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Prevalence and Correlates Of Insecticide-Treated Bednet Use Among HIV-1 Infected Adults In Kenya

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Abstract

HIV-1 infected adults are at increased risk for malaria. Insecticide treated bednets protect individuals from malaria. Little is known about correlates of ownership and use of bednets among HIV-1 infected individuals. We conducted a cross-sectional survey of 388 HIV-1 infected adults recruited from 3 sites in Kenya (Kilifi, Kisii and Kisumu) to determine factors associated with ownership and use of optimal bednets. We defined an optimal bednet as an untorn, insecticide treated bednet.

Of 388 participants, 134(34.5%) reported owning an optimal bednet. Of those that owned optimal bednets, most (76.9%) reported using it daily. In a multivariate model, higher socio-economic status as defined as post-secondary education [OR=2.8 (95% CI: 1.3–6.4), $p=0.01$] and living in a permanent home [OR=1.7(1.03–2.9), $p=0.04$] were significantly associated with optimal bednet ownership.

Among individuals who owned bednets, employed individuals were less likely [OR=0.2(0.04–0.8), $p=0.01$] and participants from Kilifi were more likely to use bednets [OR=2.9 (95% CI 1.04–8.1), $p=0.04$] in univariate analysis. Participants from Kilifi had the least education, lowest income and lowest rate of employment. Our findings suggest that lower socioeconomic status is a barrier to ownership of an optimal bednet. However, consistent use is high once individuals are in possession of an optimal bednet. Increasing access to optimal bednets will lead to high uptake and use.

INTRODUCTION

Emerging evidence suggests that HIV-1 infected adults are at higher risk of malaria than the general population (Laufer et al., 2006; French et al., 2001; Whitworth et al., 2000; Chalwe et al., 2009). HIV-1 infection decreases immunologic control of malaria, both as a result of declining CD4 T-cells and reduced malaria-specific humoral immunity (Stevenson et al., 2004; Langhorne et al., 2008; Stephens et al., 2006; Wabwire-Mangen et al., 1989; Dembo et al., 2008; Rogerson et al., 2010). HIV-1 related immunodeficiency may also result in poorer response to antimalarial treatment, although it is unclear if this effect is due to delayed parasite clearance, recrudescence, or re-infection (Rogerson et al., 2010; Laufer et al., 2007; Kamya et al., 2006; Van Geertruyden et al., 2006; Shah et al., 2006).

Insecticide treated nets (ITNs) have been shown to significantly reduce malaria incidence in populations at risk (Lengeler et al., 2004; Phillips-Howard et al., 2003; Hawley et al., 2003; Diallo et al., 2004; Binka et al., 2002; Mermin et al., 2006). Despite their known efficacy among HIV-1 infected and uninfected individuals, ITN uptake and usage has been sub-optimal in many settings (Lengeler et al., 2004; Mermin et al., 2006). Some studies have reported that household income, educational status and knowledge of malaria influence ITN use in endemic areas (Ng'ang'a et al., 2009; Chase et al., 2009; Osero et al., 2005; Pettifor et al., 2008; Noor et al., 2006). In Uganda, after receiving bednets as part of a comprehensive care package, 89% of the HIV-1 infected individuals reported bednet use the previous night on a follow-up survey (Colindres et al., 2008). However, we are not aware of studies evaluating chronic patterns and factors associated with bednet use among HIV-1 infected adults. Defining barriers to ITN use is an important first step to improve ITN coverage among HIV-1 infected individuals.

We conducted a cross-sectional analysis to determine the prevalence and correlates of ITN use among HIV-1 infected individuals in Kenya. Participants in the study were recruited from 3 sites in Kenya in which bednet use is recommended for prevention of malaria; Kisumu, Kisii and Kilifi.

METHODS

Study Design

This cross-sectional study was nested within an ongoing randomized clinical trial (NCT00507221) of de-worming among HIV-1 infected adults in Kenya. All participants in the ongoing randomized clinical trial were offered informed consent and those that consented were enrolled. This study was approved by the Institutional Review Board at the University of Washington and the Ethical Review Board at the Kenya Medical Research Institute (SSC #1251).

Population

Participants were recruited from Kisumu and Kisii in Nyanza Province and Kilifi in Coast Province in Kenya. Kisumu is an area of intense malaria transmission with an entomologic inoculation rate of 31.1 infectious bites per year (Ndenga et al., 2006). Kilifi and Kisii have less intense rates of malaria transmission with an entomologic inoculation rate of 4 and 0.4

infectious bites per year respectively (Ndenga et al., 2006; Mbogo et al., 1995). Inclusion criteria included: age 18, HIV-1 positive, ART naïve, CD4 count >350 cells/mm³ at last clinic visit within 3 months of enrollment, not breastfeeding and not pregnant.

Study Procedures

A standardized questionnaire including questions related to demographic, healthcare and bednet use was administered at enrolment. Prior to this study, there had been no bednet distribution campaigns that we were aware of targeting HIV-1 infected adults at the study sites. However there had been distribution campaigns targeting children at all 3 sites (Noor et al., 2007; Fegan et al., 2007; Ter kuile et al., 2003). This study sought to determine existing patterns of bednet use and bednets were not distributed as part of this study. We did not determine how the participants obtained bednets.

Statistical Analysis

Data were entered into OpenClinica™ database and exported to SAS version 9.2. Odds ratio estimates and Chi-square tests were obtained to determine the relationship between different factors and the outcomes of interest. The outcomes of interest were optimal bednet ownership and use. Optimal bednet was defined as an insecticide-treated bednet that was not torn. We relied on self reporting to determine if the bednets were torn or treated with insecticide. If the p-value in univariate analysis was less than 0.1, the variable was included in a multivariate logistic regression model. Because permanent home was collinear with both presence of electricity in the home and income, only permanent home was retained in the multivariate models. Among those reporting optimal bednet ownership, we then performed similar analyses to determine factors associated with consistent daily usage.

Laboratory

All participants were screened with Determine™ HIV Enzyme Immunoabsorbent Assay test kits (Abbott Laboratories Dainabot Co. Ltd) at enrollment to confirm HIV-1 diagnosis. CD4 counts were measured using FACSCalibur (Becton Dickinson New Jersey, USA) at the KEMRI/University of Washington Flow Cytometry Laboratory in Nairobi, Kenya.

RESULTS

In total, 388 adults were enrolled in the study. The median age of participants was 34 years (Range 18–68) and 75.3% were female. The median CD4 count of participants was 440 (Range 3.2–1557.1) (Table 1). One third of the study participants (34.5%) reported owning an untorn treated (optimal) bednet. Of those that owned optimal bednets, most (76.9%) reported using it daily.

Table 2 outlines univariate analyses of the effects of various factors on optimal bednet ownership. Participants with post secondary level education [OR=3.2 (95% CI: 1.5–6.9), p=0.003] were significantly more likely to report optimal bednet ownership than those with primary education or less. Socioeconomic factors were also associated with optimal bednet ownership. Individuals reporting having electricity in the household had a higher odds of reporting optimal bednet ownership compared to those without electricity [OR=1.7 (95% CI:

1.1–2.8), $p=0.03$], as did individuals living in a permanent home [OR=1.9 (95% CI: 1.1–3.1), $p=0.01$].

Multivariate logistic regression analysis for optimal bednet ownership are presented in Table 3. Post-secondary education [OR=2.8 (95% CI: 1.3–6.4), $p=0.01$] and living in a permanent home [OR=1.7(1.03–2.9), $p=0.04$] remained statistically significantly associated with optimal bednet ownership in the multivariate model.

Univariate analyses of factors associated with consistent daily use among those who owned an optimal bednet are presented in Table 4. Individuals from Kilifi were significantly more likely to use an optimal bednet [OR=2.9 (95% CI 1.04–8.1), $p=0.04$] compared to those from Kisii. Individuals who were employed were less likely to use an optimal bednet [OR=0.2(0.04–0.8), $p=0.01$] as compared to those who were unemployed. Likely due to a low sample size ($N=134$), multivariate logistic regression did not yield any significant results (data not shown). However, a sub-analysis among those that owned an optimal bednet, shows that the sites differed substantially in socio-economic factors (individuals from Kilifi were significantly less educated, had higher unemployment and lower income).

DISCUSSION

In this study, 26.6% of the HIV-1 infected individuals surveyed reported using an optimal bednet. This is slightly lower than rates reported in the general population in Kenya (35.5%–43.5%) (Noor et al., 2009). The main driver of optimal bednet use in our population was ownership. About 80% of individuals that owned an optimal bednet used it consistently everyday. This finding differs from that of Atieli et al., 2011, that suggested 49.6 percent of individuals who owned a bednet did not use it.

Higher socio-economic status as defined by level of education and living in permanent homes were strongly associated with optimal bednet ownership. Prior studies have yielded conflicting results on the influence of education on bednet use (Ng'ang'a et al., 2009; Noor et al., 2006; Alaii et al., 2003). However, these studies focused on children with unknown HIV-1 status.

Among those that owned an optimal bednet, higher socioeconomic status did not appear to increase usage. Individuals with jobs were less likely to consistently use optimal bednets. Furthermore, individuals from Kilifi, which had the lowest socioeconomic indicators (lowest educated, lowest income, highest unemployment), were more likely to consistently use the optimal bednets that they owned. These findings suggest that the biggest barrier to consistent use of an optimal bednet is ownership and that once individuals are in possession of bednets they generally use them consistently, regardless of their socioeconomic background. Our findings support the use of distribution campaigns and other strategies to increase ownership as this is the main facilitator of consistent bednet use.

This study provides critical information on bednet use among a population that is at increased risk of malaria. The primary strength of the study is the inclusion of a large number of HIV-1 infected individuals at multiple geographically distinct sites in Kenya. To our knowledge, existing patterns of bednet use has not been studied among HIV-1 infected

adults in Kenya. However, the study is limited by design and sample size. This study may have lacked adequate power to accurately determine associations between various factors and optimal bednet usage.

Efforts to promote bednet use are needed among HIV-1 infected individuals living in malaria endemic areas. Our findings suggest that increasing access to optimal bednets will lead to high uptake and use. Ensuring optimal bednet use should become part of the routine HIV evaluation in malaria endemic areas (Mermin et al., 2005).

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Table 1**Characteristics of Study Population**

Variable	N=388
<u>Sociodemographic factors</u>	
Median age in years (range)	34 (18–68)
Female Gender N (%)	292(75.3)
Study Site N (%)	
Kisii	122(31.4)
Kilifi	155(40.0)
Kisumu	111(28.6)
Level of education N (%)	
Primary education or less	206(53.1)
Secondary education	92 (23.7)
Post-Secondary education	90 (23.2)
Participants who are employed N (%)	303(78.1)
Monthly Income less than 5000 KES (60 US Dollars) N (%)	137(35.3)
Participants living in permanent homes [*] N (%)	82 (21.1)
Electricity present in household	83 (21.4)
Participants with children under 5 years of age in the household N (%)	175(45.1)
<u>Health factors</u>	
Median CD4 count (range) N (%)	440(3.2–1557.1)
Taking TMP/SMZ prophylaxis N (%)	377(98.2)
Reported history of malaria within the previous 3 months N (%)	99 (25.8)
Positive malaria test within last 3 months if tested	28 (7.2)
Owens an optimal bednet	134(34.5)
Uses an optimal bednet daily	103(26.6)

^{*} homes built with cement floors, stone, cement, or timber walls, and iron, shingle, or cement roofs.

^{**} An insecticide treated bednet that is not torn.

Table 2

Univariate Determinants Of Optimal Bednet Ownership

<u>Variable</u>	Optimal Bednet Ownership OR(95%CI)	Optimal Bednet Ownership P-Value
<u>Age</u>		
Age>34 years (median)	1.0	
Age ≤ 34 years	0.7(0.5–1.1)	0.1
<u>Gender</u>		
Female	1.0	
Male	1.5(0.9–2.4)	0.1
<u>Study Site</u>		
Kisii	1.0	
Kilifi	0.9(0.5–1.4)	0.5
Kisumu	1.1(0.7–1.9)	0.7
<u>Level of education</u>		
Primary	1.0	
Secondary	1.8(0.9–3.6)	0.09
Post-Secondary	3.2(1.5–6.9) **	0.003 **
<u>Employed</u>		
No	1.0	
Yes	1.0(0.6–1.6)	0.9
<u>Income</u>		
5000 KES (60 US Dollars)	1.0	
<5000 KES	0.9(0.6–1.4)	0.6
<u>Live in permanent home</u> *		
No	1.0	
Yes	1.9(1.1–3.1) **	0.01 **
<u>Electricity present</u>		
No	1.0	
Yes	1.7(1.1–2.8) **	0.03 **
<u>Children <5 years of age in household</u>		
No	1.0	
Yes	1.1(0.7–1.6)	0.7
<u>CD4<200</u>		
No	1.0	
Yes	0.6(0.2–1.8)	0.4
<u>Self report of m alaria in previous 3 months</u>		
No	1.0	
Yes	1.1(0.7–1.8)	0.6

* homes built with cement floors, stone, cement, or timber walls, and iron, shingle, or cement roofs.

**
significant values

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Table 3

Multivariate Analysis Of Factors Associated With Ownership of An Optimal Bednet

<u>Variable</u>	<u>aOR (95%CI)</u>	<u>P-Value</u>
<u>Age</u>		
Age>34 years (median)	1.0	
Age ≤34 years	0.7(0.5–1.1)	0.1
<u>Gender</u>		
Female	1.0	
Male	1.2(0.7–2.0)	0.5
<u>Level of education</u>		
Primary	1.0	
Secondary	1.8(0.9–3.6)	0.1
Post-Secondary	2.8(1.3–6.4) **	0.01 **
<u>Live in permanent home</u> *		
No	1.0	
Yes	1.7(1.03–2.9) **	0.04 **

* homes built with cement floors, stone, cement, or timber walls, and iron, shingle, or cement roofs.

** significant value

Table 4

Univariate Determinants Of Daily Use Among Those That Own An Optimal Net (N=134)

<u>Variable</u>	<u>OR(95%CI)</u>	<u>P-Value</u>
<u>Age</u>		
Age>34 years (median)	1.0	
Age ≤34 years	1.9(0.8–4.4)	0.1
<u>Gender</u>		
Female	1.0	
Male	0.5(0.2–1.1)	0.09
<u>Study Site</u>		
Kisii	1.0	
Kilifi	2.9(1.04–8.1) **	0.04 **
Kisumu	1.5(0.6–4.0)	0.4
<u>Level of education</u>		
Primary	1.0	
Secondary	0.3(0.03–2.2)	0.2
Post-Secondary	0.3(0.03–2.5)	0.3
<u>Employed</u>		
No	1.0	
Yes	0.2(0.04–0.8) **	0.01 **
<u>Income</u>		
5000 KES (60 US Dollars)	1.0	
<5000 KES	0.8(0.3–1.7)	0.5
<u>Live in permanent home *</u>		
No	1.0	
Yes	1.5(0.6–3.8)	0.4
<u>Electricity present</u>		
No	1.0	
Yes	1.1(0.4–2.8)	0.8
<u>Children <5 years of age in household</u>		
No	1.0	
Yes	0.4(0.2–1.0)	0.06
<u>CD4<200</u>		
No	1.0	
Yes	1.2(0.1–11.4)	0.9
<u>Self report of malaria in previous 3 months</u>		
No	1.0	
Yes	0.7(0.3–1.6)	0.4

* homes built with cement floors, stone, cement, or timber walls, and iron, shingle, or cement roofs.

** significant values