cost and convenient to use. These data were supported by research from applied social psychology and health education, where attitudinal and self-efficiency believe of this nature are

important in influencing health related behaviors[28]. According to the social psychological models, these beliefs were particularly important in change because they could target for modification that used health education or promotion or other methods[28]. Thus, to improve bed net use, health education messages need to focus on the specific elements of knowledge that determine use. These include the effectiveness of bed net to prevent malaria, the severity of malaria in children, sleeping inside the house.

Other factors of bed net uses were the age. Younger people were more likely to use bed net. They were more likely to heed health education massages. Also according to the theory of adaptation of innovations commonly used in applied social psychology, young people are more likely to be innovator and early adaptors of preventive technology[28].

Our study suffered from two limitations. The information collected on use of bed nets and sleeping habit was based on a recall period of seven days. Since bed net use varied with the season, it did not reflect the variation of use through out the year. During the study conducted we observed a higher prevalence of bed net use than during our previous programme evaluation. The present study was done in the month of September, when malaria incidence peaked in Purulia district. This may have motivated people to use bed nets. Furthermore at the onset of the rainy season in the district, weather phenomenon could have increased nuisance bites from increase mosquito population and there by motivate people to use bed nets. Second the study because of its cross sectional in nature failed to establish a cause and effect relationship in most of the cases. For example, those who found bed net inconvenient were less likely to own them. Of these two – the ownership of bed net and the perception on inconveniency to use it was difficult to ascertain, which one was the cause and which one was the effect of it.

Because indicators of high socioeconomic status particularly income of family influenced bed net ownership, there is a need to increase financial access for bed nets so they are affordable by members of lower socioeconomic classes. Measures that may be used include reducing prices include subsidize rate, bulk

purchasing, sale tax exemption, local tailoring and instituting a community-based distribution and re-impregnation mechanism to ensure sustainability. The issue of public subsidy for bed nets specially impregnated one also needs to be considered. This would not only improve the ownership of bed net, but also increase the proportion of bed net required in owners' households, which in tern would improve individual use. To increase the use of bed nets, there also is a need for more health education and promotion messages on the advantages of bed net use. Because sleeping inside the room, knowledge that mosquito bite causes malaria, bed net to prevent malaria and the severity of malaria in children were important distinguishing features between users and non-users health education messages focusing on these issues may lead to behavior change. People need to be convinced that bed nets are worth the cost. They are also to be motivated to use bed net what ever convenience they felt during use of it, as they are as important as our cloths and other household utilities. Overall, measures to increase availability and use of bed net should result in reduction of the burden of disease associated with malaria in Purulia district and in other similar places in India. Pilot intervention study may help in designing the implementation strategy for malaria control in Purulia district, West Bengal.

Table 1: Households heads by socioeconomic characteristics, Purulia district, West Bengal, India, 2005 (n=540)

	Characteristics	Households	
		Number	%
Education	Illiterate	213	40
	Primary	217	40
	Secondary	100	17
	Graduate	18	3
Occupation	Agriculture	276	51
	Labour	135	25
	Service	30	6
	Others	99	18
Income	< Rs.2,000	270	50
	Rs.2,000 – Rs.3,999	207	39
	Rs.4,000 – Rs.5,999	29	5
	≥ Rs.6,000	34	6

Figure 1: Frequency distribution ownership and use of bed net, Purulia, West Bengal, India, 2005

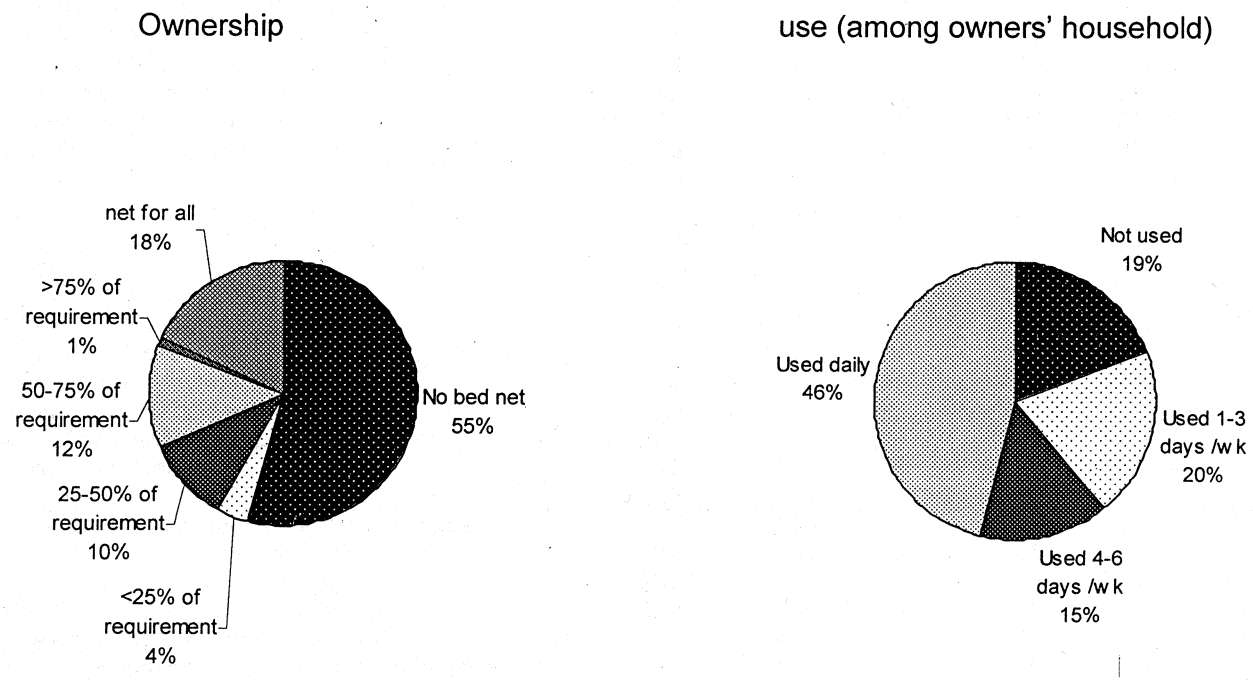

Table 2: Prevalence of bed net ownership according to selected households characteristics Purulia district, West Bengal, India, 2005: univariate analysis results (n = 540)

Characterists		Prevalence of ownership among exposed			Prevalence of ownership among unexposed			Prevalence ratio	95% confidence interval
		Number	Total	%	Number	Total	%		
Demographic characteristics	Female head of household	53	117	45	194	423	46	1.0	0.8-1.2
	Head of household < 35 yrs of age	95	189	50	152	351	43	1.2	1.0-1.4
	<5 people in household	54	146	37	193	394	49	0.8	0.6-1.0
	Presence of children <5 yrs of age	136	286	48	111	254	44	1.1	0.9-1.3
	Pregnant woman in household	16	34	47	231	504	46	1.0	0.7-1.5
	Residence in forest and hilly area	73	135	54	174	405	43	1.3	1.0-1.5
Socio-economic condition	Ownership of a radio	76	98	78	171	442	39	2.0	1.7-2.4
	Ownership of a motor cycle	28	29	97	219	511	43	2.3	2.0-2.5
	Use of electricity for lighting	72	87	83	175	453	39	2.1	1.8-2.5
	Use of gas for cooking	9	10	90	236	530	45	2.0	1.6-2.5
	Permanent house	29	37	78	218	503	43	1.8	1.5-2.2
	>1 bedroom house	198	373	53	49	167	29	1.8	1.4-2.3
	≥ 1 window in bedroom	120	188	64	127	352	36	1.8	1.5-2.1
	Head of household with primary education	196	327	60	51	213	24	2.5	1.9-3.2
	Spouse of household with primary education	169	267	63	78	273	29	2.2	1.8-2.7
	Head of household occupation as service	27	30	90	220	510	43	2.1	1.8-2.4
	>1 earning member	117	220	53	130	320	41	1.3	1.1-1.6
	Monthly income ≥Rs.2000	228	270	84	19	270	7	12.0	7.8-18.6
Knowledge, attitude and practices	Knowledge malaria causes by mosquito bite	225	438	51	22	102	22	2.4	1.6-3.5
	Knowledge mosquito bite at night	227	460	49	20	80	40	2.0	1.3-2.9
	Belief that bed net prevent malaria	239	474	50	8	66	12	4.2	2.2-8.0
	Belief that bed net prevent other bite	229	468	49	18	72	25	2.0	1.3-3.0
	Knowledge malaria is severe in children	233	466	50	14	74	19	2.6	1.64.3
	Knowledge malaria is severe in pregnant woman	231	462	50	16	78	21	2.4	1.6-3.8
	Knowledge malaria causes anaemia	223	414	54	24	126	19	2.8	2.0-4.1
	Knowledge malaria is cured by treatment	233	486	48	14	54	26	1.9	1.2-2.9
	Belief that bed net is costly	93	212	44	154	328	47	0.9	0.8-1.1
	Belief that bed net is cost worthy	237	506	42	10	34	29	1.6	0.9-2.7
	Belief that bed net is inconvenient	40	126	32	207	414	50	0.6	0.5-0.8
	Seek health care when ill	243	523	47	4	17	24	2.0	0.8-4.7
	Examined blood when fever	229	483	47	18	57	32	1.5	1.0-2.2
	Take medicine for cure	240	523	46	7	17	41	1.1	0.6-2.0
	Use mosquito repellent	141	298	47	106	242	44	1.1	0.9-1.3

Table 3: Increasing prevalence of bed net ownership among wealthy households, Purulia district, West Bengal, India, 2005

Income	Bed net owner		Bed net non owner		Prevalence ratio*
	No.	%	No.	%	
< Rs.2,000	19	8	251	85	0.06
Rs.2,000 – Rs.3,999	170	69	37	13	4.6
Rs.4,000 – Rs.5,999	26	10	3	1	8.7
≥ Rs.6,000	32	13	2	1	16

* Chi-square for trend = 330, p = 0.000001

Table 4: Bed net owners and non owners according to education of head of household stratified by household's income, Purulia, West Bengal, India, 2005

Strata	Number with primary education /total (%)		Prevalence ratio* (95% confidence interval)
	Owner of bed net	Non owner of bed net	
Income ≥ Rs.2000	188 /228 (83)	26 /42 (62)	1.2 (1.0-1.5)
Income < Rs.2000	8/ 19 (42)	105 /251 (42)	1.0 (0.4-2.4)

*Crude prevalence ratio = 2.5 (95% CI 1.9-3.2), Adjusted prevalence ratio = 1.2 (95% CI 1.0-1.4)

Table 5: Multivariate analysis of factors associated with ownership of bed net, Purulia district, West Bengal, India, 2005

	Variables	Odds ratio	P value*
Ownership of bed nets	Income ≥ Rs.2000	93	<0.0001
	Belief that bed net prevent malaria	7.8	0.05
	Belief that bed net is costly	0.2	0.000
	Belief that bed net is inconvenient	0.3	0.006

* Model chi-square = 449

Table 6: Comparison of respondents and non respondents of bed net use (among Owner's household) by age and sex, Purulia district, West Bengal, India, 2005

characteristics		Respondents		Non respondents	
		Number	%	Number	%
Age	< 18 years	909	54	39	49
	≥ 18 years	772	46	40	51
Sex	Male	841	52	40	51
	Female	824	48	39	49
Total		1681	100	79	100

Table 7: Surveyed population (bed net use) and study population by age and sex, Purulia district, West Bengal, India, 2005

Characteristics		Surveyed population		Study population (Purulia district)	
		No.	%	No. (in thousands)	%
Age	0 – 4 years	214	13	321	13
	5 –14 years	290	17	645	25
	15 – 59 years	1095	65	1508	59
	≥ 60 years	82	5	603	3
Gender	Males	841	51	1309	52
	Females	824	49	1228	48
Total		1681	100	2357	100

Table 8: Prevalence of bed net user according to the selected characteristics in households owning bed nets, Purulia district, West Bengal, India, 2005: Univariate Analysis results

Characterists		Prevalence of use among exposed			Prevalence of use among unexposed			Prevalence ratio	95% confidence interval
		No	Total	%	No	Total	%		
Demographic characteristics	Female sex	671	824	81	688	857	80	1.0	0.9-1.0
	Age < 5 yrs	211	215	98	1148	1466	78	1.3	1.2-1.3
	Age < 15 yrs	520	541	96	839	1140	74	1.3	1.2-1.4
	Age < 35 yrs	1126	1279	88	233	402	58	1.5	1.4-1.7
Socio-economic condition	Sleeping inside the house	1356	1611	84	3	70	43	19.6	6.5-59
	Primary education *	591	681	88	59	91	65	1.3	1.1-1.5
*knowledge, attitude and practices on bed net and malaria**	Know mosquito bite causes malaria	744	855	87	34	213	16	5.5	4.0-7.4
	Know mosquito bite at night	739	863	86	39	205	19	4.5	3.4-6.0
	Belief that bed net prevent malaria	756	906	83	22	162	14	6.1	4.1-9.0
	Belief that bed net prevent other bite	739	857	86	39	211	19	4.7	3.5-6.2
	Know malaria is severe in children	749	857	87	29	211	14	6.4	4.5-8.9
	Know malaria is severe in pregnant woman	744	851	87	34	217	16	5.6	4.1-7.6
	Know malaria causes anaemia	717	834	86	61	234	26	3.3	2.7-4.1
	Know malaria is cured by treatment	744	885	84	34	183	19	4.5	3.3-6.1
	Individual knows air from electric fan prevent malaria	20	49	41	758	1019	74	0.6	0.4-0.8
	Belief that bed net is costly	265	481	55	513	587	87	0.6	0.6-0.7
	Belief that bed net is cost worthy	744	901	83	34	167	20	4.1	3.0-5.5
	Belief that bed net is inconvenient	117	280	42	661	782	86	0.5	0.4-0.6
	Individual advices by others to use bed net	11	11	100	767	1057	73	1.4	1.3-1.4
	Seek health care when ill	771	1038	74	7	30	23	3.2	1.7-6.1
	Examined blood when fever	719	970	74	59	98	60	1.2	1.0-1.5
	Take medicine for cure	755	1019	74	23	49	47	1.6	1.2-2.1
	Use mosquito repellent	440	620	71	338	448	75	0.9	0.9-1.0

** Among those > 18 years (n= 1068)*

Table 9: Association between belief that bed net is inconvenient and bed net ownership among those exposed to primary education in Purulia, West Bengal, India, 2005

Strata	No. belief that bed net is inconvenient /total (%)		Prevalence ratio* (95% confidence interval)
	Owner of bed net	Non owner of bed net	
With primary education	83 /681 (12)	32 /91 (35)	0.8 (0.7-0.9)
Without primary education	34 /97 (35)	131 /199 (66)	0.4 (0.3-0.6)

*Woolf's test for effect modification: 10.8, p value = 0.001

Table 10: Multivariate analysis of factors associated with ownership of bed net and bed net uses, Purulia district, West Bengal, India, 2005

	Variables	Odds ratio	P value*
Uses of bed	Age < 35 yrs	3.0	<0.0001
nets	Sleeping inside the house	527	<0.0001
	Know mosquito bite causes malaria	4.7	0.002
	Know malaria is severe in children	11.7	<0.0001
	Use mosquito repellent	0.6	0.029

* Model chi-square = 1019

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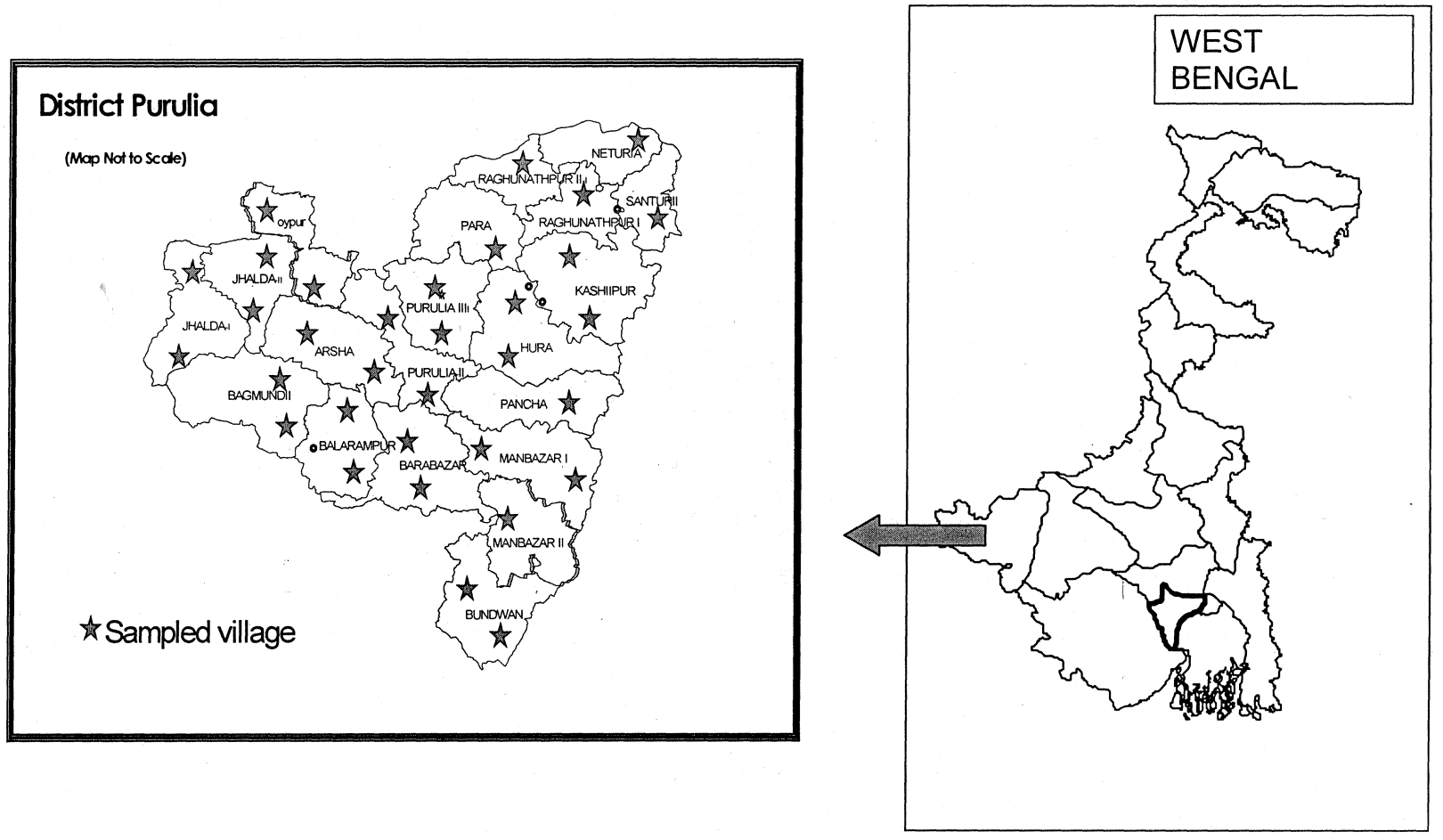
Appendix 1: Map showing sampled villages in study location, Purulia district, West Bengal, India, 2004

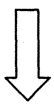


Appendix 2: Schematic presentation of methodology

District Purulia

Rural population

(2.5 million)



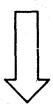
Households

Interviewed head of households

Selected by probability proportional to size methods

(17 households from each 33 village)

n = 561



Individuals

Interviewed all individuals in household owned bed net

(Guardian in minor)

n = 1760

Appendix 3: List of villages

Code No	Name of village	Block	GP	SC	Number of household
011	Imandih	Purulia I	Dimdiha	kalidasdih	209
012	Pichasi	Purulia I	Chipida B.puara	Pichasi	288
021	Gopalpur	Purulia II	Pindra	Palashkhola	66
022	Dubrajpur	Purulia II	Belma	Belma	216
031	Jorberia	Para	JJ II	Jorberia	563
041	Monipur	RNPur II	Nildih	Nildih	111
051	Laxmanpur	RNPur I	Nutandih	Salanchi	140
061	Bonra	Neturia	Bhamuria	Bonra	326
071	Krishnapur	Santuri	Ramchandrapur	Kotaldih	145
081	Rudra	Kashipur	Sonaijuri	Ahartore	197
082	Murlu	Kashipur	Barrah	Murlu	236
091	Rahamda	Hura	Kesargarh	Jagadih	430
092	Hura	Hura	Hura	Hura	630
101	Lakra	Puncha	Lakra	Lakra	214
111	Chandra	Manbazar I	Pairachali	Pairachali	222
112	kashidihi	Manbazar I	Bhalubasa	Nipania	223
121	Gobindapur	Manbazar II	Kumari	Basantapur	102
131	Barakarma	Bandwan	Kuilapal	Jorasal	203
132	Mangla	Bandwan	Bandwan	Gangamanna	184
141	Surikda	Barabazar	Bhagabandh	Adabona	65
142	Laxmanpur	Barabazar	Tumrasole	Tumrasole	181
151	Sardardih	Balarampur	Genrua	Beriadih	159
152	Bansgarh	Balarampur	Balarampur	Balarampur	241
161	Gobindapur	Bagmundi	Bagmundi	Gobindapur	467
162	Ajodhya	Bagmundi	Ajodhya	Ajodhya	55
171	Chhotopuhara	Jhalda I	Mathari Khamar	Khamar	91
172	Hesahatu	Jhalda I	Hesahatu	Brajapur	100
181	Palashdih	Jhalda II	Chitmu	Khatanga	70
182	Arkali	Jhalda II	Beliadih	Beliadih	138
191	Mantard	Joypur	Sidhi Jamda	Mantard	190
192	Monipur	Joypur	Uparkahan	Monipur	95
201	Hetjari	Arsha	Hetgugui	Hetjari	323
202	Kalabani	Arsha	Sirkabad	Nunia	175

Appendix 4: Informed consent form

Greetings,

You know that malaria is a problem in our Purulia district. I am _____ and working with the district health administration. We are look in to reasons that why people own and use a bed net in rural Purulia. Your response will help us to identify the problem and thus we will able to suggest improving owning and using of mosquito nets in the district. The National Institute of Epidemiology, Chennai is also working with us on this investigation.

To find out why people own a bed net and use it, we need to ask you questions on your household, economy and knowledge, attitude and practices on bed net. Thus, between _____ and _____, we will be asking these questions to head of family and all other members, in selected households in selected villages. We would like to confidentially ask these questions. Answering these questions should take 15 minute for head of household and 10 minutes for other members. Taking part in this survey is voluntary. You can choose not to take part. You can choose not to answer a specific question. You can also stop answering these questions at any time without having to provide a reason. This will not affect your right to health care. However, taking part in the survey may benefit the community, as it will help us to understand the problem.

The information we will collect in this survey will be completely confidential. We will not write your name on this form. We will only use a code instead. This key to this code will only be with principal investigator. It will be kept under lock and key. It will be destroyed after completion of the analysis.

If you wish to find out more about this survey before taking part, you can ask me all the questions you want. You can also contact Dr. Asit Kumar Biswas, MAE scholar, NIE ICMR at the telephone number 03252 227 480.

I have received sufficient information about the project, I have had opportunities to ask questions and these questions have been answered to my satisfaction. I consent voluntarily to this assessment and I understand I have the right to withdraw at any time without any consequence on the type of medical care I receive.

_____ Signature Date: _____

(Consent and signature should be collected from a parent/ guardian in of minors)

Identifiers collection form

(To ensure confidentiality, identifiers will not be collected in the paper questionnaires)

HOUSEHOLD ID:				**Chief of the household name:**	
Household address:					
ID1 name:		ID2 name:		ID3 name:	
ID4 name:		ID5 name:		ID6 name:	
ID7 name:		ID8 name:		ID9 name:	

Identifiers collection form

(To ensure confidentiality, identifiers will not be collected in the paper questionnaires)

HOUSEHOLD ID:				**Chief of the household name:**	
Household address:					
ID1 name:		ID2 name:		ID3 name:	
ID4 name:		ID5 name:		ID6 name:	
ID7 name:		ID8 name:		ID9 name:	

Household data collection form (For the head of the household)

HOUSEHOLD ID: _____ Sex of head of household: 1. Male 2. Female Residential area: 1. Plane 2. Hilly /forest	Team number: _____	Date: _____

I would like to ask you a few questions about you and your household:

Questionnaire items	Options		Coding
1. How many people are in your household now?	_____	Persons	
2. How many of them under 5 years of age?	_____	Persons	
3. Are you married?	1. Yes	2. No	
4. What is your age?	_____	Years	
5. Is there any pregnant woman in your household?	1. Yes	2. No	
6. What is the number of bed you use during sleeping at night?	_____	Numbers	
7. Do you own a bed net?	1. Yes	2. No	
8. What is the number of bed net in your household?	_____	Numbers	
I would like to ask you now a few questions about the socio-economic conditions of your family?			
9. Do you own a radio?	1. Yes	2. No	
10. Do you own a motorcycle?	1. Yes	2. No	
11. Are you use electricity for household?	1. Yes	2. No	
12. Are you use gas for cooking?	1. Yes	2. No	
13. Are you live in permanent house?	1. Yes	2. No	
14. How many bedroom you have in your house?	_____	Numbers	
15. How many window you have in your bedroom?	_____	Numbers	
16. What is your education level?	1. Illiterate	2. Pry-school	
	3. High-school	4. College	
17. What is the education level of your spouse?	1. Illiterate	2. Pry-school	
	3. High-school	4. College	

18. What is your occupation?	1. Service	2. Agriculture	
	3. Labour	4. Others	
19. How many members in your family earns?	_____	Numbers	
20. What is your monthly family income?	Rs. _____		
I would like to ask you a few questions about your Knowledge, attitude and practices on malaria and bed net:			
Questionnaire items	Options		Coding
21. What is the cause of malaria?	1. Mosquito bite	2. Air borne	
	2. Water borne	4. Others	
22. When the mosquito bite?	1. At night	2. Other time	
23. Why bed net is use?	1. Prevent mosquito bite	2. Other	
	1. Prevent malaria	2. Other	
24. Is mosquito net in prevention of other bite?	1. Yes	2. No	
25. Can malaria affect in children?	1. Yes	2. No	
26. Can malaria affect in pregnancy?	1. Yes	2. No	
27. Can malaria causes anaemia?	1. Yes	2. No	
28. Do you know that malaria is cured by treatment?	1. Yes	2. No	
29. Do you thing that a bed net is costly to own?	1. Yes	2. No	
30. Do you think that bed net is cost worthy?	1. Yes	2. No	
31. Do you think bed net is inconvenient to use?	1. Yes	2. No	
32. Are you seek medical advice when fever?	1. Yes	2. No	
33. Are you examine your blood during fever?	1. Yes	2. No	
34. Are you take medicine for cure during fever?	1. Yes	2. No	
35. Are you uses mosquito repellent?	1. Yes	2. No	

Appendix 7: Form C

Individual data collection form

HOUSEHOLD ID: _____	INDIVIDUAL ID: _____

Part – A (to be filled for all individuals. In case of minor respondent will be mother /guardian)

I would like to ask you a few questions about yourself:

Questionnaire items	Options		Coding
1. Gender:	1. Male	2. Female	
2. What is your age in years?	_____	Years	
3. Where you sleep at night?	1. Indoor	2. Outdoor	
4. Do you use mosquito net during sleeping?	1. Yes	2. No	
5. How many days in a week you use bed net during sleeping?	_____	Days	

Part – B (to be filled for person of age 18 years and above)			
I would like to ask you a few question on your socio-economic condition			
7. Literacy level	0.Illiterates	1.Can read & write	
	2. Primary	3. High school	
	4. Others.		
8. What is your occupation?	1. Agriculture	2. Service	
	3. Trade	4. Student	
	5. Housewife	6. Unemployed	
	7. Others	—	
I would like to ask you now about your knowledge, attitude and practices on malaria and bed net?			
9. What is the cause of malaria?	1. Mosquito bite	2. Air borne	
	2. Water borne	4. Others	
10. When the mosquito bite?	1. At night	2. Other time	
11. Why bed net is use?	1. Prevent mosquito bite	2. Other	
	1. Prevent malaria	2. Other	
12. Is mosquito net in prevention of other bite?	1. Yes	2. No	
13. Can malaria affect in children?	1. Yes	2. No	
14. Can malaria affect in pregnancy?	1. Yes	2. No	
15. Can malaria causes anaemia?	1. Yes	2. No	
16. Do you know that malaria is cured by treatment?	1. Yes	2. No	
17. Do you thing that a bed net is costly to own?	1. Yes	2. No	
18. Do you think that bed net is cost worthy?	1. Yes	2. No	
19. Do you think bed net is inconvenient to use?	1. Yes	2. No	
20. Are you seek medical advice when fever?	1. Yes	2. No	
21. Is the head of family insists you for using bed net?	1. Yes	2. No	
22. Do you think sleeping in wind by electric fan prevent mosquito bite?	1. Yes	2. No	
23. Do you think mosquito repellant is effective in prevention of mosquito bite?	1. Yes	2. No	
24. Are you examine your blood during fever?	1. Yes	2. No	
25. Are you take medicine for cure during fever?	1. Yes	2. No	

Appendix 8: Variable dictionary

Study on factors associated with ownership and uses of bed net in Purulia district, West Bengal (India), 2005	
Variable dictionary - Ownership	
ID	
Identification number	
1HOURES	
Residential area of house	1 = Plane 2 = Hilly / forest
2HOUSTR	
Structure of house	1 = Permanent (made of brick with concrete roof) 2 = Semi-permanent 3 = Temporary
3HOFSEX	
Sex of head of household	1 = Male 2 = Female
4HMNUM	
Number of members in household	_____ numbers
5HMU5	
Number of members under five years of age	_____ numbers
6HOFAGE	
Age of head of household	_____ years
7HPREG	
Presence of pregnancy	1 =Yes 2 = No
8PRENUM	
Number of pregnant women	_____ numbers

9BEDNUM	
Number of bed in use during sleeping	_____ numbers
10PRENET	
Presence of bed net	1 =Yes 2 = No
11NETNUM	
Number of mosquito net in household	_____ numbers
12OWNRDO	
Owner of radio	1 =Yes 2 = No
13OWNCYC	
Owner of motor cycle	1 =Yes 2 = No
14PREELC	
Presence of electricity for use	1 =Yes 2 = No
15PREGAS	
Presence of gas for cooking	1 =Yes 2 = No
16ROMNUM	
Number of bedroom	_____ numbers
17WINNUM	
Number of window	_____ numbers
18EDSELF	
Education level of head of household	1 = Illiterate 2 = Pry school 3 = High school 4 = Graduate
19EDSPOU	
Education level of head of household	1 = Illiterate

	2 = Pry school 3 = High school 4 = Graduate
20OCSELF	
Occupation of head of household	1 = Agriculture 2 = Labour 3 = Service 4 = Others
21ERNNUM	
Number of earning member	_____ numbers
22INCOME	
Income of household	RS. _____
23KNOMAL	
Knowledge on malaria transmission	1 = Mosquito bite 2 = Air 3 = Water 4 = Others
24KNBITE	
Knowledge on time of mosquito bite	1 = Day 2 = Night
25KNONET	
Knowledge on use of bed net	1 = Prevention of malaria 2 = Others
26KNOTBI	
Knowledge on other prevention of other bite from use of bed net	1 = Yes 2 = No
27KNMACH	
Knowledge on malaria in children	1 = Yes 2 = No
28KNMAPR	
Knowledge on malaria in pregnancy	1 = Yes 2 = No

29KNMACU	
Knowledge on malaria is curable	1 = Yes 2 = No
30KNMAAN	
Knowledge on malaria causes anaemia	1 = Yes 2 = No
31NETCOS	
Bed net costly	1 = Yes 2 = No
32NETUSE	
Bed net cost worthy	1 = Yes 2 = No
33NETINC	
Bed net inconvenient	1 = Yes 2 = No
34FEADME	
Medical advice when fever	1 = Yes 2 = No
35FEBLEX	
Blood examination when fever	1 = Yes 2 = No
36FETAME	
Taking medicine when fever	1 = Yes 2 = No
37USMORE	
Use mosquito repellent	1 = Yes 2 = No

Study on factors associated with ownership and uses of bed net in Purulia district, West Bengal (India), 2005	
Variable dictionary - User	
ID	
Identification number	
ISEX	
Sex of individual	1 = Male 2 = Female
IIAGE	
Age of individual	_____ years
1PLASLP	
Place of sleeping	1 = Inside of room 2 = Outside of room
2USENET	
Use net during sleeping at night	1 =Yes 2 = No
3USEDAY	
Number of days use net	_____ days
4EDSELF	
Education level of head of household	1 = Illiterate 2 = Pry school 3 = High school 4 = Graduate
5OCSELF	
Occupation of head of household	1 = Agriculture 2 = Labour 3 = Service 4 = Others
6KNOMAL	
Knowledge on malaria transmission	1 = Mosquito bite 2 = Air

	3 = Water 4 = Others
7KNBITE	
Knowledge on time of mosquito bite	1 = Day 2 = Night
8KNONET	
Knowledge on use of bed net	1 = Prevention of malaria 2 = Others
9KNOTBI	
Knowledge on other prevention of other bite from use of bed net	1 = Yes 2 = No
10KNMACH	
Knowledge on malaria in children	1 = Yes 2 = No
11KNMAPR	
Knowledge on malaria in pregnancy	1 = Yes 2 = No
12KNMAAN	
Knowledge on malaria causes anaemia	1 = Yes 2 = No
13KNMACU	
Knowledge on malaria is curable	1 = Yes 2 = No
14NETCOS	
Bed net costly	1 = Yes 2 = No
15NETUSE	
Bed net cost worthy	1 = Yes 2 = No
16NETINC	
Bed net inconvenient	1 = Yes 2 = No

17NETADV	
Other advice to use bed net	1 = Yes 2 = No
18FEADME	
Medical advice when fever	1 = Yes 2 = No
19PREFAN	
Air from electric fan prevent malaria	1 = Yes 2 = No
20FEBLEX	
Blood examination when fever	1 = Yes 2 = No
21FETAME	
Taking medicine when fever	1 = Yes 2 = No
22USMORE	
Use mosquito repellent	1 = Yes 2 = No