Reduction in the burden of malarial anemia: Confirmation of an anti-vector approach

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Introduction

Malaria is a principal cause of at least one-fifth of all young child deaths in Africa (WHO/UNICEF, 2003). Malaria is thought to be the primary cause of severe anemia (Hb < 7 g/dl) in at least 50% of people living in malaria-endemic areas (Gillespie, 1998). With increasing levels of chloroquine resistance (Trape, 2001), the Roll Back Malaria partnership goal to halve the malaria burden by 2010 suggests the need for integrated approaches to combat malaria and reduce its consequences. Various projects and controlled trials have found improvement in anemia levels with the use of bednets, particularly insecticide treated nets (ITNs). However, the efficacy of bed net use has not been evaluated with national survey data.

Malaria endemic risk based on climate conditions (long-term rainfall and temperature) suitable for transmission is 100% for Benin. Some of the other West African countries such as Burkina Faso, Cote D'Ivoire, Ghana, and Liberia also share the same risk of malaria. However, the percentage of children under five years who slept under an insecticide treated mosquito net during the night preceding the survey is higher in Benin (7.4%) compared to other West African countries (WHO/UNICEF, 2003). In 1992, the International Research Development Center (IDRC) initiated an "Impregnated bednets and Community Prevention of Malaria in Benin. Similarly, as part of the Global Malaria Control Strategy, WHO in 1995 provided technical cooperation and financial support to malaria control activities in some countries including Benin. Therefore, data from Benin (DHS 2001) serves as an excellent source to analyze the effect of ITNs on anemia levels in children. Benin is also the recipient of grants for the Malaria Control Booster Project which will support the country's Roll Back Malaria Strategic Plan from 2006-2010.

Background

Acute and chronic hemolysis, secondary folate deficiency, specific or non specific immune responses (red cell survival is shortened) and dyserythropoiesis (disordered red cell development observed mainly in children with severe anemia) are some of the mechanisms involved in the etiology of malarial anemia (Gillespie, 1998). In tropical countries, other factors contribute to anemia risk; these include iron deficiency, malnutrition, and genetic defects. Therefore, it is difficult to estimate the percentage of anemia in a population that can be attributed to malaria. The two main forms of malnutrition among children worldwide are anemia and stunting (height for age < 2 SD below the NCHS/WHO International Growth Reference (Branca, 2002).Therefore, it is necessary to control for height for age/stunting in order to assess anemia burden as a result of malaria in children under 5 years.

It has also been indicated that malaria disproportionately affects the poorest of the poor populations in Sub-Saharan Africa and Southern Asia. More limited excess to preventive measures and curative treatment may partially explain worse outcomes among the poorest. A number of studies have examined the equity dimensions of the use of preventive measures,

particularly ITNs. For example, data from an ITN social marketing project in Tanzania, demonstrated that the least-poor quartile of the population were 2.74 times more likely to own a bed net than the poorest quartile (Barat, 2004). Hence, the present study also controlled for SES to analyze the use of bed nets and its impact on the anemia levels in children less than 5 years of age.

Data and methods

Data from the 2001 Benin DHS were used for this analysis. Funded by the US Agency for International Development (USAID), the survey was implemented by Benin's Institut National de la Statistique et de l'Analyse Économique with technical assistance from MEASURE DHS, a Macro International project. Ninety-seven percent of the selected households responded to the survey, resulting in completed questionnaires for 5,769 households. Data on a broad range of topics were collected, including fertility, reproductive health and family planning, mortality, nutrition, maternal and child health, malaria, knowledge about and prevalence of HIV, prevalence of anemia, women's social status, and domestic violence.

In addition to the above topics, the DHS core questionnaire also includes a small number of questions on malaria. These include Intermittent Preventive Treatment (IPT) promotion, prompt and effective treatment of fever, and bed net/ITN use. According to the DHS tabulation plan an ITN is a permanent net that does not require any treatment or a pretreated net obtained within the last six months or a net that has been soaked with the insecticide within the past six months.

The study sample for this analysis consists of all children under five years of age that were found in surveyed households, regardless of whether the child's mother was co-resident (N = 1950).

Chi-square tests of independence and one-way ANOVAs are used in bivariate analyses, while logistic regression was chosen for multivariate analysis. All statistical analysis was conducted with SPSS 12.5.

The dependent variable is dichotomous, reflecting whether or not a child was found to be anemic. The independent variable of interest reflects use of bed nets in the household, and has the following three categories: no bed nets in the household/none used by children the previous night, some but not all children under age 5 in the household slept under bed nets the previous night, and all children under age 5 in the household slept under bed nets the previous night. Control variables include sex of child, household wealth, and height-for-age.

Anemia status was assessed by measuring children's hemoglobin levels. The procedure involved drawing a drop of capillary blood from a fingerstick. The child's hand (or heel for children less than 6 months) was wiped with an alcohol swab and dried with a sterile gauze. The finger or heel was punctured with a sterile, retractable safety lancet. The first drop of blood was wiped with sterile gauze and the second drop of blood was collected in a mirocuvette for analysis of hemoglobin using the hemoglobinometer by HemoCue Systems (Sweden). The microcuvette contains the dried reagent that mixes automatically with the blood to cause a reaction; the microcuvette was then placed inside the equipment and the results were read in less than a

minute and reported to the respondent. Respondents whose hemoglobin levels were low enough for them to be considered severely anemic were referred for medical attention.

Anthropometric measurements included weight and height/length of children less than 5 years of age. A UNICEF Seca Scale was used to measure the weight of the child. Based of the age of the child, either length or height was measured using a Height Board (Shorr Inc.).

Household wealth was measured using asset-based wealth index quintiles (details on the construction of this variable can be found in Rutstein and Johnson 2004).

Results

This study found that use of bednets by all children in the household results in a 50 percent reduction in the likelihood of anemia compared to children living in households where bednets were not used. The significance of the findings remains after controlling for household wealth and stunting in children, both of which have a significant relationship with anemia.

Similar results have also been obtained in other studies. A community-based, group randomized, controlled trial of ITNs in western Kenya, followed infants from birth to 24 months. The study observed that the ITNs reduced the malaria attack rates (force of infection) by 74% in infants. The incidence of clinical malaria and moderate-severe anemia were reduced by 60%. Also, the infants from ITN villages experienced better height and weight gain (Kuile et al, 2003). In Tanzania, Njagi et al (2003) also observed the protective efficacy of ITNs and Sulfadoxine-pyrimethamine on anemia was 55.8%, SP alone was 50.9% and of ITNs 41.6% in pregnant women. However, a study from Ladji, Benin showed reduced efficacy associated with pyrethriod resistance occurred in *Anopheles gambiae* (N'Guessan, 2007).

Next steps in the analysis of data on bednet efficacy include a comparison of the Benin DHS 2001 and 2006 results to determine whether Benin has met with the Abuja 2005 target (Abuja Malaria Summit, 2000) to cover 60% of those at risk of malaria, particularly children under 5 years of age and pregnant women, who will benefit from a suitable combination of personal and community protective measures, such as ITNs.

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