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Retrospective Analysis of School Based Malaria Treatment Programme and Impact on Health and Education Outcomes in Mangochi District, Malawi

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Abstract

This report presents a retrospective evaluation of the school based malaria treatment programme implemented in Mangochi district, Malawi. The teachers were trained to identify and treat children suffering from malaria. The evaluation was undertaken using the school administrative records. The intervention and comparison schools were matched using propensity score matching. The impact was assessed using generalized linear modeling of family Poisson and also Kaplain Meier for survival analysis. The results showed significant reductions in general absenteeism and grade repetition by students. Treating the cost-savings arising from the reduced rate of repetition as the benefits of the program, the study showed that benefits far outweighed costs.

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INTRODUCTION

This paper presents the findings of a retrospective evaluation of a school-based malaria treatment programme implemented in Mangochi district in Malawi, where malaria accounts for 40 percent of outpatient visits and eighteen percent of all hospital deaths (Malawi Government, 2005). It is a major cause of anaemia in children under age 5 years. The anaemia in turn is responsible for 40 percent of all under-five hospitalizations. Mangochi district experiences perennial malaria transmission (Bruce et al 2008), which increases the vulnerability of students to malaria and risk of school absenteeism and drop-out. Mangochi district's proportion of malaria cases identified at outpatient departments (OPD) is 49 percent (HMIS 2008).

The economic impact of malaria is considerable. For example, it is estimated that the yearly gross national product (GNP) is two percent lower in highly endemic countries such as Malawi compared to countries where malaria is not endemic (Chima et al 2003). The disease costs Africa about US$12 billion every year, disproportionately affecting the poor of the poorest; the social consequences of malaria at household level are poorly understood.

There is also strong evidence demonstrating that limited access to health services such as treatment for malaria leads to absenteeism and low performance (Brooker et al 2008 and Fernando et al 2003). In addition it is documented that malaria, particularly cerebral malaria, can cause impairment that negatively affects intellectual development in children (Fernando et al 2005).

In addressing the challenges of access to treatment, Save the Children, a US-based nongovernmental organization, implemented a school-based malaria treatment programme. The programme also aimed to decrease malaria mortality rates and enhance positive school outcomes for students.

This study, funded by the Global Development Network, sought to evaluate the impact of Save the Children's school-based malaria treatment programme in Mangochi district on school and health outcomes. The authors assessed the impact within the intervention schools in comparison with non-intervention schools. The objectives were to assess the impact of the intervention on all-cause mortality, routinely reported sickness, general absenteeism and total absenteeism, repetition and drop-out. A cost-benefit analysis of the intervention was also carried out.

Description of the intervention

The school malaria treatment programme covered 101 of 242 primary schools in Mangochi district, which included a student population of 91,284, about half of the total student population in the district. Schools were selected for Save the Children's Health and Nutrition Programme in collaboration with the Primary School Advisors from the Ministry of Education. Some factors that informed the selection were population size of the schools and levels of participation of community members in school committees.

Intervention materials for teachers were developed in 2000, including information, education and communication materials, and a training manual and job aids. Two or three teachers from each selected school participated in a training on when and how to utilize the malaria treatment kits. The trainings for teachers and also health surveillance assistants from Ministry of Health were for five days in 2000, 2001 and 2002 and for three days in subsequent years. These sessions focused on developing teachers' skills in persuading students to come to school when they are sick; encouraging students to tell the teachers as soon as they feel unwell; and convincing students to take the medicine as needed. The teachers were also trained as drug dispensers to diagnose malaria and other health problems on the basis of signs and symptoms according to the national protocol. Teachers were given a manual and a flow chart of signs and symptoms to help them decide what treatment should be given and when a child should be referred to the health centre. The health surveillance assistants were part of the training to orient them to the programme concept because they were responsible for supporting teachers. One-day trainings for school health committees were designed to help them understand, support, and sustain the project from the community perspective.

The teachers detected suspected malaria cases and provided age-appropriate doses of Sulfadoxine-Pyrimethamine (SP) tablets and Paracetamol to the student at the school (and extra doses of Paracetamol for headache and pain) to take home. The medications were given free of charge, as in most public health facilities in Malawi. The only advantage the students in the study had over the control school students is their access to the treatment within schools that relieved them of having to travel long distances to health facilities.

A sick student was monitored by the teacher and if there is no improvement within 48 hours, the student was referred to the local health centre. Student's received pupil's treatment kits (PTKs) which also included tetracycline (for eye infections) and iodine and dressings for minor cuts and wounds. Save the Children staff monitored the dispensers through spot-checks of in-school treatment and medicine inventories and attended the monthly meetings.

The PTKs costed approximately $40 per school and Save the Children covered 90 percent of costs for the initial kit. Parents and communities paid the remaining 10 percent of the cost of the first kit, and an increasing percentage for additional kits as they were needed so that by the end of the program, the communities were fully supporting the cost of the intervention. The drugs and finances were monitored on a register and audited monthly by the School Health and Nutrition Committee comprised of parents and teachers. A separate treatment register was used to record every health problem and the treatment received in the schools.

An initial evaluation of the intervention showed that it had a positive impact in reducing the mortality. In the three years prior to the introduction of the PTKs, the malaria-specific mortality rate was 1.42 deaths per 1000 student-years. In the 2 years following introduction of the PTK, the rate dropped to 0.44 deaths per 1000 student-years in the intervention schools (Pasha et. al, 2003). Although the initial analysis showed a positive impact of the intervention on mortality and drop-out rates, there were no comparison groups against which to measure the results and isolate the impact of the intervention. Without comparison schools it is hard to isolate secular trends since mortality and other health indicators could likely improve despite this intervention due to other factors that also influence issues of both health and school outcomes, such as the provision of other health services and improved welfare for the communities.

STUDY DESIGN

In this study, the differences were compared in outcomes at school and the individual student level in the intervention and comparison groups – an empirical strategy referred to as differences-in-difference. The difference compared was over time for all selected school between project onset (2000/2001 academic year) and at the close of the project in 2006. The mortality and enrollment comparison was undertaken at the school level over time, while repetition, reported sickness, and general absenteeism were undertaken at the student level.

Save the Children did not consider matching or randomization when designing its intervention school selection process. The selection of intervention schools might therefore have led to challenges of geographical incomparability between the intervention and comparison schools. In order to control for bias factors in outcomes in the evaluation analysis the intervention and comparison schools were matched using radius propensity score matching

(PSM) based on selected key characteristics and variables. The radius propensity score matching was used because it is normally difficult to have schools with exactly the same propensity scores. Radius matching uses the nearest neighbor within each radius, equally weighting all of the comparison members within each radius in order to estimate the expected counterfactual (Chintrakan 2008). The results were also compared to kernel propensity matching in which each case in the treatment group is matched to a weighted sum of individuals with similar propensity scores, with greatest weight being given to people with closer scores. The variables used in the propensity score matching were identified through consultation with the project stakeholders who were involved in assigning schools for the intervention. These were sociological and political factors that would influence selection of the school and affect the outcomes. The variables included the geographical location of schools according to traditional authority and education zone, poverty levels of the school and geographical accessibility by road. Poverty and sex are also linked to attendance and continuation of education. Some studies have shown that the poorest girls are the least likely to enroll and more likely to drop out of school (Castron-leal 1996).

A logit model with linear covariates was used to estimate the propensity score for each intervention and comparison school, as described by Dehejia and Wahba (2002)[4]. The following model was used:

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[4] *The Review of Economics and Statistics,* February 2002, 84(1): 151–161
' 2002 : Propensity score matching methods for non experimental causal studies

$$\Pr(T_i = 1 \mid X_i = \frac{e^{\lambda h(X_i})}{1 + e^{\lambda h(X_i)}} \quad (1)$$

Where Ti is the treatment status and $h(X_i)$ is made up of linear and higher-order terms of the covariates on which we conditioned to obtain an ignorable treatment assignment. This was undertaken using STATA software.

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Sources of the data

School and student level data were used to assess the effectiveness of the intervention on both health and school outcomes. The school level data was obtained from all schools =, matched and unmatched. The school level data obtained included enrollment, dropout, and mortality rates by age and sex. After matching of schools 93 schools were randomly selected for cohort analysis of pupils. From these schools, 10 pupils were also randomly selected. The students level data was obtained for a cohort recruited retrospectively from academic years 2000 to 2001 to 2006. Ten students were randomly selected from the registers taking into account sex and age factors from each school. The random selection of ten students was conducted from the registers at baseline academic years 2001 to 2002 and followed up until 2006 using either school records (such as daily attendance registers, mortality records, or transfer out records). In some instances, details of missing students were obtained from long-serving class teachers. Schools with gaps in data were excluded.

Analysis of the impact was carried out after matching the schools using regression-adjusted conditional difference-in-differences, especially for controlling time-invariant characteristics (Heckman et al 1997). The average outcome equation for calculating outcomes for both cohort and schools being Y_{ij}, where $_i$ is the state of school outcome (morbidity and absenteeism), $_j$ is the year of evaluation/data collection point;

$$Y_{ij} = \beta_0 + \sigma_1 T_{ij} + \sigma_2 V_{ij} * X_{1ij} + \beta X_{ij} + \mu_{ij} \tag{2}$$

βX_{ij} are observed children or school characteristics such as enrollment, age and sex, T_i is the dummy variable for school status where 1 stands for Intervention schools and 0 for comparison schools; V_{ij} is the vector of $\Gamma 1$ village dummy and μ are unobserved variables for traditional authority and sub-traditional authority.

The drop-out and repetition factors for individual level data obtained from the cohort of pupils followed from 2001/2002 to 2006 were analysed using the Kaplan-Meier product limit estimates of survival. The log rank test was used to determine differences between the probability of remaining in school or not dropping out. In the Kaplan Meir survival analysis, the probability of surviving is plotted against time to graphically show the failure rates of the studied main outcomes over time between the intervention and control groups. To adjust for covariates while taking into the correlation due to clustered pupils in schools, generalized linear modeling (GLM) with log link and family Poisson was used to measure the impact of the intervention. Robust standard errors were used to improve precision.

Cost Benefit

The cost benefit analysis was undertaken by comparing the cost of the program against its benefits of averting school grade repetition. This was based on the evidence that malaria leads to absenteeism that affects the performance of students (Fernando et al 2003 and Brooker et al 2000).

Benefit of the programme intervention

The benefits were defined as repetition averted as a result of intervention. The direct benefit was computed by monetizing repetition using the standard reported per capita expenditure of primary school education in Malawi. This information was obtained from Ministry of Education and review of literature on Malawi[5]. The data on primary education in Malawi indicate that it costs the Malawi government about US$14 for a primary school pupil, per year, with pupil to teacher ratio at primary school standing at 62:1 and drop-out rates for all standards at 17 percent. The national level average rate of repetition is 16 percent in primary school. The repetition rate among the intervention schools was 8.5 percent

The formula for calculating the benefit used was as follows:

$$B_{benefit} = (C_{repet} * RR_{repet\_avert} * N_{pupil\_interv}) \qquad (3)$$

w where $B_{benefit}$ = total benefits accrued; C_{repet} =cost of repetition per pupil (cost of primary school education per pupil); RR_{repet_avert} = rate of repetition averted by the programme ; and N_{pupil_interv} = number of pupils in intervention schools;

[5] Per capita expenditure was derived by working out the cost of teaching one child out of the cost of teaching one pupil per year, which was translated into the cost of repetition. The expenditure per child consists of school materials and cost of human resources. This comprises teaching materials and the economic cost of the time of teachers per child

The average benefit of the program per pupil was calculated as follows:

$$AV_{benefit} = B_{benefit} / N_{pupil\_\mathrm{int}erv} \quad (4)$$

Where $AV_{benefit}$ =average benefit per pupil (cost per repetition case averted); $B_{benefit}$ and $N_{pupil\_\mathrm{int}erv}$ were as defined in (3) above.

Cost of the intervention

The cost data was obtained from Save the Children with support from the London School of Hygiene and Tropical Medicine. The financial cost was obtained from the project accounts and included the cost of developing training manuals, printing, training of teachers and school committee members, purchase of drugs and quarterly review meetings. The training facilitators and participant's costs included their transport and a US$1.50 (Malawi Kwacha 250) subsistence allowances, their salary costs and the cost of refreshments. The economic cost was calculated by estimating the time health workers and teachers took to implement and participate in training, review meetings and dispense drugs. The cost centres were identified as information, education and communication materials, treatment kits, training, drug delivery, monitoring and evaluation and dispensing of drugs by teachers. The set up cost of the PTK was thus determined by annualizing the original purchase cost over the years of use. The number of years of PTK use varied according to the number of schools entering the program each year.

The annual rate of treatment kits restocking was calculated from data derived from 2006. In 2006 intervention schools purchased 40,000 SP and 142,000 paracetamol tablets. The price for training components in previous years was substituted with the equivalent prices from 2007. Dependent on their date of training, costs was annualized over the programs duration.

The cost of dispensing was therefore determined by the salary costs of the teachers and the use of a register book. The management of the PTK program was the concern of Save the Children Fund's Mangochi office. The management cost was derived from the building maintenance and management costs (including water and electricity), the cost of computers, printers and phones used and salary apportioned based on the quantity of time project staff spent in PTK work. The direct cost of the programme was defined as follows:

$$C_{prog} = T_{teach} + Off_{run} + \mathrm{Re}\,v_{meet} + PTK_{comp} + Spot_{check} + S_{desp} + Com_{\sup erv} + IEC_{mat} \quad (5)$$

Where C_{prog} = cost of the programme; T_{teach} = cost of training teachers and school committee; Off_{run} = office running costs; $\mathrm{Re}\,v_{meet}$ = cost of review meetings; PTK_{comp} = costs of PTK components; $Spot_{check}$ = cost of spot checks; S_{desp} =school based dispensing; $Com_{\sup erv}$ = cost of community supervision;

The average cost per pupil was:,

$$AVC_{prog\_pupil} = C_{prog} / N_{pupils} \quad (6)$$

Where AVC_{prog_pupil} is the average cost per pupil; N_{pupils} is the total number of pupils; and C_{prog} is as defined above.

Net benefit

We calculated the net benefit per pupil as follows:

$$NB_{benefit\_per\_pupil} = AV_{benefit} - AV_{\cos t} \tag{7}$$

Where $NB_{benefit\_per\_pupil}$ = net benefit of the intervention programme; $AV_{benefit}$ and $AV_{\cos t}$ are average benefit per pupil and average cost of the program per pupil, respectively.

STUDY RESULTS

Results of matching of the schools

Two hundred and forty schools (141 intervention schools and 99 comparison schools) were included in the matching procedure. Two schools were left out because of incomplete data. The school level matching was undertaken using the radius propensity score matching based on poverty of the catchment population, whether the school was along the road or not, traditional authority (TA) which is the local administration unit within the district and school zone. The results for school level matching showed that poverty, and school zone factors such as being on a road significantly influenced the estimated probability of a school being an intervention school or not as shown in table 1a. The comparison with kernel propensity approach yielded similar results as shown in table 1b with all schools matched. The exercise resulted in 96 intervention schools and 141 comparison schools were matched for analysis, three intervention schools were dropped.

The descriptive statistics of schools after performing PSM showed that the intervention and comparison schools were similar. The poverty level for intervention schools was 64.8 and 65.9 for comparison. However two traditional authorities did not have any school in the intervention group. Our initial assumption was that most of the schools picked were along a road, this might be due to easy accessibility by Save the Children Fund. The PSM contradicts our assumption as schools which were along the road were less likely to be selected for the intervention.

Out of 237 matched schools, 93 schools were randomly selected for cohort analysis of pupils. The demographic characteristics of the schools selected were similar to those of the entire schools matched. For example the poverty level among all comparison schools matched was 67 percent compared to 68 percent for the comparison schools included in the random selection. Table 2 provides an overview of other characteristics of schools.

Sixty-three schools included in this study were intervention schools and 30 were comparison schools. Of the sixty intervention schools 10 were among the first schools which started the intervention in years 2000 to 2002, the rest had the interventions integrated after 2002. Two hundred and seventy-nine students had incomplete information for some follow-up years. Their names were checked against death records but no matches were identified. These missing students could have dropped out, self transferred, or been transferred out by school authorities without being documented. They were regarded as lost to follow-up and were not included in the study.

A total of 651 pupils from intervention (422) and non intervention (229) schools were captured in the follow-up from 2002 to 2006 and were included in the analysis. The mean age of pupils in the cohort was 9.9 years. Distribution by sex and age of the school children was similar in both intervention and comparison schools see table 3.

Effect of intervention on sickness, general and total absenteeism

Sickness-related absenteeism (sick days) was defined as the number of days absent from school due to sickness as reported in daily attendance registers in both intervention and control schools. The mean sickness reported over the years decreased as shown by figure 1a. The mean number of days pupils were reported to be sick over the entire period was 2.97 (sd:4.6) in intervention schools and 2.05 (sd: 3.5) in comparison schools as shown in Table 3.

Before adjusting for poverty, the children in the intervention schools were 31 percent more likely to report that they were absent because of sickness before adjusting for covariates (IRR[6], 1.31p=0.04). After adjusting for poverty the effect of increasing reporting for sickness related absenteeism was 29 percent (IRR: 1.29, p=0.15).

General absenteeism decreased in the intervention areas over the review years as shown by figure 1b. The aggregated general absenteeism days

[6] IRR is Incidence risk rate.

during the evaluation period, 2001/2002 to 2005/2006 academic years was 102 days (sd[7]:62.5) in comparison schools and 104 days (sd: 65.5) in comparison schools over the period of analysis. Before adjusting for covariates the effect of the intervention in reducing on absenteeism was 13 percent (IRR 0.87; p=0.00). With adjustment using poverty and sex the intervention effect in reducing absenteeism was 12 percent (IRR 0.88, p=0.01).

Aggregated all-cause absenteeism, defined as sickness and general absenteeism, was slightly lower in intervention schools. The mean all-cause absenteeism for intervention schools was 105 days while for comparison schools it was 106 days. The effect of the intervention on all-cause absenteeism was a 6 percent decrease for intervention schools (p<0.01) and a 5 percent decrease for comparison schools (p=0.32) after adjusting the results for poverty and sex.

Effect of the intervention on repetition of grades

The pupils followed were assessed for their grade repetition rates over the follow-up period. Of the children followed up, significantly more pupils in comparison schools repeated grades compared to those in intervention schools (16% and 9%, respectively, Chi2=7.8, p=0.005), see table 2.

Survival analysis using Kaplan Meier showed that children in intervention schools had significantly higher survival rates for not repeating grades during

[7] Sd: standard deviation

the follow-up period compared to the non-intervention schools (Chi2= 15.01, p= 0.0001) as shown in fig 2. The crude impact of the intervention showed that it reduced repetition rates by 51 percent (95% confidence interval: 31-76%, p=0.001). Identical rate reductions were obtained after adjusting for both age and sex (51% with 95% CI: (31 - 77%), p=0.002].

Effect of the intervention on school drop out rates

Drop outs of sampled children including the dates when this occurred were recorded in the daily attendance register. The percentage of pupils who dropped out during the follow-up period was significantly higher among students in the comparison school (18 percent compared to 13 percent in intervention schools, Chi2=3.98, p=0.046), see table 2. No significant difference between comparison and intervention schools was noted in the percentage of pupils who transferred out (10.5% in comparison schools vs 8.5% in intervention schools).

The crude dropout rates in intervention schools was reduced by 39 percent compared to control schools ((rate ratio = 0. 612 with 95% confidence interval: 0.415 - 0 .901, p=0.013), see figure 3. After adjusting for both age and sex of the pupils, the treatment effect was 37 percent (rate ratio=0.63, 95% CI: 0.423 - 0.942, p=0.024).

When we modeled staying in school for at least 10 months as an outcome variable, the effect of intervention in reducing drop out was 9 percent (rate ratio=0.910, 95% CI: 0.873 – 0.948, p=0.0001). After adjusting for age of the pupils, sex and whether the schools were located along a road or not, the effect of the intervention remained the same (rate ratio=0.914, 95% CI: 0.875 – 0.955, p=0.0001).

Effect of treatment on mortality rates – school level

The school level analysis was undertaken after the matching exercise and the three schools that did not match were excluded from the analysis. In calculation of all cause mortality rates, deaths of school children occurring by year from 2000 to 2006 with their corresponding school enrolment in the matched schools were computed to generate mortality rates among school pupils in the respective time periods. In the years 2000 and 2001 the all cause mortality between the intervention and comparison were not different (0.3 and 0.32 per 1000 student-years respectively). In both the intervention and comparison schools the trend over the years rose. However it was much higher in the comparison school in 2006, 1.1 deaths per 1000 student-years compared to 0.5 deaths per 1000 student-years in intervention schools (figure 4 and table 5). The malaria specific analysis was not undertaken due to lack of evidence on diagnosis.

Cost of the intervention and the drivers

The total financial and economic cost of implementing the intervention was US$16,897 and US$35,267 respectively. The total economic cost of the programme in 2007 was US$ 36,368 (Table 4). The financial cost was US$ 21,271

Training of teachers and school committee was the major cost driver which represented 49 percent of the annual economic cost of PTK delivery in Mangochi. This equated to an annual cost of US$ 17,670 for the 101 enrolled schools. The office running cost was second contributing to 14 percent of the annual cost (US$ 5,102) Review meetings represented 12.5 percent of the PTK programme's annual cost (US$ 4,555). The cost of the PTK components was 9.8 percent of the overall costs (US$ 3,536). Spot checks represented 8.8 percent (US$ 3,125) of the annual cost whilst school based dispensing, community supervision and IEC materials represented 3.6 percent, 2 percent ad 0.7 percent respectively (US$ 1,317; 712; 246).

The total programme cost was US$36,262 for a total student population of 91,284 pupils. This resulted in an average cost of the program per pupil of US$0.40.

Cost benefit of the intervention

The benefit was assessed by first projecting the rate of repetition averted by the intervention. The output of cohort data analysis was used to calculate the level of absenteeism averted by the intervention. This number was multiplied by US$14 to project the expected cost of repetition. The national level average cost of a primary school student in Malawi is US$14 per year. The benefit was then calculated as the cost of repetition averted by the intervention. The total benefit of the programme amounts to U$3,485.72 for a total of 422 pupils in intervention schools, thus the average benefit per pupil was US$8.26. The cost of the programme per pupil was US$0.40. The net benefit was US$7.86.

DISCUSSION

The evaluation solely depended on availability of administrative data for students at school level. We found that although primary schools in Malawi are poorly resourced, availability of data was reasonable. Teachers managed to keep students records although they had challenges with storing data and continuity of teachers who are transferred in and out of schools.

This study demonstrated that malaria interventions if properly implemented at the school level would lead to reduction in general absenteeism and drop out rates and reduce grade repetition leading to savings to the education sector. The results suggest that the benefits of the intervention greatly exceeded the costs, and it is feasible to reduce grade repetition for primary school pupils. The Millennium Development Goal of Universal Primary Education is an inclusive target for all children in sub-Saharan Africa who are facing a range of challenges that affect their school performance.

The cost benefit analysis also demonstrated that investment in treatment of school children by teachers is beneficial both to the students and, ultimately, the education system. It is estimated that grade repetition is as high as 25 percent in some countries (World Bank 2004). Studies conducted in Africa have shown that governments are needlessly spending vast resources due to grade repetition. For example in 1998, nearly 40 percent of all resources were being lost due to repetition and dropout in Francophone Africa, and one quarter of resources were lost in Anglophone Africa (World Bank, 2002, p.

55). According to World Bank estimates, a reduction of one percentage point in repetition in sub-Saharan countries would lead to savings of up to US$300,000.00. A study conducted in Malawi showed that a one-percentage point decrease in the primary repetition rate (below the average rate of 16%) could lead to a 0.2 percentage point increase in the grade 8 pass rate (World Bank, 2004, p. 76 and Michaelowa (2003, p. 17). Some have also argued that repetition can also lead to drop-out of children. The study also showed that 20 percent of resources are wasted due to high rate of repetition.

Past studies have demonstrated that malaria contributes to 50 percent of preventable absenteeism in Africa (Some 1994). Other studies have documented that malaria contributes to absenteeism ranging from 17 to 54 percent in endemic areas (Clarke et al. 2005, Brooker et al. 2000, Some 1994). Repeated and/or severe episodes of malaria can also affect student performance due to neurological and other damage. A study conducted in Sri Lanka linked repeated malaria episodes to lower student performance in class (Fernando et al 2003). Although the evaluation did not assess the severity of the disease, prompt treatment of fever and malaria in high transmission areas prevents development of severe malaria.

The significant impact of the intervention was the reduction in repetition and drop out of students. The levels of economic, social, and health welfare in Malawi positively correlate with the level of education. Households with adults with secondary level of education have higher income levels, followed by those who have completed primary school (NSO 2006). Completion of primary school education is a gateway to secondary school, as such, progression between grades and continuation of schooling through primary school can positively impact the economic growth. The national dropout and grade repetition rates in Malawi are around 10 percent.

The preliminary evaluation showed that the intervention led to reduction of the mortality. Although this evaluation has shown a reduction in all-cause mortality over the years, the difference between the programme and non-programme areas was not significant (Pasha et al 2003). One of the factors for this disparity is that the assessment was mainly based on available school data. This might exclude deaths which were not formally reported in both programme and non-programme areas.

The evaluation process demonstrated that the school based records can be used to scientifically evaluate health interventions linking them to school outcomes. Future studies could also consider prospective cohort analysis which would create opportunities for obtaining more information on related social factors that influence access to education.

The Malawi government has changed treatment policy for malaria. Artemisinin based combined therapy (ACT) has been introduced. These drugs are relatively more expensive than SP so such presumptive treatment would be costly. This calls for operational research to explore the use of rapid diagnosis tools by teachers to treat students. The process also revealed the need of strengthening the systems of data and record keeping in primary schools in Malawi.

CONCLUSION

The evaluation has shown that the school-based treatment programme implemented by Save the Children Fund was effective in reducing absenteeism and repetition. The programme further improved the skills of teachers and reporting of sickness among the pupils. The results suggest that the benefits of the proposed intervention would greatly exceed the costs, and it is feasible to reduce repetition cases for primary school pupils. Future studies should focus on exploring the feasibility of implementing Artemisinin based combined therapy (ACT) in primary schools using rapid diagnosis tools as this might increase effectiveness of the approach. In addition analysis on how the intervention can lead to reduction in disease burden would be important.

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REFERENCES

Bruce M.C, Macheso A, Louise A.K, Nkhoma S, McConnache A, Molyneux M (2008) Effect of setting and mixed species infections in clinical measures of malaria in Malawi. *PloS ONE,* 3(7) e2775

Castron-leal F (1996) Who benefits from the public education spending in Malawi? Results from the recent reforms. *PSP Discussion Paper Series*, 19721

Brooker, S. Clarke, R. Snow, D. Bundy S. (2008) Malaria in African schoolchildren: options for control. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 102(4):304-305

Brooker,S., Guyatt,H., Omumbo,J., Shretta,R., Drake,L., and Ouma,J. (2000). Situation analysis of malaria in school-aged children in Kenya - What can be done? *Parasitology Today*, 16, 183-186.

Chintraka (2008), Estimating the Euro effects on trade with propensity score matching. *Review of International Economics,* 16(1),186-198.

Clarke SE, Brooker S, Jukes MCH, Njagi JK, Khasakhala L, Otido J, Crudder C, McGlone B, Magnussen P & Estambale BBA. (2006). Randomised controlled trial of intermittent preventive treatment in schoolchildren: Impact on malaria, anaemia & school performance [abstract]. *American Journal of Tropical Medicine & Hygiene* Suppl 75 (5): 123.

Clarke S, Njagi J, Jukes M, Estambale B, Khasakhala L, Ajanga A, Luoba A, Otido J, Ochola S & Magnussen P. (2005). Intermittent preventive treatment in schools: Malaria parasitaemia, anaemia and school performance [abstract]. *Acta Tropica*, Suppl 95: S133.

Fernando S.D, Gunawarden D.M, Bandara R.S.S, De Silva D, Carter R, mendis K.N, Wickremasinghee A.R (2003) The impact of repeated malaria attacks on the school performance of children. *American Journal of Tropical Medicine & Hygiene 69(6):582-588*

Dehejra, Wahba (2002) Propensity score matching methods for non experimental causal studies. *The Review of Economics and Statistics,* 84(1): 151–161

Heckman J, Ichimura H, Smith J, Todd P (1998) Characterising selection bias using experimental data. *Econometrica* 66(5):1017-1098

Ministry of Health (2008) *Health Management Information System Report*. Lilongwe, Malawi

Michaelowa, K. (2003). *Determinants of Primary Education Quality: What Can We Learn from PASEC for Francophone Sub-Saharan Africa?* Background paper prepared for ADEA Biennial Meeting in Mauritius, 2003. Paris: ADEA.

National Statistical Office (2005) *Demographic Health Survey*. Malawi

National Statistical Office (2006) *Integrated Household Survey*. Malawi

Pasha O, Del Rosso J, Mukaka M, Marsh D (2003) The effect of providing fansidar (sulfadoxine-pyrimethamine) in schools on mortality in school-age children in Malawi, *Lancet.* 361:577-78

Some E.S (1994) Effects and control of highland malaria epidemic in Uasin Gishu District, Kenya. *East African. Medical Journal* 71(1):1

World Bank (2004). *Cost, Financing and School Effectiveness of Education in Malawi: A Future of Limited Choices and Endless Opportunities*. African Region Human Development Working Paper Series, No. 78.Washington DC: World Bank.

World Bank (2002). *Le Système Educatif Béninois: Performance et Espaces d'Amélioration pour la Politique Educative.* African Region Human Development Working Paper Series, No. 19. Washington DC:World Bank

List of Tables

Table 1a: Results of matching using radius propensity score matching*

INTERVENTION	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Traditional authority	.0789446	.0903674	0.87	0.382	-.0981723 .2560615
School zone	.06999	.0342796	2.04	0.041	.0028031 .1371769
Poverty level	-.0228093	.010879	-2.10	0.036	-.0441317 -.0014869
Along the road	-.7974862	.2807396	-2.84	0.005	-1.347726 -.2472467
_cons	1.481182	.7941389	1.87	0.062	-.0753018 3.037666

Number of obs=240,

LR chi2(4)=18.40,

Prob > chi2 = 0.0010,

Log likelihood =-153.4621, Pseudo R2= 0.0566

* The table shows variables used for matching schools and the factors significantly influenced the estimated probability of a school being an intervention school

Table 1b: Results of matching using kernel matching*

TREATED |	*Coef.*	*Std. Err.*	*z*	*P>|z|*	*[95% Conf. Interval]*
Traditional authority	*.0789446*	*.0903674*	*0.87*	*0.382*	*-.0981723 .2560615*
School Zone	*.06999*	*.0342796*	*2.04*	*0.041*	*.0028031 .1371769*
Poverty level	*-.0228093*	*.010879*	*-2.10*	*0.036*	*-.0441317 -.0014869*
Along the road	*-.7974862*	*.2807396*	*-2.84*	*0.005*	*-1.347726 -.2472467*
_cons |	*1.481182*	*.7941389*	*1.87*	*0.062*	*-.0753018 3.037666*

Number of observation = 240,

LR chi square2(4) = 18.40,

Prob > chi2= 0.0010

Log likelihood= -153.4621 Pseudo R2 = 0.0566

Table 2: Demographic characteristics of schools

	Initial matching		**After excluding some schools**	
Characteristics	**Intervention N= 96**	**Control N=141**	**Intervention N=63**	**Control N=30**
Mean poverty levels§	68.7 % (95% CI: 65.2 to 72.3%)	67.2% (95% CI, 64.8 to 69.8%)	65.0% (95%CI 61.8 to 68.2%)	68% (95% CI: 66 to 70%)
Schools along the road	50% (95% CI:39.9 to 60%)	35% (95% CI: 26 to 42%)	32% (95% CI: 32 to 58%)	44% (95% CI: 23 to 41%)
School level enrolment*				
Mean enrolment 2001/2002	859	389	766	422
Mean enrolment 2002/2003	833	393	782	420
Mean enrolment 2003/2004	857	424	805	461
Mean enrolment 2004/2005	894	468	837	501
Mean enrolment 2005/2006	873	437	816	453

§ The poverty level and access to road similar as the confidence level overlaps

* The mean enrollment in intervention are similar between initial matching and when some schools were removed due to unavailability of data and similarly for the control schools

Table3: Descriptive characteristics of the students in the cohort analysis

	Intervention N=422	**Comparison** N=229
Sex		
Male	166 (72.5%)	284 (67.3%)
Female	63 (27.5%)	138 (32.7%)
Mean age	9.9 (sd:2.4)	9.9 (sd:2.6)
Poverty level	71% (CI: 69.7 -72.4%)	63.3% (CI: 61.6 – 65%)
Access to road	48 (CI: 41-55%)	64% (CI: 59 – 68%)

Notes:

1. Poverty level, means level of poverty with the students area

2. Access to the road mean school is located along the road

Table 4:* Student level *outcomes

	Intervention N=422	**Comparison N=229**
Children repeated	36 (8.5%, CI: 6 – 11%)	36 (15.7%, CI:10 – 20%)
Children transferred out	36 (8.5%, CI: 6 – 12%)	24 (10.5%, CI: 11 – 20%)
Children dropped out	53 (12.6% CI: 9 – 16%)	42 (18.3%, CI:12 – 23%)
Children died	0	0
Aggregated mean days absent*	102 (sd:62.5)	104 (sd:65.5)
Aggregated mean days sick[§]	2.97 (sd: 4.6)	2.05 (sd: 3.5)
All absenteeism[c]	105 (sd: 62.5)	106 (sd: 65.5)

Notes

sd= standard deviation; CI: 95% confidence interval

**This represents all days absent over the intervention years*

[§] *This represents all days sick over the intervention years*

[c] This represents all forms *of absenteeism over the intervention years*

Table 5: Total deaths in all matched intervention and comparison

N for intervention = 141, N for comparison =96

	2000	2001	2002	2003	2004	2005	2006
Intervention							
Mean population	47166.5	55490	56775	57782	61121	67155	63120
Total deaths	12	10	10	8	17	20	25
mortality per 1000 student	0.254	0.180	0.176	0.138	0.278	0.298	0.396
Comparison							
Mean population	21658	25480	27480	24243	24624	26906	25057
Total deaths	7	7	9	19	21	12	28
mortality per 1000 student-	0.323	0.275	0.328	0.784	0.853	0.446	1.117

Table 6: Average annual cost of SC's PTK programme in Mangochi (101 schools)

COST CENTRES	MK	US$	% Total cost
TRAINING COSTS (TOTAL)	**2466331**	**17670**	**48.6**
Allowances	1378184	9874	27.2
Salaries	818991	5868	16.1
Transport	111206	797	2.2
Consumables (stationary, refreshments, fuel)	157950	1132	3.1
REVIEW MEETING COSTS (TOTAL)	**635702**	**4555**	**12.5**
Allowances	69600	499	1.4
Salaries	472931	3388	9.3
Transport	57504	412	1.1
Consumables (stationary, refreshments, fuel)	37680	270	0.7

COMMUNITY SUPERVISION COSTS (TOTAL)	**99422**	**712**	**2.0**
Salary cost	99422	712	2.0
SPOT CHECKS (TOTAL)	**448706**	**3215**	**8.8**
Salary costs	267815	1919	5.3
Transport costs	100892	723	2.0
Consumables (fuel)	80000	573	1.6
MANGOCHI OFFICE COSTS (TOTAL)	**710477**	**5090**	**14.0**
Salary costs	571787	4097	11.3
Capital costs (computer, phone, fax, printer, fan)	1552	11	0.0

LIST OF FIGURES

Figure 1a: Trend in reported sickness for students within the cohort over the years

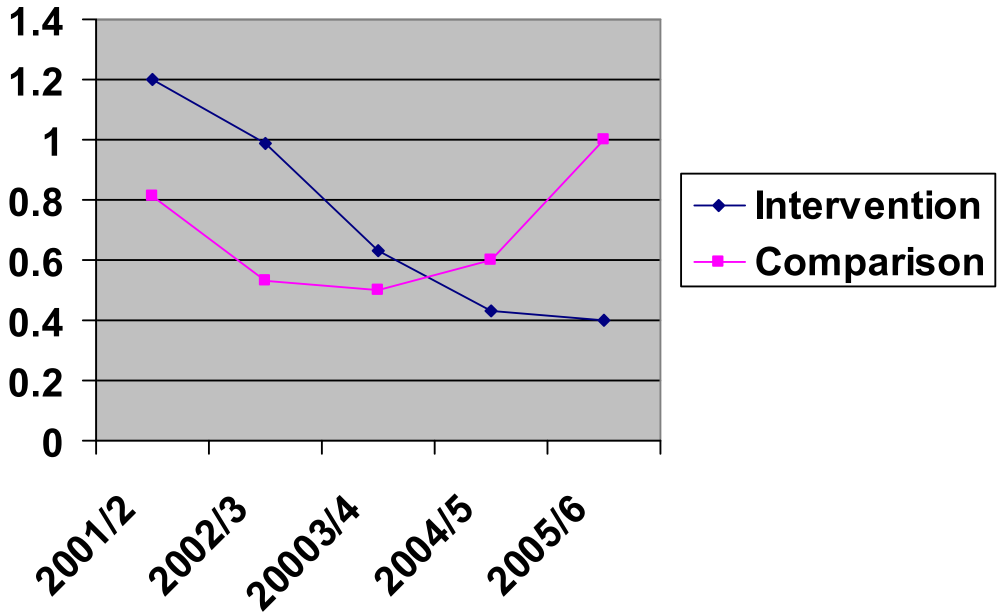


Figure 1b: Trend in absenteeism for students within the cohort over the years

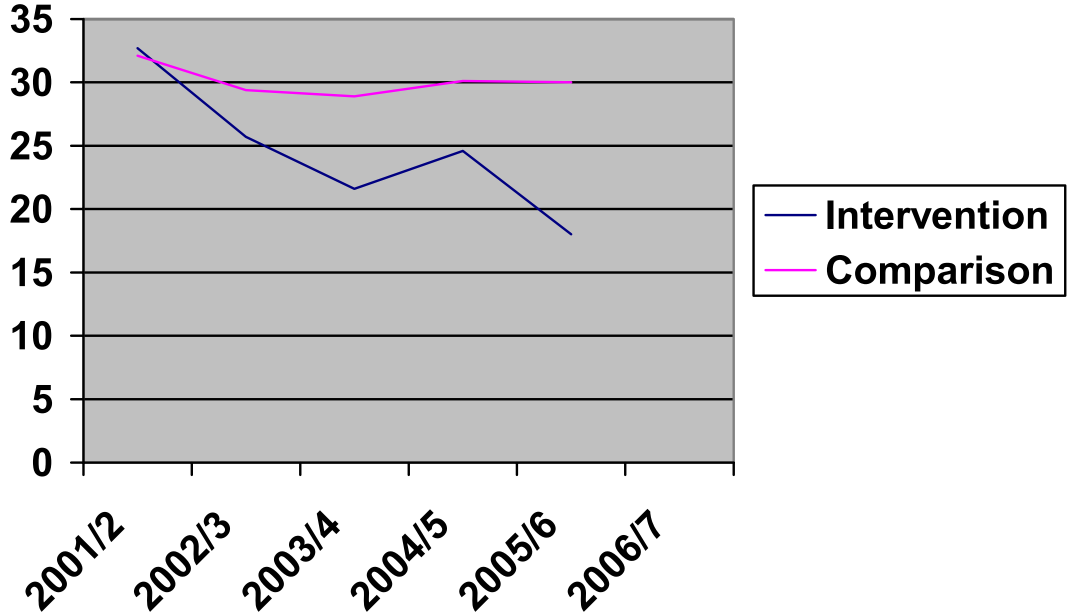


Fig 2: Survival curves for repetition rates in pupils from the intervention and comparison schools

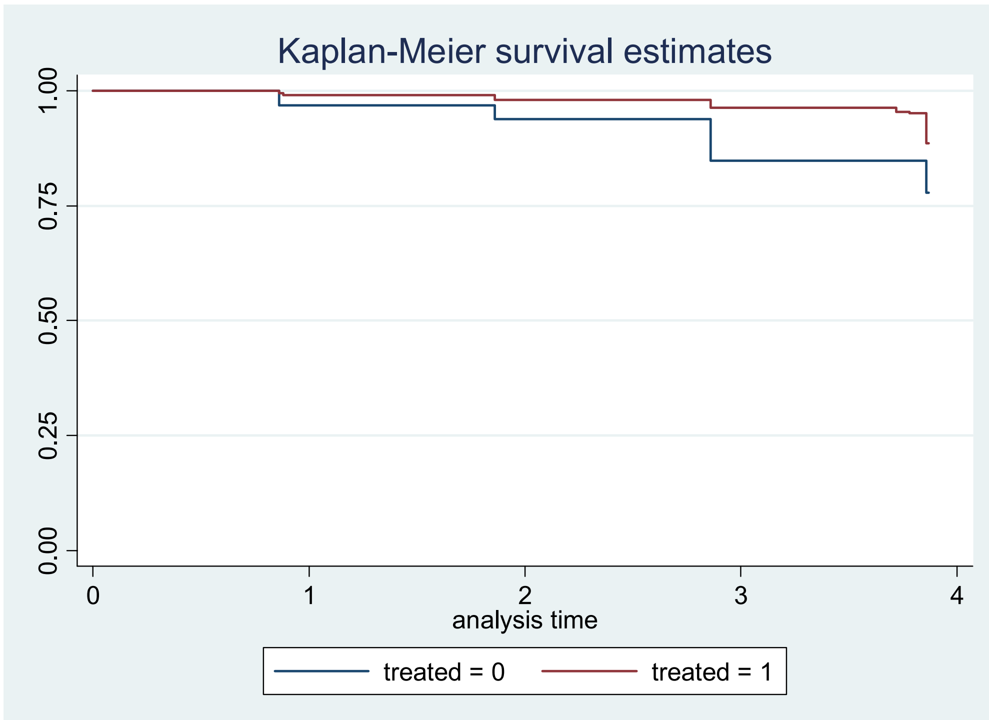


Fig 3: Survivor curves for dropout rates in pupils from the intervention and comparison schools

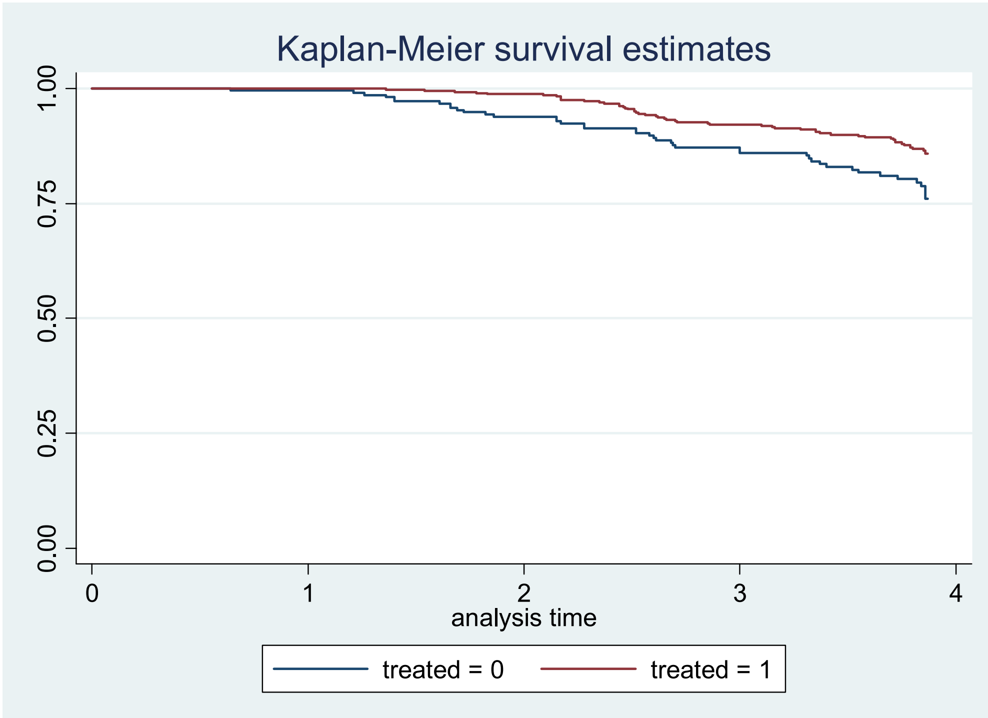
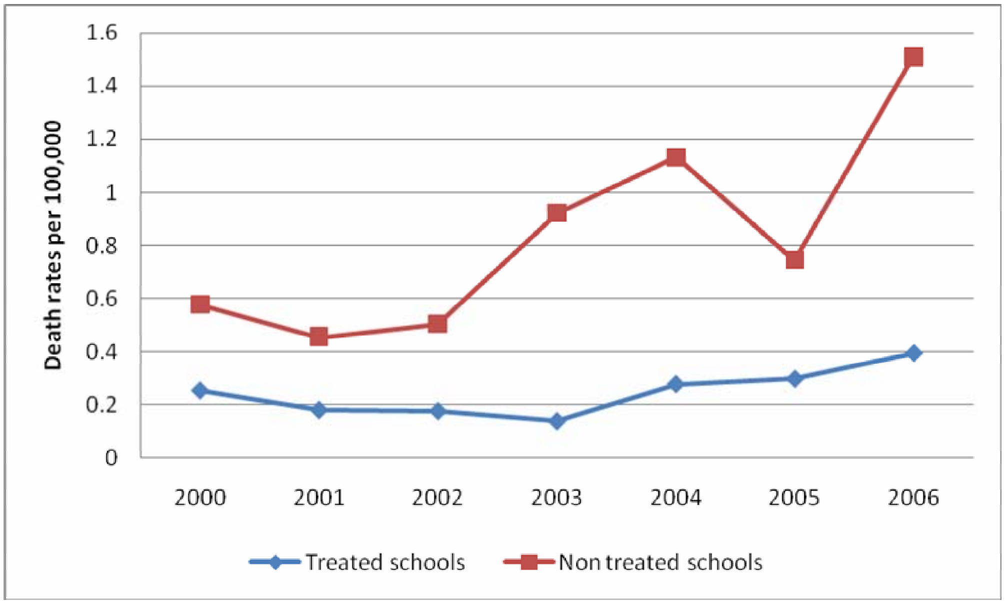


Figure 4: Trends in mortality rate per 1000 student-years, 2000 to 2006 by treatment category*



*** Yearly mortality rates per 100,000 between treatment and control schools**