

Use of insecticide-impregnated bed nets in Gambian primary health care: economic aspects

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Village-wide use of permethrin-impregnated bed nets, compared with placebo-treated nets, has reduced clinical attacks of malaria by 63% in the Gambia. Costs were calculated for nets made by local tailors and for their treatment with insecticide in the villages, as well as for targeted chemoprophylaxis and back-up treatment for fever, in a comprehensive malaria control strategy through primary health care. The villagers' preferences for bed net fabrics and willingness to pay for them, and their preferences for various items of expenditure by ranked order, age group, and sex are given. Ethnic differences in the use of bed nets are also discussed.

Bed nets for malaria control

Before the start of the 1987 rainy season, nets were provided for use on every bed in 16 Fula villages situated between the north bank of the River Gambia and the Senegal border, near the market town of Farafenni. In 7 of these villages all the nets were treated with permethrin (0.5 g/m²); the remaining 9 villages received placebo-treated nets. The incidence of clinical attacks of malaria was subsequently reported to have been reduced by 63% in children who slept in the villages where everyone used a permethrin-treated net (10).

Although insecticide impregnation of all bed nets in a community appears to reduce malaria transmission enough to have an impact on morbidity, antimalarial drugs are still needed for treating some febrile episodes, and there may be an advantage in using malaria chemoprophylaxis for vulnerable groups during the rainy transmission season (1). Whatever malaria control strategies are adopted by the Gambian government, these will have to be carried out through a primary health care structure of community health nurses and village health workers within a severely constrained national health budget (2). Some tasks like the distribution of antimalarial drugs may be carried out through the government services, while others such as the provision of bed nets may be managed by the private sector with guidance from health workers. A comprehensive malaria control strategy may thus involve both the private and public sectors. This paper

describes the situation of supply and demand of bed nets from a community perspective.

Costs

The principal malaria vector is *Anopheles gambiae* s.l., a night-biting mosquito that prefers human blood and tends to rest indoors after feeding. The use of insecticide-treated bed nets is a focused intervention, which requires far less insecticide for impregnating about 10 square metres of light nylon netting than for spraying the interior of a whole house. Delivery is also cheaper since there is no need for spray equipment, spray teams, extra vehicles, etc.

To calculate the local cost of bed nets, we interviewed 154 people in 1985 in a large Mandinka village where 98% of the inhabitants were using locally-made nets at the time of a baseline study. We asked them how long they had been using their current net, assessed its degree of wear, and estimated that the average net lasted about 6 years. We were told that replacement of a net would cost about 55 Gambian dalasis (US\$ 9.00); the cost of using a bed net was therefore about \$1.50 per year. Later, in December 1987, the average local cost rose to about 66 dalasis (US\$ 10.50), or \$1.75 per year. One treatment of the net with permethrin (0.5 g/m²) in 1985 cost US\$ 0.30, and about the same in December 1987; therefore the cost per year for the use of an impregnated bed net was \$2.05. Since children in the Farafenni area have about one episode of malaria per year, one must add the cost of chloroquine treatment (about 1.00 dalasi (\$0.16) per year) and chemoprophylaxis with pyrimethamine-dapsone (Maloprim) which is used for non-immune children and pregnant women during the transmission season (June to November); the latter costs \$0.56 per year

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for a child over one year or \$0.28 for a younger child. Thus the total cost (for a child aged over one year) of using a permethrin-treated net, plus chemoprophylaxis and back-up treatment would be about \$2.77 per year. However, it is common for two or more children to share one bed and its net so that the cost of coverage with an impregnated net per child per year drops to about \$1.05. If chemoprophylaxis was limited to the wet transmission season only (1), the cost for a child aged over one year would be about \$0.19. Thus, the overall cost per child could be about \$1.24. Depending on the size of the family, the aggregate cost for each household could be \$6.00 to \$10.00 per year. When transmission is reduced, the cost of chemotherapy will similarly be reduced but by what amount is difficult to forecast.

Provision of bed nets

Numbers needed. When all the beds in a community are covered by insecticide-impregnated nets the mass killing effect on the mosquito population is optimal (3). As the target populations for protection are semi-immune children under the age of 10 years, impregnated nets will be needed for most of the beds in the community because children under about 18 months old sleep with their mother, and the older ones sleep with a same-sex sibling, grandparent or other relative. Of 99 children surveyed in 1985, 39% were sleeping with a parent or adult relative, 45% with an older sibling, and 16% in their own bed. The survey identified 8% of Wolof and 24% of Fula children who slept on a low platform of millet stalks or sticks without a grass mattress, and 8% of Fula children who slept on a goatskin or a piece of sacking on the floor. In both cases there was no mattress under which to tuck a bed net, and if the millet stalks were not covered by even a mat, the child was vulnerable to bites from below (4). Therefore, in these cases the protective intervention should include a local type of mattress (usually sacking filled with grass) as well as an impregnated net. When the treated nets are laid upon these mattresses to dry, some of the permethrin soaks into the mattress and gives protection from other nuisance insects, and may even protect a child from mosquito bites from below in a bed that has no adequate mattress (5).

Fabric preferences. If the Gambian government should recommend the use of impregnated bed nets these could be imported (from Europe or Asia) or produced locally. In either case, if people must buy their own nets both local demand and cultural considerations should be taken into account.

Observations on the types of nets made by local tailors and those used in the non-intervention villages showed that the four most common fabrics

were terylene lawn, polyester jersey, rayon sheeting, and open nylon netting. The first three are opaque light sheeting or fine knitted jersey, and the fourth is the fabric of choice for industrial producers of bed nets. Samples of these four fabrics were shown to 134 adults in 12 Fula villages to assess their preferences. In 6 of these villages everyone had already been given nets made from open nylon netting, but only 15% of the people interviewed chose this fabric; other preferences were 54% for terylene lawn, 23% for polyester jersey, and 7% for rayon sheeting.

The heavier opaque fabrics were preferred because they lasted longer, through many washings, and were strong enough to protect against rats, lizards and snakes from entering the bed or from dropping their faeces and urine from the thatch roof. In these villages most of the beds are made of sticks and millet stalks with projecting ragged points which could easily tear a fragile net, especially when the beds are occupied by playful children. Opaque fabrics were also preferred because they provided privacy in rooms with more than one bed, kept out dust blown by the harmattan winds, and were considered attractive. Some 15% preferred open netting fabric because it weighed less and was easier to wash, looked attractive, and was cooler to sleep under; in contrast, others said that the opaque fabrics kept them warmer in the cool hours before dawn. With regard to colour, 129 (76%) persons preferred white, 23 (4%) said blue, and 18 (10%) gave other colours.

Differences between ethnic groups. Bradley et al. reported that nets were used in the Farafenni area by 99% of Mandinka, 64% of Wolof, and 58% of Fula ethnic groups (6). We also found marked differences in preference for nets by ethnic group (4). While the Mandinka, Wolof and Fula villages are found interspersed in a similar ecological setting, we were not able to quantify the subtle differences in their economies. All three ethnic groups grow millet, groundnuts, rice and other crops, and keep goats, sheep, cattle and other animals. Mandinka tend to grow more rice and groundnuts that are easily marketed for cash; they may also have more relatives in urban areas who remit some earnings to their ancestral village. Although the Gambian Fula also live in sedentary agricultural villages, they tend to keep more of their wealth in herds which are not readily sold for cash but are used for bridewealth transactions and other social purposes. Compared with Mandinka they tend to marry more within their own ethnic group, are more self-contained, and slightly less likely to migrate to areas of urban employment.

In 1985 all 81 adults, randomly selected in a Mandinka village, said they would be willing to pay the local market price for a bed net and that they

already owned one; of 77 adults in a nearby Wolof village, 74 (96%) said they would not buy one; and in a nearby Fula village 49 out of 52 adults (94%) said they would not buy one. We concluded that the ethnic differences were not only due to economic constraints but also to such cultural factors as Mandinka sleeping habits and the need for privacy, the provision by Mandinka husbands of bed linen including a net as part of marriage exchanges, and Fula preferences for being unencumbered with goods so that they might move with their herds whenever necessary (4).

In the 1987 trials of permethrin-impregnated bed nets in 16 Fula villages the population had been monitored epidemiologically, and also in terms of the distribution of bed nets as an intervention in villages where few had wanted them in the past.

Fula hamlets study. In 1985, only 6% of adult Fula in a randomly chosen village said that they had a net or would be willing to buy one. In 1986, unimpregnated bed nets were given to everyone in 7 of the 16 Fula intervention villages. Near the end of the rainy season in 1986, we surveyed 12 villages (six with and six without nets) and found a marked increase in willingness to pay the local market price of 55 dalasis (US\$ 9) (77 out of 83 (93%) and 81 out of 87 (93%) in the villages with and without nets, respectively).

When questioned about their likes and dislikes regarding bed nets, virtually all appreciated the protection from biting insects. A list of identified advantages and disadvantages, according to the responses, is given in Table 1 and Table 2, respectively.

In 1987, after the distribution of nets to the inhabitants in the 16 Fula villages (in 7 villages the nets

were impregnated with permethrin and the rest were treated with a placebo), the mothers were asked to comment on the nets. Of the 106 mothers in the permethrin group, 103 (97.2%) said they liked the treated nets very much because they were effective against nuisance insects including bed bugs and lice, and they requested that the treatment should be continued. Only 12 out of 121 mothers (9.9%) in the placebo-treated group made similar positive comments. Thus, the demand for permethrin-impregnated nets in the intervention villages may be said to have resulted from satisfaction in using them.

To investigate seasonal variation in the households' capacity to purchase bed nets, we questioned a random selection of 170 men and women in 12 of the Fula project villages. All replied that the dry season was the time of year when they would buy a net. Although the mosquito nuisance and malaria occur in the wet season, presumably stimulating the desire for protection, households have nearly used up their grain stores from the previous harvest and may be facing a shortage of food and money as they farm intensively and wait for the crops to ripen (7). Only in the post-harvest dry season, when the surpluses have been marketed, can they afford health-related and other purchases (8).

Expenditure preference survey

Survey design

Bias may be introduced by direct questions on the willingness to pay for bed nets in an area where villagers had heard about a bed nets project. Therefore we conducted an expenditure preference survey as an indirect measure of Fula intentions to purchase household items, including a bed net. Project villages

Table 1: What is liked about bed nets

Response	Villages using nets (n = 83)		Villages without nets (n = 87)	
	Number of responses	%	Number of responses	%
Protects from insects (100% of respondents)	83	51	85	45
Barrier against dust and droppings from roof	32	20	28	15
Protects from cold in very early morning	26	16	12	6
Protects from lizards, snakes, etc.	11	7	27	14
Looks attractive	9	5	23	12
Gives privacy	2	1	15	8
I feel secure	1	1	0	0
Nothing liked	0	0	1	1
Total	164	101	191	101

Table 2: What is disliked about bed nets

Response	Villages using nets (n = 83)		Villages without nets (n = 87)	
	Number of responses	%	Number of responses	%
Nothing disliked (77% of respondents)	64	75	52	57
Not large enough for the bed	10	12	15	16
Flaps at entrance do not overlap enough	7	8	2	2
Tears easily	3	4	3	3
Not high enough (not enough drop)	1	1	1	1
Gets dirty (extra work to wash)	0	0	12	13
May be too hot in the dry season	0	0	5	6
Not interested in it	0	0	1	1
Total	85	100	91	99

were surveyed in 1986, before nets had been given to everyone and before any nets had been treated with permethrin. The rains had come, people had planted, and it seemed the harvest would be good, with some surplus to market. In two-stage random sampling we selected 12 out of the 16 project villages, then randomly selected the residential compounds within these villages and interviewed every available member aged 10 years and above. The 170 interviews constituted a 10.5% sample of the total study population.

We asked a single open-ended question: "If you have a good harvest this year what are the most important purchases you will make?" The first item named was ranked as the first preference. People were encouraged to give at least two further choices. In a second stage we coded the responses into categories.

Preference categories

The clothes and adornment category included clothing, shoes, and jewellery; even a gold tooth was mentioned by two women. House furnishings included iron beds, foam mattresses, bed sheets, bed mats, and chairs. Animals mentioned most often were goats and sheep but a few desired cattle or a plough horse. Food as the first choice usually meant an adequate quantity of staple grain, especially millet, to see the household through the year. As a second or third choice was given rice, which is seldom grown in the environment of these villages, as well as meat, fish and oil which give variety to the diet. Ceremonies among the Fula, which include feasting, are related to (1) rites of puberty, marriage, death, etc., and (2)

certain Muslim religious holidays. Gifts were most often given to show love and respect for elders, or affection, especially of a young woman for her younger 'sister' (sister or cousin), or as a duty, e.g., when a husband provides clothes for his wife and children. Some savings were for anticipated health or school needs; others for immediate needs, such as treatment for infertility, or the purchase of school books.

Findings

Table 3 gives expenditure preferences by ranked order, age group and sex. House furnishings, the category including bed nets, were mentioned as the first choice by 32 people (19%), compared with 18 (10%) whose first choice was to buy animals and increase their herds. Among married people aged 20 to 39 years who had homes, household items were mentioned 48 times (23%), compared with animals 30 times (14%). With increasing age, preference for furnishings decreased as preference for animals increased. Women mentioned house furnishings 90 times (28%) compared with animals 34 times (10%); among men the preferences were, respectively, 15 times (8%) and 43 times (23%). We did not investigate how much cash the women actually control, or how much influence they have in household expenditure decisions, but we do know that some of the women carry out farming, especially of rice, and some own goats, sheep and even cattle.

In whatever way the responses are analysed, health is given low priority among the items of expenditure.

Table 3: Expenditure preferences by ranked order, age group, and sex, based on the responses of 510 Fula villagers

	Preference			Age group			Sex		Total
	First choice	Second choice	Third choice	10-19 years	20-39 years	≥40 years	Female	Male	
Clothes and adornments	82 (48) ^a	48 (28)	36 (21)	59 (44)	71 (33)	36 (22)	120 (37)	46 (25)	166
House furnishings	32 (19)	37 (22)	36 (21)	30 (22)	48 (23)	27 (17)	90 (28)	15 (8)	105
Animals	18 (10)	30 (18)	29 (17)	13 (10)	30 (14)	34 (21)	34 (10)	43 (23)	77
Food	6 (4)	3 (2)	20 (12)	3 (2)	15 (7)	11 (7)	10 (3)	19 (10)	29
Cooking utensils	2 (1)	14 (8)	11 (6)	7 (5)	15 (7)	5 (3)	26 (8)	1 (1)	27
House improvements	12 (7)	8 (5)	7 (4)	2 (1)	10 (5)	15 (9)	9 (3)	18 (10)	27
Agricultural implements	3 (2)	5 (3)	1 (1)	2 (1)	4 (2)	3 (2)	1 (0)	8 (4)	9
Ceremonies and hospitality	3 (2)	4 (2)	3 (2)	0 (0)	4 (2)	6 (4)	2 (1)	8 (4)	10
Savings, school and health items	3 (2)	7 (4)	12 (7)	7 (5)	8 (4)	7 (4)	18 (6)	4 (2)	22
Gifts and alms	2 (1)	6 (4)	5 (3)	5 (4)	4 (2)	4 (2)	6 (2)	7 (4)	13
Trade and business	1 (1)	4 (2)	0 (0)	0 (0)	2 (1)	3 (2)	0 (0)	5 (3)	5
Taxes and debts	6 (4)	2 (1)	1 (1)	0 (0)	0 (0)	9 (6)	0 (0)	9 (5)	9
No further choice	0 (0)	2 (1)	9 (5)	6 (5)	2 (1)	3 (2)	8 (2)	3 (2)	11
Total	170 (101)	170 (100)	170 (100)	134 (99)	213 (101)	163 (101)	324 (100)	186 (101)	510

^a Figures in parentheses are percentages.

Discussion

In some parts of West Africa physical barriers against night-biting insects have been used for centuries or longer (9). In these areas the introduction of tailored bed nets, especially after insecticide impregnation, appears to be viewed as an improvement. People are more willing to pay for innovations which they have experienced as a positive comfort and health benefit. Among ethnic groups who have not used bed nets, we must be cautious of the kind of generalization often expressed in the Gambia, such as "the Fula will only spend money on cows". Fula expressed in this survey an intention to make a wide range of purchases. In the intervention study, once they experienced the benefits of impregnated bed nets, including the health impact on their children, demand appears to have been stimulated. Whether the Fula in non-intervention villages will hear of the benefits and spontaneously buy their own nets to be treated with permethrin, or whether the government (perhaps through donors) will need to subsidize the first round of purchases of bed nets is not known. The latter is a more certain approach if impregnated nets should be included within the nation's broad primary health care plan.

We would recommend local production of bed nets because it is an income-generating activity involving the grass roots of the rural economy. Tailors, responding to consumers' preferences, are providing the kind of nets people want to buy, including those that will fit the different sizes and shapes of beds in use. However, primary health care workers have a role in advising villagers on such

matters as ensuring sufficient overlap on the net's opening side, and adequate length to allow the net to be tucked under the mattress. Permethrin treatment of nets can also be done locally, with primary health care workers assisting village women (10).

In areas with marked seasonal malaria transmission (e.g., in Gambia during the wet season), the most effective control strategy will probably be a combination using impregnated bed nets and anti-malarial drugs (1). But what is the proper mixture of public and private provision of services? If bed nets should be purchased by households from the private sector, then some stimulation of demand for permethrin-treated nets among people who have not used nets may be necessary. This may have to be funded by the government, perhaps with assistance from donor agencies. As for antimalarial drugs, it is doubtful whether families have sufficient cash to pay for them in the rainy season when they are needed (8). However, at present the government's policy is to charge a fee.

Acknowledgements

This investigation was supported by the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases. We would also like to thank all the field staff at Farafenni and the villagers for their support, as well as Dr Steve Lindsay.

Résumé

Utilisation de moustiquaires imprégnées d'insecticide en Gambie dans le cadre des soins de santé primaires : aspects économiques

On a constaté que l'utilisation généralisée, à l'échelon du village, de moustiquaires de lits imprégnées de perméthrine, comparée à celle de moustiquaires traitées avec un placebo, réduisait de 63% les atteintes de paludisme clinique en Gambie. On a calculé le coût des moustiquaires fabriquées par des tailleurs locaux et de leur imprégnation à l'aide d'insecticide dans les villages mêmes, ainsi que celui d'une chimioprophylaxie ciblée et d'un traitement complémentaire des malades, en vue d'établir une stratégie globale de lutte contre le paludisme dans le cadre des soins de santé primaires.

Une enquête menée dans 12 villages a permis de savoir quels étaient les tissus préférés par les villageois pour la fabrication des moustiquaires, de déterminer dans quelle mesure ils étaient prêts à payer pour s'en procurer, et quels étaient les postes de dépenses qu'ils considéraient comme prioritaires (vêtements, ameublement, animaux, aliments et ustensiles de cuisine, amélioration du logement, etc.), par groupe d'âge et par sexe.

Le coût global de l'utilisation de moustiquaires imprégnées de perméthrine a été évalué à US\$ 6-10 par foyer et par an, selon la taille de la famille.

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Reprint No. 4969