## Do untreated bednets protect against malaria?

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## Abstract

Bednets are thought to offer little, if any, protection against malaria, unless treated with insecticide. There is also concern that the use of untreated nets will cause people sleeping without nets to receive more mosquito bites, and thus increase the malaria risk for other community members. Regular retreatment of nets is therefore viewed as critical for malaria control. However, despite good uptake of nets, many control programmes in Africa have reported low re-treatment rates. We investigated whether untreated bednets had any protective benefit (in October and November 1996) in The Gambia where nets, although widely used, are mostly untreated. Cross-sectional prevalence surveys were carried out in 48 villages and the risk of malaria parasitaemia was compared in young children sleeping with or without nets. Use of an untreated bednet in good condition was associated with a significantly lower prevalence of *Plasmodium falciparum* infection (51% protection [95% CI 34–64%], P < 0.001). This finding was only partly explained by differences in wealth between households, and children in the poorest households benefited most from sleeping under an untreated net (62% protection [14–83%], P = 0.018). There was no evidence that mosquitoes were diverted to feed on children sleeping without nets. These findings suggest that an untreated net, provided it is in relatively good condition, can protect against malaria. Control programmes should target the poorest households as they may have the most to gain from using nets.

Keywords: malaria, Plasmodium falciparum, disease control, vector control, bednets, children, poverty, The Gambia

## Introduction

Treating mosquito nets and other fabrics with insecticides makes them an effective method of reducing malaria attacks and deaths (ALONSO et al., 1993; LENGELER, 1998). Whilst malaria control programmes in Africa have reported good uptake or purchase of nets, very few people, for a variety of reasons, re-treat their nets (WINCH et al. 1997; SNOW et al., 1999). For example, despite a long history of net use in The Gambia, and a national impregnation programme (NIBP) since 1992, fewer than 15% of nets are regularly retreated (CHAM et al., 1997). In practice, this means that large numbers of people are sleeping under untreated nets. It is thus important to know whether these people are protected against malaria.

An intact net, if used correctly, can provide an effective barrier to mosquitoes (PORT & BOREHAM, 1982; LINES et al., 1987; LINDSAY et al., 1989; BURKOT et al., 1990), but whether the reduction in biting is sufficient to reduce malaria infection and morbidity rates in the human population is not clear. No study has convincingly demonstrated a protective effect for bednets that have not been impregnated with insecticide. Only 3 randomized intervention studies have been carried out. In community-based trials, children in villages using untreated nets had 38% fewer clinical attacks in The Gambia (SNOW et al., 1988), and 33% fewer in Tanzania (MAXWELL et al., 1999). Neither result, however, was statistically significant. In only one trial has a significant difference in the incidence of malaria attacks been seen (NEVILL et al., 1988), but the possibility that this difference was due to increased infection among the control children, who slept in the same room as those using nets, cannot be ruled out.

Now that the enhanced impact of impregnated nets has been demonstrated, further randomized trials of untreated nets are unlikely, and the question of whether untreated nets can protect against malaria may never be definitively resolved. Evidence for a protective effect of untreated nets will remain poor, being based largely on anecdotal accounts and cross-sectional data, in which users of untreated nets were self-selected (BRADLEY et al., 1986; CAMPBELL et al., 1987; LINDSAY &

GIBSON, 1988; GENTON et al., 1994; D'ALESSANDRO et al., 1995). In these studies, confounding by other factors, such as wealth, could have been responsible for the lower prevalence observed among those that used nets compared to those that did not. It is also possible that the risk of transmission in non-net users was exacerbated because mosquitoes were diverted from users of untreated nets to feed on non-net users in the same house or village. In other words, the observed difference could have resulted from an increase of malaria among non-users rather than from a decrease among net users.

Previous analyses lacked data on confounders, such as socio-economic status, and other measures used to reduce mosquito biting. Data from a cross-sectional study carried out in The Gambia included this information, and thus provided an opportunity to take account of the most likely alternative explanations when we compared the risk of malaria infection in children sleeping with or without nets, and thereby re-evaluate whether untreated nets can protect those who sleep under them from malaria.

## Materials and Methods

Study area and population

Data were available from 48 villages in The Gambia, in a rural area with low-to-moderate malaria transmission concentrated in a single seasonal peak each year (LINDSAY et al., 1993). The study area was located about 200 km inland, and covered about 2500 km<sup>2</sup> (between UTM 410 000E and 480 000E) around the towns of Farafenni, Soma and Kaur. The population, described in more detail by AIKINS et al. (1993), comprises predominantly subsistence farmers of the ethnic groups Mandinka, Wollof and Fula. Villages are discrete units, typically consisting of a cluster of family compounds, composed of closely related households. Health services within the study area include: 4 government health centres and private pharmacies located in towns; government dispensaries in 10 villages; and primary health care (PHC) workers in the larger villages. Outreach clinics also operate once a month in 26 of the PHC villages, and are equally well attended by villagers from both PHC and non-PHC villages (HILL et al., 2000). A geographically stratified random sample (not proportional to size) was drawn from all villages

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