# Effect of large-scale social marketing of insecticide-treated nets on child survival in rural Tanzania

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## Summary

**Background** Insecticide-treated nets have proven efficacy as a malaria-control tool in Africa. However, the transition from efficacy to effectiveness cannot be taken for granted. We assessed coverage and the effect on child survival of a large-scale social marketing programme for insecticide-treated nets in two rural districts of southern Tanzania with high perennial malaria transmission.

**Methods** Socially marketed insecticide-treated nets were introduced step-wise over a 2-year period from May, 1997, in a population of 480 000 people. Cross-sectional coverage surveys were done at baseline and after 1, 2, and 3 years. A demographic surveillance system (DSS) was set up in an area of 60 000 people to record population, births, and deaths. Within the DSS area, the effect of insecticide-treated nets on child survival was assessed by a case-control approach. Cases were deaths in children aged between 1 month and 4 years. Four controls for each case were chosen from the DSS database. Use of insecticide-treated nets and potential confounding factors were assessed by questionnaire. Individual effectiveness estimates from the case-control study were combined with coverage to estimate community effectiveness.

**Findings** Insecticide-treated net coverage of infants in the DSS area rose from less than 10% at baseline to more than 50% 3 years later. Insecticide-treated nets were associated with a 27% increase in survival in children aged 1 month to 4 years (95% CI 3–45). Coverage in such children was higher in areas with longer access to the programme. The modest average coverage achieved by 1999 in the two districts (18% in children younger than 5 years) suggests that insecticide-treated nets prevented 1 in 20 child deaths at that time.

**Interpretation** Social marketing of insecticide-treated nets has great potential for effective malaria control in rural African settings.

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*See Commentary page 1219*

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## Introduction

Malaria remains the greatest threat to survival for young African children, causing at least 750 000 deaths each year.[1] In endemic areas, people of all ages have regular attacks throughout their lives, yet young children and pregnant women are most at risk of severe malaria and death. Malaria also contributes to other child deaths by affecting immunity to other diseases. Successful malaria control measures could therefore result in a larger reduction of deaths than that due to malaria alone.[2] African leaders and the international community have made a major commitment to prevention and treatment of malaria as part of the Roll Back Malaria (RBM) movement.[3]

Despite the huge malaria burden in Africa, there are alarmingly few control tools. Current policy options include prompt treatment of patients with an effective antimalarial drug, and malaria prevention through reduction of human–vector contact. Insecticide-treated nets are a practical malaria control tool with proven efficacy, but some fear a detrimental effect on immunity in long-term users.[4,5] In a meta-analysis of randomised controlled trials, insecticide-treated nets reduced overall child mortality by 19%.[6]

Despite this evidence of efficacy, the effectiveness of insecticide-treated nets on mortality in a programme setting has yet to be shown, especially in high-transmission areas.[7] Efficient delivery mechanisms are urgently needed, since the goal of RBM is to protect 50 million African children by 2005,[3] but the public sector alone is unlikely to be able to provide nets on a large scale. In an assessment of the only national programme of net treatment in Africa to date, d'Alessandro and colleagues[8] reported from The Gambia that communal net treatment distributed free of charge by regional health teams led to improved child survival. However, people were unwilling to pay for services that had once been free, and mortality rates returned to their previous values after the introduction of a cost-recovery programme.

The delivery mechanism of the private sector has the advantage of being universally available: soft drinks, beer, and soap reach the most remote areas of Africa. Large-scale net manufacturers in Tanzania sell their products through wholesalers to shopkeepers and petty traders in remote rural areas, so that untreated nets are not uncommon: nationwide, 13–17% of rural households with children were using nets in 1999.[9] However prices are commonly inflated, compromising equity, and there has been no distribution of insecticide for nets.

One large-scale model more appealing than either public or private sector alone is a public–private mix, with each contributing according to their strengths and skills, as advocated by the health-sector reform movement. For example, the public sector might be responsible for generic promotion, and creation and regulation of an enabling environment through the removal of taxes on insecticide-treated nets; and the private sector might be responsible for distribution and branded advertising.[10] Social marketing is a form of public–private partnership



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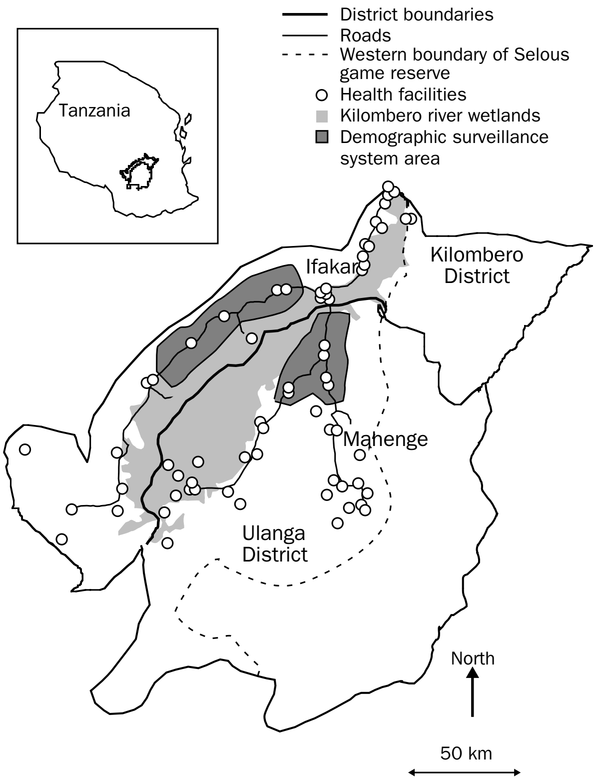


Figure 1: **Map of Kilombero and Ulanga Districts showing demographic surveillance area**

that uses a commercial marketing approach but without the motive of financial profit.[11] Social marketing usually involves subsidies to make insecticide-treated nets more affordable and accessible. Non-governmental organisations (NGOs) commonly take a lead, mediating between public and private sector.

In 1996, we developed a social marketing programme, known as KINET, for insecticide-treated nets in two rural districts of Tanzania (Kilombero and Ulanga), with the aim of achieving substantial and sustainable use of such nets in young children and pregnant women. The positive effect of insecticide-treated nets on malaria and anaemia in children is described elsewhere.[12]

Kilombero and Ulanga districts are in southern Tanzania, mainly in the flood plain of the Kilombero river (figure 1). The main rainy season is from November to May, although rain can fall in any month. About 480 000 people live in widely scattered households in 144 villages, grouped into divisions of about 14 villages each. The population is highly mobile: families often live in shamba (farm) areas several hours' walk from their homes for many weeks each year. Most villagers are subsistence farmers growing rice and maize. Ethnic groups include the Wandamba, Wapogoro, Wabena, Wambunga, and Wahehe. About 40% of the population are Muslim and 60% Christian. Transport is dependent on the TAZARA railway and an unpaved road network. Some villages are difficult to access for several months each year because of flooding. Despite fertile soil, food security is a problem: after two poor harvests in succession, there was a famine in Ulanga in 1998 during which food aid was distributed by the Tanzanian Government, Caritas, and the World Food Programme.

Malaria is the foremost health problem reported through the health services and perceived by local people, for both adults and children.[13] Malaria transmission by *Plasmodium falciparum* is intense and perennial. *Anopheles gambiae* and *A funestus* are the main vectors, with an estimated 200–300 infective bites per person per year in two villages within the area.[14] Life-threatening malaria occurs mainly in children, especially in those younger than 1 year.[15] Anaemia is very common in young children, with around two-thirds being attributable to malaria.[16]

During the study period, malaria control was dependent on treatment of fever cases with chloroquine. A 7-day parasitological failure rate of 65%[17] undermined the effectiveness of this national policy, which has recently been reviewed and now includes sulphadoxine-pyrimethamine as first-line treatment for fever cases. The public-health system has a network of dispensaries, health centres, and hospitals. Routine vaccination coverage is over 80%.

Here we report the effect of socially marketed insecticide-treated nets on child survival and coverage over 3 years of implementation.

## Methods

*Social marketing of insecticide-treated nets*

The social marketing was phased in from May, 1997, to June, 1999, starting in the 25 villages covered by the demographic surveillance system (figure 1) and reaching one or two more divisions every few months (figure 2). Treated nets and insecticide for net treatment were introduced together in each area. After sensitisation meetings in 1996, formative research studied householders' perceptions of causes of child death, mosquito nets, net treatment, and malaria.[18] Details of the social marketing programme are given elsewhere.[19] Briefly, treated nets (pretreated with 20 mg/m$^2$ deltamethrin, supplied by Siamdutch, Bangkok, Thailand; A to Z, Arusha, Tanzania; or TMTL, Dar es Salaam, Tanzania) and insecticide for net treatment at home (lambdacyhalothrin, Icon, Zeneca, Haslemere, UK) were packaged and branded according to local preferences. Sales agents in each village included health workers, shopkeepers, religious leaders, and village government members. At first, different agents were chosen for nets and insecticide, but, over time, many agents started selling both products. Successful agents were generally shopkeepers and a few health personnel. Every division had a wholesale agent.

A comprehensive information, education, and communication campaign was developed and implemented. Increased emphasis was given to the insecticide when it became clear that insecticide-treated nets were more popular than net treatment. Retail prices were set at around US$5 for a treated net and $0·42 for insecticide treatment kits. Retail prices of nets remained the same throughout the study period. Higher-dose net treatment kits were sold at $0·50 from February, 2000. In 1997, ex-factory prices were subsidised by about 25% for nets and 90% for treatment kits. By 2000, ex-factory prices had reduced: nets were sold without subsidy and treatment kits had a 40% subsidy. The cost of the information, education, and communication campaign, and distribution to wholesalers was about $1·70 per treated net or insecticide kit. Detailed information on costs will be presented elsewhere.

*Assessment of effect of insecticide-treated nets*

Data on insecticide-treated net coverage were obtained from various surveys. Figure 2 shows the time-line for the introduction of insecticide-treated nets and the cross-sectional surveys described below. All questionnaires were written in Swahili, the national language, which is very widely spoken throughout the study area.



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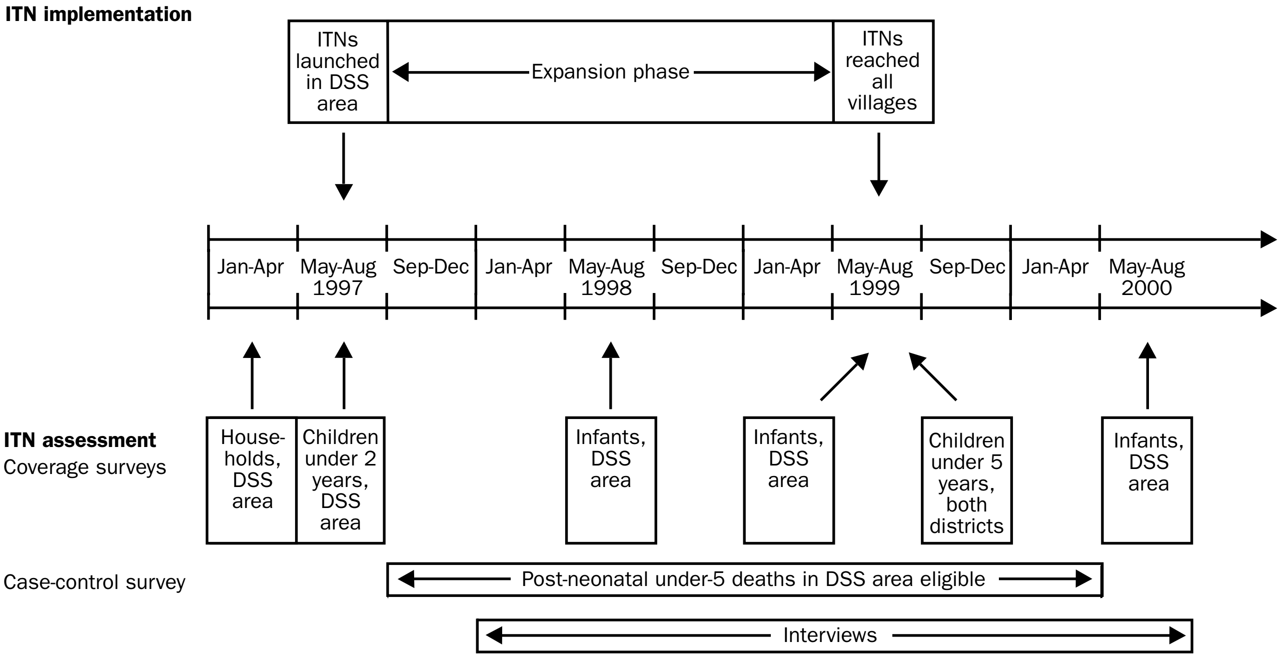


Figure 2: **Time-frame for social marketing implementation and assessment**
ITNs=insecticide-treated nets; DSS=demographic surveillance system.

A demographic surveillance system (DSS)[20,21] was established in the 25 villages (more than 60 000 people) where insecticide-treated nets were first launched in May, 1997 (figure 1). A baseline census was carried out from September to December, 1996. From January, 1997, a dedicated team of 30 full-time interviewers and supervisors visited every household every 4 months, recording information on pregnancy, birth, in and out migration, and death.

A baseline survey, in which all household heads were asked the number of nets in the household, was done in early 1997 in the DSS area. Insecticide for net treatment was not available at this time. In June, 1997, just after the launch of insecticide-treated nets in the DSS area, use of nets and insecticide-treated nets was investigated in a simple random sample of children younger than 2 years selected from the DSS database.[12]

Mothers of children born within the DSS area from January, 1998, to August, 2000, were interviewed within 12 months of the child's birth and asked whether the child had slept under a net the previous night and, if so, whether and when the net had been treated. These children were recruited to a cohort study of the long-term effects of insecticide-treated nets on child survival[19] for which field work will continue until 2003.

Coverage in children younger than 5 years was estimated through a cluster sample survey in Kilombero and Ulanga in July–August, 1999. 30 clusters of 20 households were chosen from Ulanga District, and 35 clusters of 20 households from Kilombero District. Villages were chosen with probability proportional to estimated population size, and 20 households were sampled using a modified expanded programme of immunisation scheme (details available from the authors). Mothers of children younger than 5 years were asked whether each child had slept under a net the previous night, and if so, when the net was purchased, whether it had ever been treated, and when it was last treated.

A case-control study within the DSS area was used to estimate the effect of socially-marketed insecticide-treated nets on child survival.[7] We compared reported use of nets and net treatment in each child who had died of any cause aged 1 month to 4 years (cases) with that in four children who were alive on the day the case died (controls). Information on insecticide-treated net use and other known risk or protective factors for child survival (potential confounding factors) was collected by questionnaire. Controls were chosen at random from children living in the DSS area, and frequency-matched on age (fixed categories of 1–5 months, 6–11 months, 1 year, 2 years, 3 years, and 4 years); village; season; and calendar time (week of study). Families of both the cases and controls were visited at home at least 6 weeks after the death of the case and, after obtaining verbal consent, a questionnaire was administered. For cases, questions related to usual insecticide-treated net use and other factors for a reference period of 1 month before the death, which was about 3 months before the interview. For controls, the reference period for questions related to the insecticide-treated net use and other factors was 1 month before the median date of death of the matching cases, and was about 3 months before the date of the interview. Questions on insecticide-treated net ownership were validated by comparing information reported during the case or control interview with that reported from the subset of these children who were interviewed in the infant coverage survey, using the κ statistic.[22] Further validation of these questions by direct observation is reported elsewhere.[12] Validation of insecticide on netting, by use of the only existing field test, was abandoned when we found the test was unreliable for coloured nets.[23]

An extensive list of potential confounders was grouped into five categories: measures of demographics and socioeconomic status included ethnic group, sex, religion, household size, other deaths in the household reported through the DSS, and proxy measures of socioeconomic status such as household ownership of a tin roof, bicycle, or radio, and the amount of rice harvested in the previous year; measures of health-seeking behaviour included maternal use of an antenatal clinic, child's use of a



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weighing clinic, vaccine coverage, and place of birth; accessibility of the household was assessed through time taken to reach the nearest health facility and drug-selling shop; household environment was assessed through questions on exposure to indoor air pollution from cooking fires or tobacco smoke, waste disposal, use of soap and latrines, and distance to, and type of, drinking water supply; and the child's care within the household was assessed through the number of people sleeping in the same room as the child, fostering, birth order, twinning, birth interval, place of birth and person attending delivery, mother's or guardian's age and marital status, mother's or guardian's educational level and literacy, and age at which weaning was started.

*Data analysis*

All data were double entered in FoxPro (Microsoft Corporation, Seattle, WA, USA) by two different data-entry clerks, and any errors were corrected with reference to the original forms. Range and consistency checks were also done on a regular basis.

Insecticide-treated net coverage, defined as the proportion of children who slept the previous night under a net which had ever been treated, was tabulated by year, with exact binomial CIs. Analysis of the infant coverage data was restricted to interviews in May–August for comparability with other surveys. Proportions were compared using $\chi^2$ tests or Mantel-Haenzsel $\chi^2$ tests. District-wide coverage in children younger than 5 years was tabulated by area. CIs adjusted for clustering were calculated with standard STATA commands such as svymean and svylogit (STATA version 5, TX, USA).

Estimates of the effects of treated nets allowing for matching variables were made with logistic regression models with case or control status as the outcome. Potential confounders were defined as variables which had a large or significant association with risk of death, where large was defined as an odds ratio between 1·5 and 0·67 and significant was defined as an effect with a likelihood ratio $\chi^2$ test statistic p value of less than 0·10. Confounding was assessed for each potential confounder in turn through comparison of adjusted and unadjusted effect estimates of treated nets: if these varied by more than 10%, the variable was regarded as a confounder. Interaction was assessed between net use and all other variables in the final model. Model robustness was assessed by use of $\delta$-$\beta$ influence statistics,[24] and fit was checked with the Hosmer-Lemeshow $\chi^2$ test.[25] Individual effectiveness[7] for insecticide-treated nets was defined as $(1-\text{odds ratio})\times 100$.

Community effectiveness of insecticide-treated nets was calculated as individual effectiveness (from the case-control study) multiplied by coverage.[7]

Post-neonatal mortality estimates from the DSS area in 1997 (73·3/1000 per year in infants and 12·9/1000 per year in children aged 1–4 years) were applied to district-wide population estimates for 1999 and then multiplied by the estimates of individual effectiveness and coverage to give an estimate of the number of deaths averted. The number of children younger than 5 years in each district was estimated from population data provided by the district health management teams multiplied by the proportion of post-neonatal children younger than 5 years in the DSS. Since we had no data on the effect of insecticide-treated nets on neonates, we made the conservative assumption that insecticide-treated nets had no effect on neonatal mortality. Effects of insecticide-treated nets on malaria and anaemia in pregnancy will be reported elsewhere.

Verbal consent for the interviews was sought from mothers or guardians. No interview was carried out within 6 weeks of the death of a child in keeping with the usual mourning period in this population. No physically invasive procedures were used. The study was approved by local and national ethical committees.

## Results

In early 1997, 3826 of 10 313 (37% [95% CI 36–38]) households in the DSS area had at least one net. In June, 1997, just after the launch of insecticide-treated nets in the DSS area, 140 of 240 (58% [52–65]) children younger than 2 years were using a net, and only 24 of 240 (10% [9–15]) were using a treated net.[12]

During May–August, 1998 (a year after the social marketing programme was launched in the DSS area), coverage of insecticide-treated nets in infants was 291 of 646 (45% [41–49]). 2 years later, in May–August 2000, insecticide-treated net coverage for infants had further risen to 541 of 1001 (54% [51–57]; p=0·0007). Insecticide-treated net use was more common in older infants than in neonates (56% *vs* 44% in May–August, 2000; p=0·003). There were minor seasonal fluctuations in insecticide-treated net use, with peaks during rainy months (data not shown).

Of 1235 households identified in the cluster survey in July–August, 1999, 61 (5%) were unavailable for interview and 11 (1%) declined to take part. 757 of the remaining 1163 had one or more children younger than 5 years, and the total number of such children was 1113. Insecticide-treated net coverage in the two districts was 18% (14–23) in children younger than 5 years. A further 28% (23–33) of children used a net that had never been treated. Insecticide-treated net coverage was similar in younger and older children (p=0·25). Coverage was higher in areas with longer access to socially-marketed insecticide-treated nets (Ulanga p=0·005; Kilombero p<0·0001). Figure 3 shows coverage in Ulanga and Kilombero Districts by area, in order of the time when the social marketing reached each area. About a third of insecticide-treated nets had been treated in the 6 months before the survey ("recently-treated"): overall in the two districts, 6% of children (4–8) used a recently-treated net.

All-cause infant mortality fell from 96 per 1000 livebirths in 1997 to 90 per 1000 livebirths in 1999. Child mortality (age 1–4 years) fell from 14·6 to 12·9 per 1000 per year over the same period. Overall there was a 16%

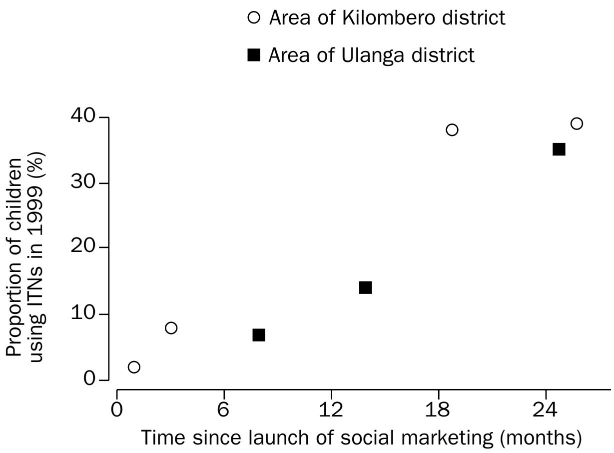


Figure 3: **Coverage of insecticide-treated nets in children younger than 5 years in July–August, 1999**

The two points with the longest time since launch of social marketing are in the DSS area.



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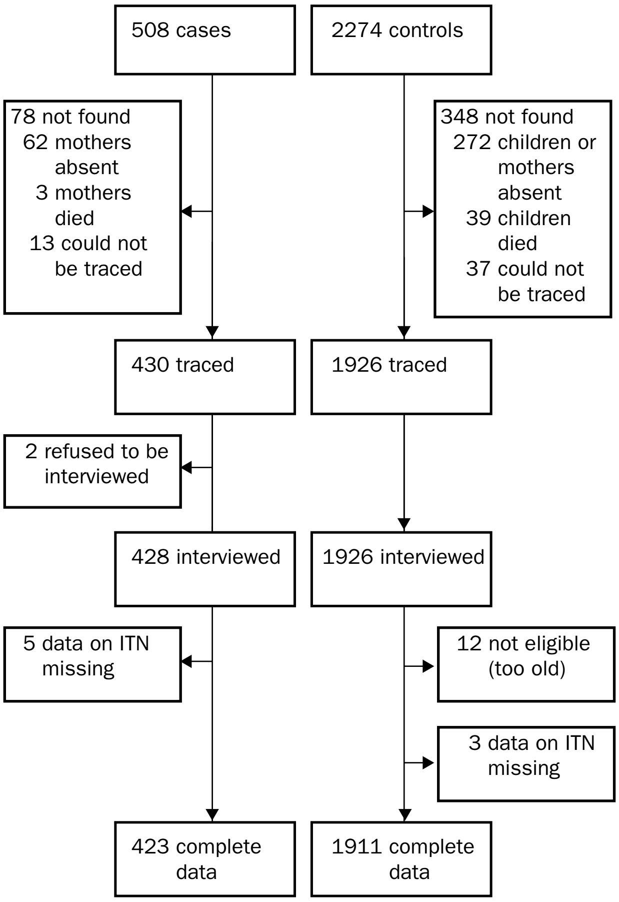


Figure 4: **Case-control study profile**
ITN=insecticide-treated net.

reduction in mortality in children younger than 5 years (rate ratio adjusting for age 0·84 [95% CI 0·7–1·0], p=0·06).

There were 508 deaths in children aged 1 month to 5 years in the DSS area between Dec 1, 1997, and April 2, 2000. Complete data were available on 423 (83%) cases and 1911 (84%) controls (figure 4). With this number of cases and controls and the measured level of insecticide-treated net coverage, the study had 74% power to detect an odds ratio of 0·75 as significant at the 5% level. The age profile of cases interviewed and those not interviewed was similar (data not shown). Table 1 shows age, sex, socioeconomic status, and the recall period for insecticide-treated net use for cases and controls. Table 2 shows use of untreated and treated nets among cases and controls, and the resulting odds ratio for the effect of net use on risk of death, adjusting for matching factors. The estimated individual effectiveness was 27% (3 to 45) for treated nets and 19% (−9 to 40) for untreated nets. The estimated effect of treated nets seemed to be slightly higher in nets treated within the previous 6 months (28% [2 to 48]) than in those treated longer ago (25% [−6 to 47]).

| | Cases (n=423) | Controls (n=1911) | p |
|---|---|---|---|
| **Age** | | | |
| 1–5 months | 119 (28%) | 476 (25%) | 0·46 |
| 6–11 months | 120 (28%) | 560 (29%) | |
| 1 year | 97 (23%) | 481 (25%) | |
| 2 years | 55 (13%) | 232 (12%) | |
| 3 years | 21 (5%) | 84 (4%) | |
| 4 years | 11 (3%) | 78 (4%) | |
| **Sex*** | | | |
| Male | 147/321 (46%) | 877/1686 (52%) | 0·04 |
| Female | 173/321 (54%) | 809/1686 (48%) | |
| **Socioeconomic status*** | | | |
| Tin roof, bicycle, or radio in household | 207/388 (53%) | 1006/1699 (59%) | 0·04 |
| **Median (IQR) days between death and interview** | 83 (52–133) | . . | . . |
| **Median (IQR) months between reference period† and interview** | 4 (3–5) | 4 (3–5) | 0·31‡ |

*Data collected through routine demographic surveillance system; some are missing.
†For cases, reference period was 1 month before date of death; for controls, reference period was 1 month before median date of death of matching cases.
‡Two-sample *t* test with unequal variances.

Table 1: **Descriptive data for cases and controls**

| | Cases (n=423) | Controls (n=1911) | Unadjusted odds ratio (95% CI) | p | Adjusted odds ratio* (95% CI) | p |
|---|---|---|---|---|---|---|
| No nets | 111 (26%) | 402 (21%) | 1 | | 1 | |
| Untreated nets | 125 (29%) | 578 (30%) | 0·78 (0·59–1·04) | | 0·81 (0·59–1·0) | |
| Treated nets | 187 (44%) | 931 (49%) | 0·73 (0·56–0·95) | 0·02 | 0·73 (0·55–0·97) | 0·04 |

*Adjusted for age, season, calendar time, and village, which were matching factors in the design.

Table 2: **Use of treated and untreated nets in cases and controls**

Other factors with an independent association with risk of death (p<0·05) were ethnic group; sex; child's use of weighing clinic; household size; being carried on the back while cooking; whether or not the child slept with the mother; fostering; maternal education; ownership of tin roof, bicycle, or radio; and age of weaning. Detailed information on these risk factors will be presented elsewhere. None of these factors nor any other large or significant factor investigated as a potential confounder (mother's use of antenatal clinic, vaccine coverage, use of latrines, place of birth, type of water supply, and amount of rice harvested the previous year) confounded the association of insecticide-treated net use with mortality. There was no evidence that the effect of insecticide-treated nets varied by age, season, village or calendar time (p=0·39, p=0·22, p=0·49, and p=0·75, respectively). In cases, cross-validation of information on insecticide-treated net use was done for children who had been interviewed for the insecticide-treated net coverage survey in infants less than 12 months before their deaths; 68 of 81 agreed (84%; κ=0·65). Similarly, in controls, cross-validation of insecticide-treated net use in children who were interviewed for the infant coverage survey within the same 3-month period as their case-control study interview showed substantial agreement (45 of 53 [85%]; κ=0·70).

Multiplication of individual efficacy (0·27) by coverage (0·18) gave a 5% estimated community effectiveness of insecticide-treated nets for mortality in infants aged between 1 month and 4 years in the two districts during mid-1999. 1999 coverage levels in the two districts resulted in the prevention of about 94 deaths each year in Kilombero and Ulanga, or 1·34 deaths per 1000 children per year. If the coverage and estimated effect of untreated nets were taken into account (acknowledging the wide CI for their effect) community effectiveness for nets in 1999 was about 10%.

## Discussion

We present results from the first assessment of a large-scale social marketing programme of insecticide-treated nets on child survival in Africa, in an area of high-intensity malaria transmission. We have shown that social



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marketing with a high cost-recovery level is an effective way to deliver insecticide-treated nets. More than half of all infants in the DSS area were sleeping under ever-treated nets in mid-2000—ie, 3 years after the start of the social marketing activities. Overall coverage of ever-treated nets in the two districts was 18% in children younger than 5 years in mid-1999. Since this period was only a few months after the activities had been introduced in some areas, this figure could be expected to rise with time. Insecticide-treated nets were associated with a 27% reduction in the risk of post-neonatal child death, which is compatible with findings from previous studies.[6] Combining this estimate with 1999 coverage suggested that treated nets prevented one in 20 post-neonatal child deaths at that time, this figure rising to one in ten if the effect of untreated nets was taken into account. Child survival in the DSS area increased between 1997 and 1999, supporting the positive effect of the insecticide-treated nets. These findings do not support the contention of no benefit of insecticide-treated nets in an area of very high transmission.[4,5]

Despite the DSS-based sampling strategy for the controls, our case-control study could still have the usual limitations of this type of observational research—eg, information bias, the difficulty of finding and interviewing mothers who have recently lost a child, inaccurate exposure assessment, and residual confounding. Our interview data on the exact timing of net treatment might be particularly liable to misclassification. However, we believe that our approach was a useful model for programme assessment in a situation in which no other suitable control group is available. Our coverage data made use of various surveys to maximise the available resources. Following the plausibility framework, which is the most feasible method for assessing effectiveness under real-life circumstances,[26] our current findings, together with those on malaria morbidity,[12] provide evidence to support a beneficial effect of socially-marketed insecticide-treated nets on child mortality and morbidity in this area of very high transmission. However, we were not able to study the effect of the insecticide-treated nets on malaria-specific mortality because most deaths occur beyond the reach of health services, and the bereavement interview or verbal necropsy is the only tool available to identify cause of death. Previous work[27,28] has shown the low sensitivity and specificity of verbal necropsy for malaria deaths.

We were encouraged by the rapid uptake of insecticide-treated nets despite low incomes (median monthly household expenditure in 1997 was between \$77 and \$96, 75% of which was spent on food),[21] and particular economic hardship due to a famine in early 1999. This finding demonstrates the success of social marketing as an NGO-mediated public–private partnership. Mutual mistrust is common between the profit-motivated private sector and the often-bureaucratic public sector: such worries were often voiced in our first village sensitisation meetings. However, after health education and promotion at government maternal and child health clinics, most of the nets and insecticide were purchased through small retail shops. Prices were widely advertised and there was usually more than one retail outlet in each village; social market prices were therefore generally adhered to by the retailers and perceived as fair by the customers.

The subsidies used in social marketing often raise questions about long-term sustainability. Will donors or governments be willing to continue financial support, or will users be expected to pay higher prices for insecticide-treated nets over time? Fortunately, costs of both nets and insecticide have decreased in recent years, so reduced subsidies have not led to higher retail prices. We argue that insecticide-treated net programmes should be partly public-financed in the interests of equity and efficient use of public funds.[29] Until permanently-treated nets become widely available, general insecticide subsidies remain appealing to try to increase coverage of net treatment. Targeted subsidies are another option to improve equity, for example through subsidised transport for insecticide-treated nets to remote areas or through price reductions for pregnant women or those with newborn children.

Uptake of net treatment was disappointing. Despite intense promotional activities and a relatively high subsidy, only a third of insecticide-treated net users had treated their nets in the previous 6 months. However, this proportion is substantially higher than the 20% or less seen in several previous rural African projects.[30] We investigated the reasons for the low uptake through focus-group discussions, and in-depth and informal interviews with community members, sales agents, and community leaders. The findings suggest that one reason for the low uptake is the lack of a visible benefit: there is no easy way of knowing when the insecticide has worn off (data not shown). Occasional unfounded rumours, for example of an adverse effect on male fertility, further reduced compliance, despite active health education.[18] Some users also felt cheated when they saw mosquitoes (unlikely to be malaria-transmitting *Anopheles* mosquitoes) near a recently-treated net. So-called permanently-treated nets have recently become available at similar prices to ordinary treated nets. Although the exact longevity of the insecticide remains to be established under real-life conditions, there is little doubt that the public-health benefit of these nets will be greater than self-treated nets. This technology needs to be accessible to African insecticide-treated net manufacturers: ideally all nets sold would be pretreated in a permanent way so that social marketing of net treatment would not be needed.

A Tanzanian national insecticide-treated net task force was formed in March, 2000, with the aim of making insecticide-treated nets available in all 116 local authorities in the country. Representatives from public and private sectors, NGOs, multilateral and bilateral donors, and the research community, chaired by the Director of the National Malaria Control Programme, have developed a strategic framework based on the creation of national-level demand. Supply of insecticide-treated nets will be based on the principles of social marketing. We have shown that this is a realistic and potentially sustainable mechanism for the delivery of the pledge made by African leaders at the Abuja summit in April, 2000.[3] If mortality rates and efficacy are similar in other parts of the country, our data suggest that a modest level of 30% insecticide-treated net coverage throughout Tanzania could be achievable within 3 years of the start of a national campaign, and could prevent up to 10 000 child deaths each year.

*Contributors*

S Abdulla, N Kikumbih, C Lengeler, H Minja, H Mshinda, R Nathan, J Schellenberg, and M Tanner conceived and designed the study. C Lengeler, H Mponda, and J Schellenberg developed and managed the social marketing intervention. S Abdulla, T Marchant, O Mukasa, and R Nathan managed the DSS and data collection within the DSS area. O Mukasa was responsible for data management. A Mushi and J Schellenberg managed the 1999 coverage survey in Kilombero and Ulanga. H Minja was responsible for social science aspects and N Kikumbih for economic aspects. J Schellenberg analysed the results and wrote the first draft. All investigators contributed to the interpretation of data and review of the paper, and contributed to the writing of the final draft.



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