

Community factors associated with malaria prevention by mosquito nets: an exploratory study in rural Burkina Faso

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Summary

Malaria-related knowledge, attitudes and practices (KAP) were examined in a rural and partly urban multiethnic population of Kossi province in north-western Burkina Faso prior to the establishment of a local insecticide-treated bednet (ITN) programme. Various individual and group interviews were conducted, and a structured questionnaire was administered to a random sample of 210 heads of households in selected villages and the provincial capital of Nouna. *Soumaya*, the local illness concept closest to the biomedical term malaria, covers a broad range of recognized signs and symptoms. Aetiologically, *soumaya* is associated with mosquito bites but also with a number of other perceived causes. The disease entity is perceived as a major burden to the community and is usually treated by both traditional and western methods. Malaria preventive practices are restricted to limited chloroquine prophylaxis in pregnant women. Protective measures against mosquitoes are, however, widespread through the use of mosquito nets, mosquito coils, insecticide sprays and traditional repellents. Mosquito nets are mainly used during the rainy season and most of the existing nets are used by adults, particularly heads of households. Mosquito nets treated with insecticide (ITN) are known to the population through various information channels. People are willing to treat existing nets and to buy ITNs, but only if such services would be offered at reduced prices and in closer proximity to the households. These findings have practical implications for the design of ITN programmes in rural areas of sub-Saharan Africa (SSA).

keywords Africa, malaria control, mosquito nets, insecticide, community, Burkina Faso

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Introduction

Of the estimated annual 300–500 million clinical malaria cases and 1.5–2.7 million deaths that are directly attributable to malaria, the great majority occur in young children of remote rural areas of sub-Saharan Africa (SSA) (WHO 1997; Snow *et al.* 1999). As malaria control mainly relies on early diagnosis and prompt treatment with effective and affordable first-line antimalarial drugs, the rapidly increasing level of resistance to chloroquine in SSA is likely to contribute substantially to observed reversals in child mortality rates (Müller & Garenne 1999; Trape 2001).

For more than two decades now, insecticide-impregnated bednets and curtains (ITN) have raised renewed

interest as a tool in malaria control. In Africa, five major trials in areas of different malaria transmission intensities have documented a reduction in all-cause mortality of young children associated with ITN protection (Alonso *et al.* 1991; D'Alessandro *et al.* 1995; Nevill *et al.* 1996; Binka *et al.* 1997; Habluetzel *et al.* 1997). A meta-analysis of all randomized controlled trials showed an overall protective efficacy against all-cause mortality and malaria disease episodes of 18 and 45%, respectively (Lengeler 1998).

ITNs have since become an integral part of the global malaria control strategy and the global 'Roll Back Malaria' partnership (World Bank 1993; Nabarro & Tayler 1998). Until today, the distribution of ITN through the

governmental health system and the sale through the private sector by a social marketing approach are the two major strategies for implementing community-based ITN interventions in SSA (Lines 1996).

To date, however, experience with local factors influencing the effectiveness and sustainability of ITN programmes remains limited. In the Gambian National Impregnated Bednet Programme (NIBP), the introduction of fee-for-service was accompanied by a sharp drop in impregnation coverage from 85% during the first year to 14% in the second year (D'Alessandro *et al.* 1995). An evaluation of the activities of the NIBP during its third year showed that offering insecticide through private channels leads to increased impregnation coverage, and that providing insecticide through maternal and child health services is effective in targeting young children (Müller *et al.* 1997). More recently, in Tanzania, a major ITN social marketing pilot project achieved high coverage of the intervention, which was associated with a substantial reduction in malaria morbidity in young children (Armstrong-Schellenberg *et al.* 1999; Abdulla *et al.* 2001).

Prior to the intervention, a number of ITN programmes conducted community-based research to elucidate community knowledge, attitudes, and practices (Procacci *et al.* 1991; Aikins *et al.* 1993, 1994; Ettlting *et al.* 1994; Gyapong *et al.* 1996; Van Bortel *et al.* 1996; Vundule & Mharakurwa 1996). Much of this research was based exclusively on survey research. Only in the late 1990s, triangulated public health research using both qualitative and quantitative approaches to data collection was promoted (Agyepong *et al.* 1995; Gyapong *et al.* 1996; Agyepong & Manderson 1999; Rashed *et al.* 1999) and anthropologically informed studies were undertaken (Agyepong 1992; Winch *et al.* 1994; Makemba *et al.* 1996; Winch *et al.* 1996; Binka & Adongo 1997; Winch *et al.* 1997). Profound, long-term ethnographic research related to malaria and its prevention is still an exception and much needed (Hausmann Muela *et al.* 1998).

This body of research suggests that mosquito nuisance, perceived malaria risk, household income and other household variables such as ethnicity, age and gender are the most important determinants of mosquito net ownership and use (Aikins *et al.* 1993, 1994; Winch *et al.* 1994; Gyapong *et al.* 1996; Zimicki 1996). As mosquito nuisance is one of the major determinants for use of mosquito nets, compliance is usually much lower during the dry season than the rainy seasons (Winch *et al.* 1994; Zimicki 1996; Binka & Adongo 1997).

As an exploratory study prior to a district-based ITN programme in northwestern Burkina Faso, we conducted descriptive research on community factors associated with malaria prevention including mosquito net use. We also

examined issues of acceptability of ITNs by the local population.

Methods

Study area

Our study was conducted in the research zone of the *Centre de Recherche en Santé de Nouna* (CRSN), Burkina Faso (Kouyaté *et al.* 2000). Nouna, the capital of Kossi province, is situated about 280 km northwest of Ouagadougou. The CRSN study area comprises Nouna town (20 000 population) and a rural area of 41 villages (35 000 population). Most of the population belongs to the Marka, Mossi, Bwaba, Peulh and Samo ethnic groups. The main socio-economic activity is subsistence farming. Malaria is holo-endemic but markedly seasonal, with most transmission and disease occurring at the end of the rainy season, which usually lasts from June to October (Müller *et al.* 2001).

The study focused on 10 of the 41 rural CRSN study villages and all sectors of Nouna town. The villages were purposely selected to represent the rural study population in its socio-cultural, demographic and geographical diversity.

Study design

The study was exploratory and descriptive in nature, using both qualitative and quantitative approaches to data collection. The research team comprised of the investigators and four trained interviewers who were familiar with the local setting and the local languages. All questionnaires were translated into Dioula, the lingua franca of the study area, and were pre-tested before being administered. The survey instrument was informed by findings of the qualitative research.

Qualitative research

Focus group discussions (FGD), individual interviews and key informant interviews were conducted in four of the 10 study villages and in Nouna town. Ten FGDs (five with men and five with women) were held with groups of 10 participants each. We selected participants with at least one child below 5 years in their household, because we felt that they would have more specific experience with malaria and would be able to contribute more to the discussions. The discussions dealt with community knowledge of malaria-related concepts, and attitudes and practices regarding malaria prevention and treatment. We deliberately focused on naturalistic illness concepts close to the biomedical concept of malaria, relevant and amenable to

the mosquito net programme as a public health intervention, at the expense of a more elaborate ethnographic investigation of local illness terminologies and taxonomies, supernatural aetiologies and their ethnographic context (Hausmann Muela *et al.* 1998). The local illness terminology reported by FGD participants was supplemented by information from semistructured interviews with 40 persons of mixed ethnicities in Nouna town. We also conducted nine key informant interviews with medical personnel, local tailors and traders of mosquito nets, users of mosquito nets, traditional healers and ambulant drug peddlers. The interviews assessed the respondents' beliefs concerning malaria aetiology, nosology and prevention, and their practices on current malaria prevention and treatment measures including pattern of mosquito net ownership and use.

Raw field notes and tape recordings were first transcribed and translated. The data were processed and analysed with ATLAS.ti, a software package for qualitative data analysis, using a pre-established code list (ATLAS.ti 1997).

Quantitative research

Concepts and categories emerging from qualitative research informed the construction of the survey instrument, notably the definition of variables. Respondents were sampled through a modified Expanded Programme for Immunization (EPI) cluster sampling methodology. This was carried out by first dividing the CRSN study area into two geographical clusters, urban and rural. The urban cluster comprised Nouna town while the rural cluster comprised a random sample of six of the 10 purposely selected villages for this study. In the second stage, the urban cluster was subdivided into seven subclusters (all seven Nouna sectors), and the rural cluster into six subclusters (all six study villages). Overall, 210 households were selected proportional to the size of the geographical cluster, and the participating households were finally chosen at random in each cluster. A structured questionnaire was administered to the heads of the selected households. The questions focused on socio-demographic characteristics, ownership and use of mosquito nets, factors determining the possession and use of mosquito nets, knowledge and acceptability of insecticide-impregnated mosquito nets and the knowledge and practice of other malaria prevention and treatment methods.

The data were analysed with the Statistical Package for Social Sciences (SPSS) for Windows 95. Simple proportions were used to describe the parameters investigated.

Approval was granted by the Ethical Committee of the Heidelberg University Medical School and the Ministry of Health in Burkina Faso.

Results

Description of the study population

Most of the study population was within the age range 20–40 years and the great majority was illiterate. All respondents in the qualitative research with the exception of two FGD participants and four key informants were farmers, with different ethnic background. While roughly half of the participants on the qualitative interviews and discussions were females, the great majority (87%) of the heads of households interviewed during the survey were males. Of those, 80/210 (38%) were from Nouna town and 130/210 (62%) were from the six villages. The distribution of ethnicity was as follows: Bwaba 71/210 (34%), Marka 55/210 (26%), Mossi 46/210 (22%), Samo 26/210 (12%), Peulh 9/210 (4%) and others 3/210 (1%). Most respondents were married (190/210 = 90%) and most were in a monogamous union (137/190 = 72%).

Knowledge and awareness of malaria

There is no one-to-one equivalent for the biomedical concept of malaria in any of the local languages. The Djoula term *soumaya*, a broad syndromic entity, is closest, and generally used in public health discourse to communicate with the population on malaria-related matters. *Soumaya* literally means 'a state of being cold'. Although most people acknowledge that mosquitoes can transmit *soumaya*, other aetiological factors such as humidity, exposure to rain and cold are widely being held as causative factors.

Soumaya is unanimously considered a serious illness, as expressed by the following citation from one of our FGDs: 'When we hear of *soumaya*, it is a serious illness ... Because it is the mother of all illnesses. All illnesses which have not yet developed, begin to appear when you have *soumaya*. Headache, backache, constipation, all come from *soumaya*.'

Soumaya is perceived to manifest through different signs and symptoms, the more general ones being headaches, constipation, muscle weakness, eye pains, stomach pains, fever, tiredness, cold, itching of hands, neck and back pain. According to our respondents, these symptoms indicate a simple type of malaria common to adults as well as children. The more serious reported manifestations of *soumaya* are jaundice, dizziness and joint pains. The latter symptoms were associated with the Djoula term *djokadjo*, which means 'yellow eyes'. All the ethnic groups further knew of *djokadjo* as an illness common in adults and children.

Virulent fevers with convulsions during childhood are often interpreted as resulting from an ibou bird (translated as *kono* in local language and *engoulevant* in French

language) flying during full moon over the village taking away the soul of the child. A variety of preventive efforts are undertaken to avoid this, for example, women clap their hands when they see an ibou flying over a village at night. Pregnant women are forbidden to sleep outside during full moon.

The serious types of malaria were perceived as very problematic and characterized by severe suffering of victims. Participants of our FGDs considered the disease very disturbing, especially in households with children. Some of their typical statements are captured in the following citations: 'When we hear of *soumaya*, and we have children, our heart is not at peace. *Soumaya* in any way is a true problem among us here ... If your child is sick and lying down how do you get money to care for him. You either think of the work on the farm or the child and you must leave one to do the other ... *Soumaya* is a big thing because a lot of our children are losing their lives from it ...'

Some of the reported impact is economic and social distress and hardship, including the inability to work. During our FGDs, it was emphasized that *soumaya* is an illness burden particularly during the high time of agricultural activities when households have depleted most of their food stocks and have neither time nor money for transport and treatment.

Most FGD participants stated that mosquitoes cause *soumaya*. This was partly explained by mosquitoes transmitting the disease from a sick person to a healthy one, and partly through dirty water deposits responsible. Typical statements were as follows: 'There are also a lot of mosquitoes here, if they bite you, after biting a sick person, you know that the sickness has come. The wicked *soumaya* does not leave any part. It is the mosquito, which brings all that ...' 'The mosquitoes which live in water, when they bite you, they leave the water under your skin. That can also give you *soumaya*'.

The interview participants reported a number of other causes for *soumaya*, ranging from specific food to hygiene and poverty (Table 1).

Malaria treatment and prevention

Malaria treatment was often reported to be a combination of both modern and traditional methods. Depending on the type of malaria and its severity, people usually started with some traditional therapy, followed by modern treatment in case of failure. For serious disease, the nearest health centre was the most frequently cited option.

Malaria was reportedly cured with 'anti malaria drugs' such as chloroquine, paracetamol and aspirin, which were bought from merchants or governmental health services.

Table 1 Perceptions of the causes and the mechanisms of *soumaya*

Perceived causes of <i>soumaya</i>	Perceived causal mechanisms involved	Number of times mentioned during FGDs (<i>n</i> = 10)	
		Frequency	%
Mosquitoes	Sucking blood	10	100
	Deposition of dirty water under the skin of victims	6	60
Poverty and lack of means	Inability to provide good care, to prevent disease or to purchase treatment	10	100
Poor personal and environmental hygiene	Favours indirectly the growth of various parasites	6	60
Fruits (i.e. mangoes), shea nut, leaves of fresh beans, sugary foods, condiments (i.e. Maggi)	Eating food items considered cold in terms of property	6	60
Kono (bird)	Flies over the house at night	5	50
Fatigue	Weakening of the body	4	40
Dirty food	Eating	3	30
Dust	Entering one's chest	2	20
Cold, particularly cold rains	Cold temperatures, rain water falling on 'chilling' persons	2	20
Inheritance + environmental factors	Sick mother gives birth to sick child	1	10

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Although there was evidence for incorrect dosages in several instances, perceived effectiveness was emphasized by many respondents: 'We often treat malaria by taking antimalaria drugs. That is to say, you can even have the germ in the organism, but if you take antimalaria products, they completely neutralize the germ.'

Most respondents reported the regular use of traditional treatments like flowers of eucalyptus plants, acacia, citronella, papaya, guava and leaves and roots of the neem tree. The herbs were used in various combinations, the common one being eucalyptus plants with acacia and neem leaves. They are reportedly boiled, and the concoctions drunk, bathed in or perfused, depending on the perceived severity of the illness. However, unlike biomedical drugs, the effectiveness of the herbal treatments was considered uncertain, as expressed by some respondents: 'When one has *soumaya*, we uproot the leaves and bathe ... it is a question of chance. For some people it works, others use the traditional plants in vain and go to the hospital.'

Specific malaria prevention measures reported during the FGD were the use of chloroquine for pregnant women, the use of mosquito nets, the evacuation of dirty stagnant water, and the use of a specific plant (Djoula: Fariwêgnè yiri) as an insect repellent in rooms. The most frequently mentioned specific practice against mosquitoes reported from participants in the survey was the use of mosquito coils (142/210 = 68%). Mosquito coils and insecticide sprays were sold, under various brand names, in the local markets. Most of the measures against mosquitoes targeted at the perceived mosquito nuisance rather than for malaria prevention.

A statement from a key informant, a health officer, is summarized below: 'As for the preventive measures in general, it is individual protection. At the moment, where we can say something better is only with pregnant women. All the rest, we cannot say that any measure is in place ...'

Mosquito net prevalence, characteristics and use

Forty-nine percent (103/210) of respondents in the survey reported at least one mosquito net in their household (21% owned one, 13% two, and 15% more than two mosquito nets). More urban households compared with rural households owned mosquito nets (55% *vs.* 34%).

About two-thirds of the nets were rectangular, white and synthetic, of various origins and sold in the local markets. The materials are usually imported from Europe or Asia, and the mosquito nets produced by local tailors. Some were locally made mosquito nets and curtains, made from thick cotton. These were particularly preferred by older individuals, as a means to provide warmth during the colder periods of the year. Most mosquito nets were used

Table 2 Mosquito net use in households by age and sex

Persons using nets	Frequency	%
Children under 15 years alone	4	4
Young children and their mothers	20	19
Adult men alone	35	34
Adult women alone	5	5
Elderly persons	17	16
Couples	12	12
Other	10	10
Total	<i>n</i> = 103	100

for more than 3 years (60/103 = 58%). Most of households had devices on their walls (77/103 = 75%) and/or ceiling beams (63/103 = 62%) for fixing nets. Seventy-three percent (75/103) of respondents used their mosquito nets only during the raining season, only 12/103 (12%) used their nets throughout the year.

Adult men were the group who reportedly used mosquito nets most often (35/103 = 34%), followed by mothers with young children (20/103 = 19%) and elderly persons (17/103 = 17%) (Table 2).

Cost of mosquito nets and factors associated with net ownership

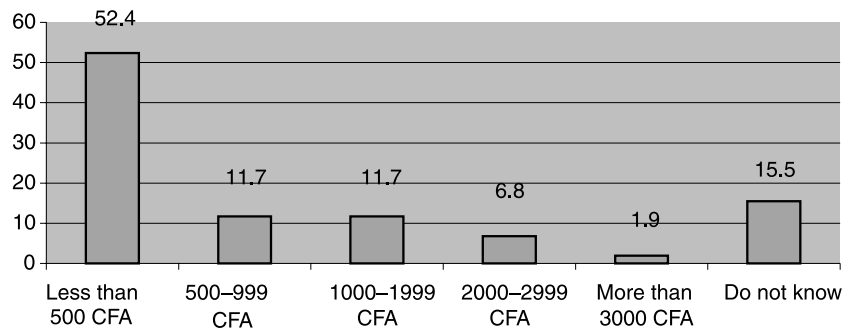
Most mosquito nets were purchased at local markets and the shops of Nouna, while a few were purchased in the major towns of Bobo Dioulasso and Ouagadougou. The price for a mosquito net ranged from 9 to 22 US\$ (mean 9.2 US\$), depending on material and size. High costs of these mosquito nets were the most frequently stated reason for not owning nets.

Ninety-five percent (98/103) of households owning mosquito nets used them as a measure against the nuisance of mosquitoes. Only a minority stated other reasons, such as privacy, protection against cold, flies and falling debris (8/103 = 8%).

Acceptability of insecticide-impregnated mosquito nets

Among the respondents owning mosquito nets, 42/103 (41%) had ever heard about the method of treating nets with insecticide. Of these, 13/42 (31%) obtained the information from health personnel, 11/42 (26%) from friends and neighbours, and 18/42 (42%) from the media (radio, television, newspapers). All these respondents were interested in the future use of treated nets, mostly because they felt it would provide them with better protection against mosquitoes (90/103 = 87%). Only a minority

Figure 1 Amount of money mosquito net owners are willing to pay for net treatment with insecticide
1 US\$ = 650 CFA.



stated that treated nets would provide them with better protection against illnesses (3/103 = 3%). When asked about how much money they would be willing to spend on net treatment, the majority did not want to spend more than 0.5–1 US\$ on treatment (Fig. 1).

Most rural and urban respondents stated that they would prefer to have mosquito net treatment services close to their home (78/103 = 76%); a few wanted to have such services to be established centrally at Nouna hospital and the surrounding health centres (22/103 = 21%).

Asked about the type of assistance needed to enable them to acquire new mosquito nets and/or to get existing ones treated with insecticide, 38/103 (37%) of respondents wanted them for free, 46/103 (45%) indicated their preference for reduced prices, and 10/103 (10%) preferred the nets to be provided on credit.

Discussion

Soumaya, the local equivalent to malaria, is considered a widespread and important health problem in northwestern Burkina Faso. As particularly young children of this area are experiencing a number of *soumaya* episodes during each rainy season, a significant additional burden is put on families at the time when agricultural work is most demanding and resources are most limited (Sauerborn *et al.* 1996; Müller *et al.* 2001). *Soumaya* manifests through various signs and symptoms. Although the majority of our study population knew that mosquitoes cause malaria, other natural and supernatural causes for malaria were frequently stated during interviews. These local perceptions of malaria are strikingly similar to findings from other malaria-endemic areas of SSA (Makemba *et al.* 1996; Ahorlu *et al.* 1997; Minja *et al.* 2001; Tarimo *et al.* 2000).

As in most of SSA and depending on accessibility, costs and on whether the entity is perceived as a 'normal' or an 'out of order' illness, malaria symptoms in our study area were usually first treated with traditional herbal remedies

and/or available western drugs (Deming *et al.* 1989; Guiguemde *et al.* 1994; Ruebush *et al.* 1995; Djimde *et al.* 1998; Nsimba *et al.* 1999; Hausmann Muela *et al.* 2000; Thera *et al.* 2000). Only in case of non-response or clinical deterioration, and depending on distance to the next health care facility, as well as on funds and time available for transport and treatment, patients visited formal health services. Although it is reassuring that western drugs are considered more effective as compared with traditional treatment, the fact that most villages in our study area are several kilometres away from the next health centre results in the great majority of illness episodes not being seen by trained health staff. There are major problems associated with this type of treatment-seeking behaviour. First, few cases are treated with an effective antimalarial drug in a timely manner (chloroquine is the officially recommended first line treatment in Burkina Faso). Second, biomedical drugs are frequently dosed incorrectly. For example, chloroquine is often given as a single dose, but sometimes daily for weeks. Third, dangerous drugs are frequently administered, for example aspirin and tetracycline are often given to children in case of fever. As a result, it is rather common that patients present with already advanced disease at health centres or hospital (unpublished observations).

However, it has repeatedly been demonstrated that the effectiveness of malaria control in SSA can be increased substantially through involving communities and particularly through training of the mothers of young children on correct antimalarial drug use (Menon *et al.* 1988; Pagnoni *et al.* 1997; Kidane & Morrow 2000). In our study area, a project focusing on training of village-based women groups in malaria treatment has recently shown to be feasible (Gerhardus *et al.* 2000).

Malaria prevention in our holoendemic study area is restricted to prescription of chloroquine prophylaxis to pregnant women during antenatal care visits. In reality, antenatal care coverage is strongly associated with living in Nouna town or in one of the few villages with a health

centre (unpublished observations). Prevention of mosquito bites through use of specific repellent plants, burning of mosquito coils and use of mosquito bednets is common. However, as also reported from many other places in SSA, these measures are primarily targeted against the nuisance of mosquitos and not against malaria (Aikins *et al.* 1994; Van Bortel *et al.* 1996; Zimicki 1996).

There are great variations in the proportions of households using mosquito nets in malaria-endemic communities of SSA (Zimicki 1996). While some countries such as The Gambia have a strong tradition of using mosquito nets for several purposes, mosquito net use is not very common in Ghana and Malawi (Binka *et al.* 1994; D'Alessandro *et al.* 1994; Ziba *et al.* 1994). Thus, the households of CRSN study area demonstrate intermediate rates of mosquito net ownership in the SSA context. Our findings confirm the higher mosquito net ownership rates in urban compared with rural areas observed in other SSA countries (Zimicki 1996).

In our study area the majority of existing mosquito nets were used by adult male heads of households instead of those at greatest risk for severe malaria, namely young children and pregnant women. A predominance of mosquito net use by male adults has also been observed in other SSA countries like Ghana and Tanzania, while in The Gambia young children and pregnant women were more frequently protected with mosquito nets than older children and non-pregnant adults (Aikins *et al.* 1994; D'Alessandro *et al.* 1994; Zimicki 1996). We also found that only a minority of households which own mosquito nets in our study area use them throughout the year. This supports similar findings regarding the influence of seasonal variations on mosquito net use from other SSA countries (Winch *et al.* 1994; Zimicki 1996; Binka & Adongo 1997). These findings have to be taken into consideration during the design of information/education/communication (IEC) messages within the framework of ITN programmes.

Mosquito nets are rather expensive in Burkina Faso, and this was the most important reason for households not owning mosquito nets. Many respondents had already heard about the benefits of treating mosquito nets with insecticides, the majority through the media, and all were interested in impregnation. When asked about their willingness to pay for treatment of existing mosquito nets, the majority were prepared to pay up to around 1 US\$ for this service and most would like to find the service close to their homes. There was also a strong argument for subsidy of mosquito net purchase and treatment. These findings demonstrate the barrier of existing high prices on mosquito net coverage in poor rural communities of SSA and have to be taken into consideration during implementation of ITN programmes.

Acknowledgements

We thank the staff of the Centre de Recherche en Santé de Nouna and the population of the Nouna study area for their support. The study was funded by the Deutsche Forschungsgemeinschaft (SFB 544, Control of Tropical Infectious Diseases). Jane Okrah was supported by a grant from the German Academic Exchange Service (Deutscher Akademischer Austauschdienst, DAAD, Germany).

References

- Abdulla S, Armstrong Schellenberg J, Nathan R *et al.* (2001) Impact on malaria morbidity of a programme supplying insecticide treated nets in children aged under 2 years in Tanzania: community cross sectional study. *British Medical Journal* **322**, 270-273.
- Agyepong IA (1992) Malaria: ethnomedical perceptions and practice in an Adangbe farming community and implications for control. *Social Science and Medicine* **35**, 131-137.
- Agyepong IA, Aryee B, Dzikunu H & Manderson L (1995) *The Malaria Manual. Guidelines for the Rapid Assessment of Social, Economic and Cultural Aspects of Malaria*. UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases, (TDR), Geneva.
- Agyepong IA & Manderson L (1999) Mosquito avoidance and bed net use in the Greater Accra region, Ghana. *Journal of Biosocial Science* **31**, 79-92.
- Ahorlu CK, Dunyo SK, Afari EA, Koram KA & Nkrumah FK (1997) Malaria-related beliefs and behaviour in southern Ghana: implications for treatment, prevention and control. *Tropical Medicine and International Health* **2**, 488-498.
- Aikins MK, Pickering H, Alonso PL *et al.* (1993) A malaria control trial using insecticide-treated bednets and targeted chemoprophylaxis in a rural area of the Gambia, West Africa. Perceptions of the causes of malaria and of its treatment and prevention in the study area. *Transactions of the Royal Society of Tropical Medicine* **87** (Suppl. 2), 25-30.
- Aikins MK, Pickering H & Greenwood BM (1994) Attitudes to malaria, traditional practices and bednets (mosquito nets) as vector control measures: a comparative study in five West African countries. *Journal of Tropical Medicine and Hygiene* **97**, 81-86.
- Alonso PL, Lindsay SW, Armstrong JRM *et al.* (1991) The effect of insecticide-treated bednets on mortality in Gambian children. *Lancet* **337**, 1499-1502.
- Armstrong-Schellenberg J, Abdulla S, Minja H *et al.* (1999) KINET: a social marketing programme of treated nets and net treatment for malaria control in Tanzania, with evaluation of child health and long-term survival. *Transactions of the Royal Society of Tropical Medicine* **93**, 225-231.
- ATLAS.ti (1997) *Visual Qualitative Data Analysis, Management and Model Building in Education, Research and Business*, Version 4.1. for Windows 95, Scientific Software Development, Berlin (www.atlasti.de).

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- Binka FM & Adongo P (1997) Acceptability and use of insecticide impregnated bednets in northern Ghana. *Tropical Medicine and International Health* 2, 499–507.
- Binka FN, Kubaje A, Adjuik M *et al.* (1997) Impact of permethrin-impregnated bednets on child mortality in Kassena Nankana district, Ghana: a randomized controlled trial. *Tropical Medicine and International Health* 1, 147–154.
- Binka FN, Morris S, Ross DA, Arthur P & Aryeetey ME (1994) Patterns of malaria morbidity and mortality in children in northern Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 88, 381–385.
- D'Alessandro U, Aikins MK, Langerock P, Bennett S & Greenwood BM (1994) Nationwide survey of bednet use in rural Gambia. *Bulletin of the World Health Organization* 72, 391–394.
- D'Alessandro U, Olaleye B, McGuire W *et al.* (1995) Mortality and morbidity from malaria in Gambian children after introduction of an impregnated bednet programme. *Lancet* 345, 479–483.
- Deming MS, Gayibor A, Murphy K, Jones TS & Karsa T (1989) Home treatment of febrile children with antimalarial drugs in Togo. *Bulletin of the World Health Organization* 67, 695–700.
- Djimde A, Plowe CV, Diop S *et al.* (1998) Use of antimalarial drugs in Mali: policy versus reality. *American Journal of Tropical Medicine and Hygiene* 59, 376–379.
- Ertling M, Steketee RW, Macheso A, Schultz LJ, Nyasulu Y & Chitsulo L (1994) Malaria knowledge, attitudes and practices in Malawi: survey population characteristics. *Tropical Medicine and Parasitology* 45, 57–60.
- Gerhardus A, Kielmann K & Sanou A (2000) The use of research for decision-making in the health sector: the case of 'Shared Care' in Burkina Faso. In: *Lessons in Research to Action and Policy*. COHRED, Document, The Council on Health Research for Development, Geneva, Switzerland, pp. 19–27.
- Guiguemde TR, Dao F, Curtis V *et al.* (1994) Household expenditure on malaria prevention and treatment for families in the town of Bobo-Dioulasso, Burkina Faso. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 88, 285–287.
- Gyapong M, Gyapong JO, Amankwa JA *et al.* (1996) Introducing insecticide impregnated bednets in area of low bednet usage: an exploratory study in northwest Ghana. *Tropical Medicine and International Health* 1, 328–333.
- Habluetzel A, Diallo DA, Esposito F *et al.* (1997) Do insecticide-treated curtains reduce all-cause child mortality in Burkina Faso? *Tropical Medicine and International Health* 2, 855–862.
- Hausmann Muela S, Muela Ribera J & Tanner M (1998) Fake malaria and hidden parasites – the ambiguity of malaria. *Anthropology and Medicine* 5, 43–61.
- Hausmann Muela S, Mushi AK & Muela Ribera J (2000) The paradox of the cost and affordability of traditional and government health services in Tanzania. *Health Policy and Planning* 15, 296–302.
- Kidane G & Morrow RH (2000) Teaching mothers to provide home treatment of malaria in Tigray, Ethiopia: a randomised trial. *Lancet* 356, 550–555.
- Kouyaté B, Traore C, Kielmann K & Mueller O (2000) North and South: bridging the Information gap. *Lancet* 356, 1034–1035.
- Lengeler C (1998) Insecticide treated bednets and curtains for malaria control (Cochrane Review). In: *The Cochrane Library*, Issue, 3. Update Software, Oxford.
- Lines J (1996) Mosquito nets and insecticides for net treatment: a discussion of existing and potential distribution systems in Africa. *Tropical Medicine and International Health* 1, 616–632.
- Makemba AM, Winch PJ, Makame VM *et al.* (1996) Treatment practices for *degedege*, a locally recognized febrile illness, and implications for strategies to decrease mortality from severe malaria in Bagamoyo District, Tanzania. *Tropical Medicine and International Health* 1, 305–313.
- Menon A, Joof D, Rowan KM & Greenwood BM (1988) Maternal administration of chloroquine: an unexplored aspect of malaria control. *Journal of Tropical Medicine and Hygiene* 91, 49–54.
- Minja H, Schellenberg JA, Mukasa O *et al.* (2001) Introducing insecticide-treated nets in the Kilombero Valley, Tanzania: the relevance of local knowledge and practice for an Information, Education and Communication (IEC) campaign. *Tropical Medicine and International Health* 6, 614–623.
- Müller O, Becher H, Baltussen A *et al.* (2001) Effect of zinc supplementation on malaria morbidity among West African children: a randomized double-blind placebo-controlled trial. *British Medical Journal* 322, 1–6.
- Müller O, Cham K, Jaffar S & Greenwood BM (1997) The Gambian National Impregnated Bednet Programme: evaluation of the 1994 cost-recovery trial. *Social Science and Medicine* 44, 1903–1909.
- Müller O & Garenne M (1999) Childhood mortality in sub-Saharan Africa. *Lancet* 353, 673.
- Nabarro DN & Tayler EM (1998) The 'Roll Back Malaria' Campaign. *Science* 280, 2067–2068.
- Nevill CG, Some E, Mungala V *et al.* (1996) Insecticide-treated bednets reduce mortality and severe morbidity from malaria among children on the Kenyan coast. *Tropical Medicine and International Health* 1, 139–146.
- Nsimba SED, Warsame M, Tomson G, Massale AY & Mbatia ZA (1999) A household survey of source, availability, and use of antimalarials in a rural area of Tanzania. *Drug Information Journal* 33, 1025–1032.
- Pagnoni F, Convelbo N, Tiendrebeogo J, Cousens S & Esposito F (1997) A community-based programme to provide prompt and adequate treatment of presumptive malaria in children. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 91, 512–517.
- Procacci PG, Lamizana L, Pietra V, Di Russo C & Rotigliano G (1991) Utilisation de rideaux imprégnés de perméthrine par les habitants d'une communauté rurale du Burkina Faso. *Parassitologia* 33, 93–98.
- Rashed S, Johnson H, Dongier P *et al.* (1999) Determinants of the permethrin impregnated bednets (PIB) in the Republic of Benin: the role of women in the acquisition and utilisation of PIBs. *Social Science and Medicine* 49, 993–1005.

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- Ruebush TK, Kern MK, Campbell CC & Oloo AJ (1995) Self-treatment of malaria in a rural area of western Kenya. *Bulletin of the World Health Organization* 73, 229–236.
- Sauerborn R, Nougara A, Hien M & Diesfeld HJ (1996) Seasonal variations of the household costs of illness in Burkina Faso. *Social Science and Medicine* 43, 281–290.
- Snow RW, Craig M, Deichmann U & Marsh K (1999) Estimating mortality and disability due to malaria among non-pregnant population. *Bulletin of the World Health Organization* 77, 624–640.
- Tarimo DS, Lwihula GK, Minjas JN & Bygbjerg IC (2000) Mothers' perceptions and knowledge on childhood malaria in the holoendemic Kibaha district, Tanzania: implications for malaria control and the IMCI strategy. *Tropical Medicine and International Health* 5, 179–184.
- Thera MA, D'Alessandro U, Thiero M *et al.* (2000) Child malaria treatment practices among mothers in the district of Yanfolila, Sikasso region, Mali. *Tropical Medicine and International Health* 5, 876–881.
- Trape JF (2001) The public health impact of chloroquine resistance in Africa. *American Journal of Tropical Medicine and Hygiene* 64 (Suppl.), 12–17.
- Van Bortel W, Barutwanayo M, Delacollette C & Coosemans M (1996) Motivation à l'acquisition et à l'utilisation des moustiquaires imprégnées dans une zone à paludisme stable au Burundi. *Tropical Medicine and International Health* 1, 71–80.
- Vundule C & Mharakurwa S (1996) Knowledge, practices, and perceptions about malaria in rural communities of Zimbabwe: relevance to malaria control. *Bulletin of the World Health Organization* 74, 55–60.
- Winch PJ, Makemba AM, Kamazima SR *et al.* (1994) Seasonal variation in the perceived risk of malaria: implications for the promotion of insecticide-impregnated bed nets. *Social Science and Medicine* 39, 63–75.
- Winch PJ, Makemba AM, Kamazima SR *et al.* (1996) Local terminology for febrile illnesses in Bagamoyo district, Tanzania and its impact on the design of a community-based malaria control programme. *Social Science and Medicine* 42, 1057–1067.
- Winch PJ, Makemba AM, Kamazima SR *et al.* (1997) Social and cultural factors affecting rates of regular retreatment of mosquito nets with insecticide in Bagamoyo District, Tanzania. *Tropical Medicine and International Health* 2, 760–770.
- World Bank (1993) *World Development Report: Investing in Health*. Oxford University Press, New York.
- World Health Organization (1997) World malaria situation in 1994. *Weekly Epidemiological Record* 72, 269–276.
- Ziba C, Slutsker L, Chitsulo L *et al.* (1994) Use of malaria prevention measures in Malawian households. *Tropical Medicine and Parasitology* 45, 70–73.
- Zimicki S (1996) Promotion in Sub-Saharan Africa. In: *Net Gain. A New Method for Preventing Malaria Deaths* (eds C Lengeler, J Cattani & D de Savigny) World Health Organization, Geneva, pp. 111–148.