

Abstract Title Page
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Title: Experimental evaluations of two strategies to improve reading achievement in Kenya: enhanced literacy instruction and treatment of malaria.

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Abstract Body
Limit 4 pages single-spaced.

Background / Context:

Description of prior research and its intellectual context.

There is increasing interest in strategies to improve education quality in poorly supported educational environments. Despite recent success in the expansion of educational access in low-income countries [1], concerns remain about levels of educational achievement and primary school completion in these countries, particularly those in sub-Saharan Africa. The reasons for this are multiple and complex, but it is increasingly recognized that poor health and nutrition affect children's cognitive functioning and therefore their ability to benefit from education [2].

There is less quality evidence on how malaria may affect cognitive abilities and educational achievement or on how schools can tackle the problem of malaria among school children [3-5]. A randomised trial among Sri Lankan children showed that weekly malaria chemoprophylaxis with chloroquine can improve school examination scores [6]. In a cluster randomised trial in Kenya, we previously evaluated the impact of intermittent preventive treatment (IPT) for malaria and found a 48% reduction in the rates of anaemia and a large effect size of 0.48 standard deviations (SD) on children's sustained attention in class [7]. Interestingly, no effect on educational achievement was observed. To achieve a measurable impact on education, it may also be necessary to improve teaching methods in order to capitalise on any improvements in health status of school children following malaria control.

Evidence on the effectiveness of interventions to improve educational quality has accumulated in recent years, with randomised trials showing that teacher incentives, student scholarships, providing textbooks, volunteer teacher aids and class size reduction can all boost student performance [8-15]. However, trials that assess the effectiveness of isolated interventions do not reflect the process of educational reform. Schools and education systems typically aim to improve quality by addressing several factors simultaneously, with the success of each one often dependent on the others. There is however very limited experimental evidence on how different interventions work together with one another to improve educational quality.

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

The Health and Literacy Intervention (HALI) project evaluated two strategies for improving educational achievement: (i) periodic screening and treatment of malaria in schools by public health workers and (ii) training workshops and text-message support for teachers to promote explicit and systematic literacy instruction

Setting:

Description of the research location.

The study was conducted in rural government primary schools in Kwale and Msambweni districts, situated approximately 50 km south from Mombasa on the Kenyan coast. The study

was carried out in these districts for several reasons. First, continuous precipitation supports intense year-round malaria (predominantly *Plasmodium falciparum*) transmission, with two seasonal peaks in malaria cases reflecting the bimodal rainfall pattern, with the heaviest rainfall typically occurring between April and June, with a smaller peak in October and November each year [16]. A 2008 survey among 20 schools in the study area found that up to 50% of school children harbor malaria parasites (Brooker, unpublished data), yet there are no initiatives specifically targeting malaria control in schools. Second, under-nutrition is common: the 2008 survey found that 21% of children were anaemic, reaching 38% in some schools (Brooker, unpublished data). Third, in terms of education, the area is one of the poorest in Kenya, having the worst mean national examination scores since 2005. The district is ranked as the seventh poorest district out of 76 districts in the country, and second poorest out of the seven districts in the Coast Province [17]. Around 80% of children attend primary school in these communities, but few proceed to secondary school.

Population / Participants / Subjects:

Description of the participants in the study: who, how many, key features, or characteristics.

Children in Class 1 and 5 in 101 primary schools in above study area.

Intervention / Program / Practice:

Description of the intervention, program, or practice, including details of administration and duration.

(i) Malaria prevention

This intervention is based on intermittent screening and treatment (IST) for malaria. Every school term, all children will be tested for malaria using a rapid diagnostic test (RDTs). Children (with or without malaria symptoms) found to be RDT-positive are treated with artemether lumefantrine (Coartem, Novartis), an artemisinin-based combination therapy.

(ii) Literacy intervention

The main components of the literacy intervention include: (i) a teacher manual, which includes 140 lessons for Class one teachers develop literacy skills in English and Swahili; (ii) an initial three-day training workshop in term 1 and a follow-up one day workshop in term 2; and (iii) ongoing support which includes weekly interactive text messaging, and monthly written communiqués providing information and motivation. This intervention is based on a comprehensive survey of existing literacy instruction practices in the study area region [18] and an analysis of how these practices can be developed to align more closely with current evidence on how best to promote successful literacy acquisition [19, 20].

Research Design:

Description of the research design.

The impact of the two interventions is being evaluated through a factorial design, cluster randomised trial, in which 101 schools are randomised to one of four groups: (i) receiving either the malaria intervention alone; (ii) the literacy intervention alone; (iii) both interventions combined; or (iv) control group where neither intervention will be implemented. Children from Classes 1 and 5 are randomly selected and followed up for 24 months to assess the impact of the two interventions. Both classes receive the malaria intervention, but the literacy intervention is

targeted only towards Class 1 as this is when children learn to read. This is an unblinded study as, following randomization, schools are aware of whether or not they will receive the malaria or literacy interventions.

Data Collection and Analysis:

Description of the methods for collecting and analyzing data.

Educational Achievement and Cognitive Tests

Among children in Class 1, literacy and numeracy tests are conducted in individualized and small-group settings. The literacy tasks focus on early literacy skills that are highly predictive of later reading acquisition [21], and include measures of oral vocabulary (receptive language), phonological awareness (matching beginning sound), letter knowledge, word recognition, passage reading, comprehension and spelling. The numeracy assessments measure foundational skills necessary for future understanding of mathematics, including numbers, operations, and geometry knowledge. In Class 5, achievement tests were administered in groups of 15 or less and involved word recognition, sentence reading comprehension tests, and a written arithmetic test. Among all children in both classes, sustained attention and non verbal reasoning are assessed.

Classroom Observations

The classroom observation involves an assessor observing Class 1 English and Swahili lessons on two separate days and involves the integration of two approaches to classroom observation. Every 90 seconds a ‘snapshot’ of the classroom is taken, based in part on the Stallings snapshot instrument [22] and the *CLASSIC* observation schedule designed to assess pedagogy for language instruction [23].

Anaemia and malaria parasitaemia

Among all children, haemoglobin concentration is assessed at baseline and 12 and 24 months follow-up, based on a finger-prick blood sample using a portable photometer. Malaria parasitaemia will only be assessed at follow-up due to the ethical constraints of testing for malaria but not treating children found to be infected in the control schools. . A finger-prick blood sample will be used to prepare thin and thick film for confirmation and quantification of malaria parasites on the basis of expert microscopy.

Data Analysis

The primary analysis will follow the intention to treat principle, whereby all children regardless of whether they received the full intervention or not will be included in the analysis. Data will be analysed both at the cluster level, by deriving summarizing summary statistics, and at the individual level (see [24]). The effect of each intervention will, in the first instance, be analysed separately.

Weighted estimates will be provided, with weights proportional to the number of schools per stratum. For binary outcomes, the overall risk for each school will be presented by intervention group and linear regression used to estimate unadjusted relative risk and 95% confidence intervals (CI) associated with each intervention. For continuous outcomes, means for each school will be shown and the arithmetic mean and SD of mean values and scores and associated 95% CI

for each intervention group calculated. Again, linear regression will be used to estimate mean difference and 95% CI for each intervention.

In addition to estimation of crude intervention effects, adjusted analysis will be performed to account for potential confounding variables measured at baseline. Depending on the outcome, logistic or linear regression will be conducted at the individual level, ignoring the clustering of the data and intervention effect. In each case the outcome will be regressed on baseline predictors and the resultant residuals will then be used as the summary measure for each school based on a comparison of the observed outcome in that school and predicted outcome in the absence of an intervention effect. Systematic differences in the residuals by intervention groups will provide a measure of intervention effect.

Findings / Results:

Description of the main findings with specific details.

Results (to be analyzed) will be presented on the impact of the two interventions on educational achievement, sustained attention, malaria and anemia prevalence after 12 months of the intervention.

Conclusions:

Description of conclusions, recommendations, and limitations based on findings.

Conclusions will be drawn relating to

- (i) The relative effectiveness and cost-effectiveness of the malaria prevention and teacher training interventions on educational outcomes
- (ii) The interaction between malaria prevention and teacher training interventions

in the context of the broader literature on interventions to improve literacy in the early grades of primary school in sub-Saharan Africa and in other resource-poor settings.

Appendices
Not included in page count.

Appendix A. References

References are to be in APA version 6 format.

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Figure 1 - The hypothesised causal pathways through which the malaria and literacy interventions are assumed to improve educational achievement

Open rectangular boxes indicate secondary and mediating outcomes; the incidence of clinical attacks is not measured. Circle boxes indicate contextual variables measured at household and school levels.

