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MOSQUITO AVOIDANCE AND BED NET USE IN THE GREATER ACCRA REGION, GHANA

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Summary. Qualitative research and cross-sectional survey methods were used in a study conducted in rural and urban areas of the Greater Accra Region, Ghana, to explore people's understanding of the cause of malaria and patterns of mosquito avoidance, in particular bed net ownership and use. The study indicated far higher bed net ownership and use in rural than urban areas, which was related partly to perceived affordability and partly to the different contexts of and reasons for avoiding mosquitoes. Knowledge of an association between mosquitoes and malaria, the most common cause of illness in both areas, was related to residence but not to literacy or formal education, and this knowledge did not predict bed net use. The paper points to the complexity of social and personal factors implicated in behavioural interventions for malaria control, and questions behavioural models that assume a linear relationship between knowledge and practice.

Introduction

In the absence of a vaccine or effective and sustainable chemical means of vector control, public health interventions remain the primary means of reducing the incidence of malaria. Current interventions with the most immediate impact aim to minimize vector–human contact and to treat malaria disease promptly. Reducing breeding sites of mosquitoes, screening of doors and windows, using mosquito nets and insecticide sprays, and prompt treatment of a malaria episode, can reduce the impact of malaria. However, people's ability to comply with interventions and to treat sickness is affected by their acceptance of the interventions, their understanding of the nature of the illness and the relationship between vector and infection, and other social, economic and cultural factors.

At present, the most promising intervention which both limits bites and kills the vector is insecticide-impregnated bed nets and/or curtains. Interest in this follows from the successful results of research conducted in The Gambia, which drew attention to the value of bed nets in reducing morbidity and mortality among infants and small children (Snow, 1988; Alonso *et al*., 1990; Greenwood & Baker, 1993). The apparent

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wide potential of bed nets in malaria control and particularly in reducing its burden on infant health led to further research in Africa, in Burkina Faso, Kenya and Ghana, which has confirmed the value of nets in areas of high endemicity (Lengeler, Cattani & de Savigny, 1996). In consequence, research is now underway to identify community perceptions of nets, and people's willingness to purchase, treat and sleep under nets.

Sleeping under nets is an apparently simple solution for malaria control, but may not be unproblematic. Margaret Gyapong and colleagues (1992), for instance, on the basis of their work in Kassena Nankana district, Navrongo, Ghana, argue that there is considerable variation in terms of the frequency and correct use of nets inter- and intra-seasonally and among households, and that this variation means that protection from disease is of little public health significance. Further, the low association between bed net use and malaria transmission in endemic communities suggests that sustained use of nets is dependent upon their other demonstrable advantages, such as the reduction of bed bugs and the general prevention of nuisance mosquito bites. This is the case in The Gambia, where bed net use is high but knowledge of the association between mosquitoes and malaria transmission is relatively low: in the study by Aikins *et al.* (1993), 86% of respondents used nets but only 28% knew that mosquitoes transmitted malaria (see also Cham *et al.*, 1996). Similarly, a recent study in Guatemala (Klein *et al.*, 1995) drew attention to the common and increasing use of bed nets to prevent nuisance mosquito bites, despite people's variable use of nets and their lack of association of the nets with disease prevention. In Malawi and Kenya too, bed net ownership and use are low, and knowledge of the role of bed nets in reducing malaria and the elimination of breeding sites to reduce vector density is also comparatively low (Helitzer-Allen, Kendall & Wirima, 1993; Ziba *et al.*, 1994; Marsh *et al.*, 1996).

The apparently tenuous links between knowledge and practice have led a number of researchers to advocate encouragement of bed net use independent of people's knowledge of the aetiology or transmission of malaria. In particular, they have stressed the importance of the low price of nets to facilitate purchase, and their insecticide impregnation, regardless of the number of mosquitoes experienced by communities (Thomson *et al.*, 1996; Marsh *et al.*, 1996; Cham *et al.*, 1996).

Methods

This paper focuses on community perceptions of mosquitoes and fever morbidity, and the use of bed nets and other means of mosquito avoidance in urban and rural areas of southern Ghana. The paper reports data collected during field trials for the development of the *Malaria Manual*, conducted in August–September 1992 (Agyepong *et al.*, 1995). The manual advocates relatively simple research tools, including in-depth interviews, focus group discussions and observations, to collect social and behavioural information of the kind required for programme implementation and/or evaluation. Consequently the emphasis of the fieldwork and the manual was on specific operational research questions, rather than the broad social, cultural and contextual issues which might characterize a more conventional ethnographic study. The data collected were tested for external validity by a cross-sectional survey conducted between November 1992 and January 1993. For this, given the emphasis in this study on rapid assessment

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procedures, a standard EPI two-stage cluster-sampling frame was used (30×7) which did not correct for population size, and which followed the methods originally developed to assess immunization status and coverage (Smith, 1989). There are clear limitations to rapid assessment approaches because of loss of context (Manderson & Aaby, 1992a,b). Even so, in the course of this work it was possible to collect detailed information about community perceptions of illness, patterns of diagnosis and treatment, and disease transmission and prevention, which are of value for malaria control interventions in the study region.

The study communities

Data were collected in two areas of the Greater Accra Region: Duffo, a rural village located in the Osudoku sub-district of Dangme West, and Odorna and Sahara, urban residential areas of Osu-Clottey sub-district, Accra Metropolis. Research was conducted by the authors and two collaborators, with a local health assistant providing translation assistance for one of the authors (L.M.) (Agyepong & Manderson, 1994).

The rural site, Duffo, is located on the Volta River several hours from Accra city, and is comprised of three hamlets with a total of around 300 households (c. 2000 population), primarily Dangme. The subsistence base of this community is cassava, consumed within the household, and corn, the surplus of which is usually sold within the village. Fish caught in the river, which forms a boundary of the village, are primarily consumed within homes, and occasional catches of fish, lobster and shrimp are taken to a neighbouring town for sale. Cash is also generated for food and other immediate household needs by men from producing quick lime and charcoal, wage labour on nearby rice farms, and the sale of prepared foods and various trade goods within the village and in nearby towns; women also work to some degree as wage labourers to increase household cash resources. The immediate health needs of the community are met by two village health workers who run a community clinic, and by nursing staff who operate an outreach clinic which visits Duffo around once a month depending on transport availability. The services provided by these clinics are limited, however, and people travel to a rural health centre across the river in an adjacent district, or down-river to a mission hospital in the case of more serious medical problems.

The urban research was conducted in Odorna and Sahara, which are adjacent residential areas in Osu-Clottey sub-district, Accra City. These areas are densely populated (c. 10,000 population) and include good established housing and make-shift huts providing shelter for recent immigrants from throughout Ghana. Disposal of both wet and dry waste is poor and allows breeding sites for both nuisance mosquitoes (*Culex* spp.) and *Anopheles* mosquitoes. Residents work for cash in both formal and informal sectors: men as labourers, semi-skilled government employees, policemen and traders; women as hairdressers, dressmakers, sex workers, traders and food hawkers. A wide range of health services are available in the area, including maternal and child health clinics, outpatient clinics and tertiary care hospitals, private medical clinics, pharmacies, and street pedlars and merchants who sell herbal enemas, drinks and inhalations, and small packages of patent drugs for various purposes. For malaria, a

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packet might include ground paracetamol, chloroquine, vitamins and the contents of an antibiotic capsule.

The cross-sectional survey, using a questionnaire developed from information collected in the village studies, was conducted in the sub-districts in which these sites were located (Osudoku for the rural sample, Osu-Clottey for the urban sample). As described above, a two-stage cluster sampling frame was used, with systematic random sampling from an official list of rural communities for the rural community, and enumeration areas of the census office for the urban area, to select 30 clusters in each of the sub-districts at the first stage, and simple random sampling to select households at the second stage. The person with primary responsibility for the care of children younger than 5 years was interviewed in each sampled household, and where there was more than one caretaker in a household or when all volunteered to be included, all were interviewed. In total 256 households in Osudoku and 215 households in Osu-Clottey were included. Survey data were analysed using Epi-Info; qualitative data were managed using word processing software and organized and analysed on a thematic basis.

Malaria as a public health problem

Malaria is the most frequently reported disease in Ghana. Crude parasite rates – that is, the percentage of people in specified age groups who are parasitaemic – range between 10 and 70% (Health Research Unit, Accra, unpublished data). Three species of human plasmodia are present, *Plasmodium falciparum*, the predominant parasite species which accounts for 80–90% of infections, *Plasmodium malariae*, accounting for 20–30% of infections, and *Plasmodium ovale*, which is relatively uncommon and unevenly distributed and accounts for 0–15% of infections (Ghana, 1992). There is considerable diversity of incidence and seasonal variation country-wide due to differences in topography, ecology, climate, and vector and human habitat and behaviour. Annual reports for the Greater Accra Region and Dangme West district, covering the study areas of this paper, show malaria consistently to be the most frequently reported disease accounting for some 40% of cases at outpatient departments (Agyepong, 1992). In Osu-Clottey, the urban research site, transmission is somewhat variable because of different local environmental conditions within the area. In some areas heavy pollution of ground water would inhibit Anopheline breeding. In other newer areas, construction work has created new breeding sites and drainage is inadequate, leading to increased risk of transmission during the rainy season. No malariometric surveys have been conducted in the area which enable quantification of the problem, but reports from clinics indicate that malaria is still the most frequently reported disease.

The folk aetiology of malaria is described in an earlier paper (Agyepong & Manderson, 1994). The term *fever* is used for the disease, which is diagnosed on the basis of a cluster of symptoms; the term does not indicate 'hot body' but an illness characterized by temperature change, fevers and chills, and often headache. The term *asra* is used synonymously among Ga-Adangme speakers, and *asraku* ('male' asra) proximates severe malaria (Agyepong, 1992).

Fever was regarded by survey respondents as a 'cause of concern' and the actions

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taken at household level for fever in both adults and children were explored. Presentation for diagnosis and treatment following onset of fever related to perceptions of effectiveness of anti-malarials on acute symptoms. Most fever in children and adults is treated initially in the home (53% of cases of adults and 60% of children with presumed fever among rural respondents; 72% of cases of adults and 76·5% of children among urban respondents), but outside advice was then sought if there was little improvement (Agyepong & Manderson, 1994). Place of presentation varied according to access but also the kinds of treatment available. In Duffo, for example, respondents used the local primary health care clinic, which was able to dispense a limited number of drugs in paediatric suspension for illnesses in small children. Adults and older children tended to travel to the rural health centre where anti-malarial treatment was available by injection, which people believed to be more effective and 'stronger' than tablets or capsules, while pregnant women with fever were usually taken to the hospital down-stream because of the perceived greater risk to mother and fetus. Assessments of the technical competence of clinic staff and efficacy of medication depending on delivery was common in both study areas (see also Wondergem, Senah & Glover, 1989).

Informants ascribed multiple causes of fever, and these included exposure to heat from sun or fire, eating oily or starchy food, unhygienic surroundings, and mosquitoes, although not supernatural causes as reported in both The Gambia and Malawi (Aikins *et al*., 1993; Helitzer-Allen *et al*., 1993). Since the focus of this paper is on mosquito avoidance, respondents' understanding of the role of mosquitoes in fever transmission is concentrated on. Respondents more commonly associated mosquitoes with fever in Osu-Clottey than Osudoku. Around 10% of rural and 47·3% of urban respondents stated that fever was transmitted by mosquitoes as the primary cause, and 33% of rural and 62·4% of urban respondents included mosquitoes as one of a number of causes of malaria. Both urban and rural dwellers were able to provide some explanation of the link, for example, because 'mosquitoes eat dirty water and inject you with it' or 'mosquitoes bite others with a disease and if they bite you later, (they) can give you fever'.

Consistent with research on knowledge undertaken in The Gambia (Thomson *et al*., 1996), functional literacy (defined as having completed primary school) was not strongly associated with a perception of mosquitoes as being a cause of fever. Around half of those who had completed primary schooling included the mosquito as a cause of fever, but this was true also for those who were not functionally literate or had not attended school. The general proportion of people associating malaria and the mosquito was consistent regardless of level of education, and differences according to years of schooling were not statistically significant. However, these data indicate a strong relationship between area of residence and knowledge of the mosquito as a cause of fever, as set out in Table 1: that is, independent of educational status or literacy, urban dwellers were more likely to associate mosquitoes with fever. The most likely explanation of this increased familiarity is the exposure of urban dwellers to information about health matters, not in terms of health education delivered formally, but with respect to information delivered via the media (radio, television and newspapers). Lack of association of mosquitoes and fever was not related to prevention of bites, however, since the irritation of household mosquitoes was a sufficient reason for most people to avoid bites.

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Table 1. Perceived cause of fever by area of residence

Area of residence	Mosquito mentioned	No mention of mosquito	Total
Rural	85	170	255
Urban	128	77	205
Total	213	247	460

Chi-square = 38·72; $p = 0{\cdot}0000$.

Mosquito avoidance

The authors' interest in mosquito avoidance derived from an interest in reinforcing protective behaviour regardless of underlying understanding of disease aetiology. Vector control programmes requiring environmental management, such as stream clearing or the distribution of larvivorous fish, are difficult to introduce where people do not accept the link between the vector and disease transmission, since there are no immediate or apparent advantages of the intervention. The use of impregnated bed nets, in contrast, is attractive as an intervention because of its value in reducing bites of all mosquitoes and in reducing other bites (e.g. of bed bugs). In addition, apart from insecticide treatment, which may need to be organized at a community level, the intervention is at the level of the household, thereby by-passing the difficulty of securing community commitment by way of donated labour without direct household benefits. Bed nets are a simple and familiar technology introduced into and monitored by householders, and potentially their use and maintenance can be readily incorporated into women's domestic routines. This emphasis on practical action rather than on the links between knowledge, belief and behaviour has the added advantage of approaching public health interventions on the basis of what people do know, therefore overcoming what Good (1994) has represented as the 'problem' of knowledge and belief, and the supposition of the correlation between (correct) knowledge and appropriate action.

The issue of mosquito avoidance was pursued in the survey because in the village studies, people often talked at length about environmental conditions, mosquito breeding and vector density, not because of their effect on malaria but in response to our interest in mosquitoes. In Odorna and Sahara urban areas, people highlighted mosquito density, which they regarded as being due to stagnant water in drains, and stressed that there was a need for drains to be cleared of weeds and rubbish. Women saw their own responsibility as being limited to domestic space, while the maintenance of public space was men's responsibility (cf. Winch *et al.*, 1994). One respondent (of some 40 women interviewed) mentioned that in the past the local police had undertaken some clearing; most felt that this was a government responsibility: 'The men don't do anything, no. Well, it's the responsibility of the government. It has to employ people to clean up'. In Duffo, women related apparent increases in mosquitoes to changes in the flow of water of the Volta River following damming; they felt there was no action that could be taken to reduce breeding.

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Table 2. Perceptions of mosquitoes

Question item	Rural respondents %	Urban respondents %
Do mosquitoes worry/annoy you?	Yes – 98·4	Yes – 92·1
Are there many mosquitos around here?	Yes – 93·7	Yes – 74·6
What are the major reasons for the presence of mosquitoes?		
stagnant water	44·7	58·0
weed in the river	36·0	—
choked gutter and drains	—	72·4
dirty environment	23·0	46·0

In the cross-sectional survey, people were asked whether mosquitoes 'worried' them, whether they perceived that there were a 'lot' of mosquitoes in their community, and why this was so. These subjective assessments yielded interesting data with respect to perceptions of mosquitoes as a nuisance, and to people's association between the environment and the vector (see Table 2).

The qualitative research, on the basis of information from focus group discussions, interviews and household observations to count nets and observe their use, indicated high levels of net use in rural areas. In Duffo, both bed net ownership *and* use were nearly universal. Women explained that the mosquito 'bites and sucks blood to give illness', and that given this, the nets were protective. The more common reason for high bed net use, however, was to be able to sleep, to avoid their 'irritating buzzing sound. The mosquitoes like your ears, they disturb too much'; 'without a net, you'd be crazy when you got up in the morning'. Hence, as reported for The Gambia (Aikins *et al*., 1993), the primary motivating factor for sleeping under a net was to ensure uninterrupted sleep. Since longitudinal data were not collected, we were not able to validate reported use according to season (cf. Gyapong *et al*., 1992).

In urban areas, bed nets were less common. Women maintained that this was because of capital outlay required: 'you can't buy just one; you'd have to have money for nets for everyone'. While cash flow into these households was greater than in rural areas, households in the city did not have a subsistence base and those who had travelled to Accra from rural areas in recent times had few household goods of any kind. In this respect, the capital outlay was a substantial investment against other, recurrent expenses. In general, urban householders used alternative means to repel mosquitoes: commercial coils, window screens, fans, chemical sprays, and manual methods (e.g. 'blowing' mosquitoes away with a cloth). Many of the larger houses in urban areas also had ceilings, windows and door screens, which provided additional protection from mosquitoes.

The measures to repel mosquitoes in one urban household (of a Ga woman and her family) provides some idea of the diversity of strategies within a single household. Sleeping individuals were protected by the following means: grandmother, window screens and fan; uncle, mother, child, coils; informant and her two children, net and

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Table 3. Methods of keeping mosquitoes away, Odabraka and Dangme

Method	Rural ($N=254$)	Urban ($N=213$)
Bed net	130 (51%)	3 (1%)
Mosquito spray	44 (17%)	90 (42%)
Mosquito coil	174 (68%)	141 (66%)
Burning herbs	23 (9%)	24 (11%)
Mosquito netting on doors and windows	8 (3%)	29 (24%)
Drive away mosquitoes with a cloth	70 (28%)	64 (30%)
Other	21 (8%)	16 (8%)
Total responses	466 (100%)	367 (100%)

coils; other adults, coils and insecticide spray in room prior to retiring for the night. This household was relatively comfortable (it had electricity for the fan, a window had screen wire, etc.). Other households were poorer and more crowded, living in structures without any screens: a 25-year-old Tamale woman, for example, shared one room with her husband, her own three small children, and the three surviving children of her deceased co-wife, with all eight sharing a single coil per night. Women held various beliefs about the effectiveness of methods of repellent, e.g. the differences in strength and efficacy of various coils (largely related to differences in cost) and the relative merits of coils versus other methods (e.g. sprays), as well as the risks of the use of coils, for example in causing 'catarrh cold' in children. In both rural and urban areas of the cross-sectional survey, the most common method mentioned was the mosquito coil (66 and 68% respectively), followed by bed nets in rural areas (51%) and insect spray in urban areas (42%). Around one-third of all respondents in both areas also mentioned using a cloth to 'drive away' mosquitoes. Other methods were used less commonly: in the rural area sprays, burning herbs, using mosquito wire over doors and windows (rare in practice), keeping surroundings clean, closing doors and killing mosquitoes by hand; in urban areas, burning herbs, incense and orange peel, and using electric fans. Most people used more than one method to deter mosquitoes (and a total of 30 different methods or combinations); the most common means of keeping mosquitoes away are set out in Tables 3, 4 and 5.

Table 3 presents summary data for both urban and rural residences, without indicating those who used methods in combination. This detail is provided in Tables 4 and 5. What is significant about these data is the lack of concordance between practices of avoidance of mosquitoes and bed net ownership. In the village study, virtually all people reported that they both owned and used their nets. In the rural survey conducted during the cooler months of the year, 96% of respondents also owned nets but only 51% mentioned bed nets as a means to avoid mosquito bites; in the urban area, only 1% mentioned nets as protective although 16% owned bed nets. Respondents in both rural and urban areas reported that bed nets were not used regularly because of heat, smell, and sense of constraint and discomfort (the net may smell or feel hot or 'stuffy').

Consistent with the village study, the wider survey revealed that bed net ownership

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Table 4. Methods of keeping mosquitoes away in rural households, combinations of methods

Method/combination of methods	No. of households ($N=255$)	% of households
Mosquito coil only	53	21
Bed net and coil	41	16
Drive away with cloth only	34	13
Bed net only	20	8
Bed net, coil and insecticide spray	14	5
Bed net, coil and drive away with cloth	13	5
Various other combinations*	80	31

*Twenty-four other single methods or different combinations of methods were used in households visited, each involving 3% or less of households.

Table 5. Methods of keeping mosquitoes away, urban households, combinations of methods

Method/combination of methods	No. of households ($N=214$)	% of households
Mosquito coil only	46	21
Spray and coil	31	14
Drive away with cloth only	28	13
Spray only	16	7
Coil and drive away with cloth	12	6
Coil and burn herbs	10	5
Spray, coil and mosquito netting on doors and windows	8	4
Spray and drive away with cloth	8	4
Others*	55	26

*All other methods and combinations ($N=21$) used by individual household; each $<4\%$.

was far higher among rural respondents (237/256) than urban respondents (34/213). In addition, rural households owned more nets per household than urban households. In many rural households all adults had their own nets, and in some cases children also had individual nets. Numbers of nets per household ranged from 1 to 26 nets in rural areas, reflecting household size (mean number of nets 4, compared with 1 [range 1–3] in urban households).

In the survey, in rural households where there were bed nets, 56% of people reported sleeping under the nets; in urban households, only 6% did so – that is, less than 3% of all urban dwellers surveyed. Table 6 illustrates which household members slept under nets and draws attention to the distinction that needs to be made between

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Table 6. Use of bed nets in households with nets, rural and urban survey respondents

Who sleeps under a net?	Urban	Rural	Total
Children	16	2	18
Adults	1	3	4
Mother and child/the elderly*	6	9	15
All household members	6	217	223
No one	2	2	4
Non responses	1	4	5
Total	34	237	271

*Only one case in the rural area where the net was reserved for the elderly. All other cases in this group were mother and child.

household ownership and personal use of bed nets. In urban areas, in households with nets, the nets were used predominantly for children (64%) or for children with their mother (24%). In rural areas use of nets was more common and where restricted, this was mostly to mother and children (50%).

The disconcordance noted between universal use in the qualitative research study and a proportion sleeping without nets in the survey may be explained by timing of data collection. The qualitative research in both rural and urban areas was conducted at the end of the rainy season, when mosquito density as well as malaria transmission was very high; the survey was conducted during the dry season when there were far fewer mosquitoes. It is possible that some people use bed nets periodically and seasonally rather than year round. Consistent with other studies (Aikins *et al*., 1993; Klein *et al*., 1995; Thomson *et al*., 1996), people often found nets hot and sleeping conditions stuffy, and because the nets were used to prevent nuisance mosquitoes, changes in mosquito density and changes in temperature affected net use.

Willingness to pay

Bed nets have gained support as an intervention to prevent malaria mortality and morbidity because of their cost-effectiveness (Kere & Kere, 1992; Picard *et al*., 1993). Calculations made may include non-cash costs and indirect costs associated with illness and the intervention, such as hours lost during mourning and costs of funeral ceremonies for malaria-related deaths, or time spent on the implementation of an intervention. However, these calculations do not necessarily reflect community perceptions of cost, and even where there are clear cost savings at a community and household level, people may not be willing to pay (MacCormack, Snow & Greenwood, 1989; Picard *et al*., 1993; Helitzer-Allen *et al*., 1993).

At the time of this study, bed nets in Ghana cost from around 3000 cedis (US $6.70 at the time of the study) for a cheap net, up to 6000 cedis (c. US $13.40) for a good-quality, durable cotton net which might last as long as 10 years. Although bed

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nets are expensive and incomes low in rural areas, ownership was, as noted, near universal, and in any house, two or three nets might be mounted to the wall or a ceiling beam, depending on the number of householders and the sleeping arrangements within the house.

In interviews, women told us that as soon as a young girl began to earn money, she would plan to buy her own bed net. Women were inclined to save for nets and to replace old, torn nets, and to borrow for other cash expenses including treatment-related costs. In pursuing the priority accorded net purchase, women were asked which they would buy – a bed net or a cloth (both around the same price) – if they had the money; and women unanimously chose the net: 'I will buy the net to get a good sleep and the peace of mind to think of how to buy the cloth.' However, it is also possible that in rural areas higher net ownership (as opposed to use) may relate to the prestige value of the nets, their ownership being analogous to the accumulation of fabric to make the traditional *kaba* and *ntama* (wax print cloth) as an investment and a sign of wealth and prestige rather than (or in addition to) practical purposes.

Both in rural and urban areas in our study, people have little income either because they are engaged predominantly in subsistence agriculture or because the work they do pays poorly and/or is available sporadically. In rural areas, the outlay for new nets is substantial. Where ready cash is not available at times of crisis (e.g. sickness), people may borrow either from kin or friends, depending usually on the cordiality of the relationship and the assessment of the financial status of the lender. Loans are paid without interest, and borrowers may renegotiate the period to repay, preferring to repay in full rather than to pay off the debt over an extended period. Cloth, jewellery or other items of value may be left with the lender as security.

In urban areas, as noted, cash is primarily used for daily expenses (food, medicine, rent). Limited savings are used for clothing, and then for prestige and leisure consumables (e.g. cassette players and tapes). Borrowing and credit facilities are limited and the absence of kinship networks among immigrants further restricts the number of people from whom they might borrow. Hence urban residents tend not to purchase bed nets, but prefer to pay small amounts of money on a regular basis for mosquito repellents. However, choice of method of mosquito repellent is driven by pragmatic considerations rather than cost. While respondents mentioned capital outlay as a disincentive to use bed nets, their preferred methods of repellent were not inexpensive: a can of mosquito spray costs about 1100 cedis (c. US $1.60) and an electric fan 13,400 cedis (US $20). Fan ownership may have prestige value. However, the high use of coils suggests that a primary factor explaining the response is time of day when protection is required; that is, the need to repel mosquitoes occurred at a time when people were still awake and sitting outside – eating, chatting, and so on. Indeed, most people (50% of all survey respondents) perceived mosquitoes to be a problem from early evening (5.30pm onwards) when bed nets would have been of little value. Methods of repellent are of course effective for various mosquitoes, and in the urban area especially, *Culex* is a major problem (Ghana, 1992).

Conclusion

The development of effective IEC (information, education and communication) material to support behavioural interventions requires good community-based data.

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The Kenyan community education programme, for instance, drew on extensive anthropological information and community survey data on the knowledge of disease transmission and prevention, perceptions of severity of the disease, and ownership and use of nets and sleeping patterns within households (Mwenesi, Harpham, Marsh & Snow, 1995a; Mwenesi, Harpham & Snow, 1995b), in order to design a health education programme to encourage bed net use. This kind of operational research is clearly relevant and necessary prior to any intervention, either at a household or community level.

To some extent, the argument for such operations research has been predicated on the need to identify informational 'gaps', thereby to develop IEC material that 'corrects' local belief systems in order to provide the rationale for preventive behaviour. In this study, health prevention was not accorded high priority where there was a need to set aside funds for this purpose, but as was noted in the introductory discussion, adherence to preventive practice also assumes shared understandings of cause and prevention. Discussions of bed net and related household interventions have also presupposed a direct and lineal relationship between knowledge and practice. However, behaviour that is protective of health may occur independently of any understanding of the relationship between behaviour and disease prevention.

This is very much the case in areas of Ghana where bed net use is high, not because of any association between nets and malaria, but because nets protect sleepers from nuisance mosquitoes. Conversely, failure to use (or own) bed nets relates not necessarily or directly to an association between the vector and disease; the decision regarding the method used to avoid mosquito bites appears to be influenced by people's own experience of period of exposure – that is, on the basis of practical reason. Rural dwellers tended to use bed nets to ensure they slept, when mosquitoes were active during sleeping hours. The rural communities surveyed did not have electricity and people tended to retire early, with the possible additional advantage of a longer period of time under bed nets compared with urban dwellers. In urban Accra, people claimed to reject nets because of the cost, but in fact used coils and repellents in the early evening when nuisance mosquitoes were most dense.

The issues involved in identifying patterns of net ownership and use open up a number of behavioural, social, cultural and economic issues. Household and family organization, access to resources, and decision-making within the household are all relevant in terms of allocating scarce cash resources for the purchase of nets: for example, sleeping patterns within the household might see some but not all householders protected, as well as being relevant where sickness occurs. The fieldwork on which this paper is based highlights the value of determining both rationale for action and prevalence of such action, although the cross-sectional nature of this work has limitations given seasonal variation in temperature, rainfall and vector density. Even so, the approach illustrates the value of the use of multiple methods both to document people's knowledge base of illness, aetiology and prevention, and to identify the motivational, contextual and practical factors that influence their behaviour in terms of disease prevention.

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