5 | Effect of Community-Led Total Sanitation on Development of Anemia among Children Aged Below Five Years in Kinango Sub-County, Kwale County

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Abstract

Anemia is a widespread public health problem with detrimental effects on both children and adults. The problem is particularly severe in the developing world, as anemia is closely associated with inadequate nutrition and poor sanitation. Though in Kenya the overall prevalence of anemia among the children is estimated to be 28.8%, a recent nested study of a 2012–2016 maternal-child cohort in coastal Kenya reported that 76% of children have been anemic on at least one time point since birth. Community Led Total Sanitation (CLTS) is a widely used approach to improve community sanitation. In Kwale County, the prevalence of open defecation is high at 51%. Though CLTS is not primarily a nutritional intervention, previous studies have established that it has potential to reduce helminthic infections among children, improve iron absorption and thus reduce anemia. This study sought to establish the effect of CLTS on Anemic status of children under five years in in Kinango Sub-County, Kwale County. This was a quasi-experiment with an intervention and control site. The intervention site received the Community-Led Total Sanitation (CLTS) intervention while the control site received no sanitation related intervention at all. Data on Anemia among children under five years was collected before and after the intervention in a sample size of 402 and 405 respondents in control and intervention sites respectively. Results established that CLTS was found to be effective in reducing the prevalence of Anemia in intervention site compared to control site. A Difference in Differences (DiD) statistic indicated that CLTS reduced prevalence of anemia by 16.1% in intervention site compared to control site. Children in intervention site were 3 times less likely to develop Anemia compared to children in the control site (Adj. OR= 3.064, 95% CI of OR=2.026-4.634, P<0.05). To help reduce Anemia among children under five years, there is need to scale up implementation of CLTS in other parts of Kwale County and in Kenya. Studies linking reduction of Anemia with adequate sanitation are not common. Therefore, more studies are also recommended to help establish more evidence linking CLTS with reduced prevalence of Anemia among children less than five years of age.

Keywords: Anemia, children under five years, community led total sanitation

Introduction

Anemia is a widespread problem defined by low counts of red blood cells or low levels of haemoglobin in the bloodstream, which implies a reduced capacity for the blood to

carry oxygen. In adults, it reduces productivity and is associated with higher maternal mortality. In children, it impairs physical and cognitive development directly and affects human capital accumulation via impacts on behavior such as school attendance. Globally, more than 40% of children have haemoglobin levels below the threshold for anemia. The problem is particularly severe in the developing world, as anemia is closely associated with inadequate nutrition (Coffey, Geruso & Spears, 2017). World Health Organization indicates that anemia is highly prevalent globally, disproportionately affecting children and women of reproductive age. It negatively affects cognitive and motor development and work capacity, and among pregnant women iron deficiency anemia is associated with adverse reproductive outcomes, including preterm delivery, low-birth-weight infants, and decreased iron stores for the baby, which may lead to impaired development. Iron deficiency is considered the most common cause of anemia, but there are other nutritional and non-nutritional causes. Blood haemoglobin concentrations are affected by many factors, including altitude (metres above sea level), smoking, trimester of pregnancy, age and sex. Anemia can be assessed by measuring blood haemoglobin, and when used in combination with other indicators of iron status, blood haemoglobin provides information about the severity of iron deficiency. (World Health Organization, 2013).

Though in Kenya the overall prevalence of anemia among the children is estimated to be 28.8% (Ngesa & Mwambi, 2014), a recent nested study of a 2012–2016 maternal-child cohort in coastal Kenya which evaluated 244 children and found 185 (76%) to have been anemic on at least one time point since birth (Kao *et al.*, 2019). Anemia has a strong adverse influence on children's mental and physical development, including learning, memory, and mental processing speed. This impact has lasting effects through mid-childhood on school performance (Kao *et al.,* 2019). Though published studies linking anemia and poor sanitation are few, researchers have argued that It is thought that inadequate sanitation may exacerbate hookworm transmission, and that hookworm infection may give rise to health problems including anemia, stunting, and wasting (Grimes *et al.,* 2017). Community Led Total Sanitation (CLTS) is a widely used, community-based approach to tackle open defecation, improve community sanitation practices and eventually tackle health-related problems associated with poor sanitation including reduction of helminthic infections in children and adults which has potential to reduce prevalence of Anemia in the community (Harter, Mosch, & Mosler, 2018).

In Kwale County, the prevalence of open defecation is high at 51% (County Government of Kwale, 2018). The county is committed to deliver its rural villages and communities to open defecation free (ODF) and raise household sanitation coverage to above 85% through the Community Led Total Sanitation (CLTS) programme (County Government of Kwale, 2018). Though CLTS is not primarily a nutritional intervention, previous studies have established that it has potential to reduce helminthic infections among children and improve iron absorption and thus reduce anemia prevalence in the

community. The proportion of children who have had anemia at a point in time along the coastal region (kwale inclusive) is high at 76% (Kao *et al.*, 2019). This study sought to establish the effect of CLTS on Anemic status of children under five years in in Kinango sub-county, Kwale county.

Methodology

The Study Area

The study area was Kinango Sub County. Chengoni and Samburu Locations were intervention and control sites respectively. The following map indicates the study site in Kenya.
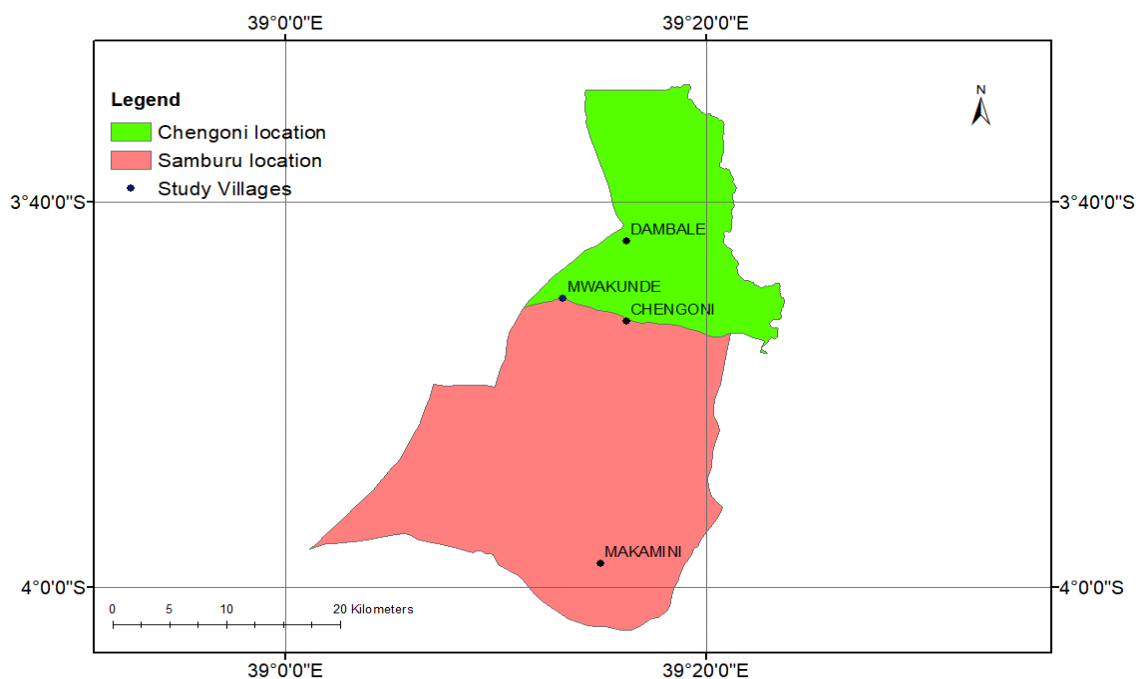

Figure 1: Map of Kinango Sub-County showing intervention (Chengoni) and Control (Samburu) Sites

The Study Design

The study adopted a quasi-experimental study design with one intervention and control site. The Quasi experiment adopted a Pretest-Post Test Study approach

Study population: Children aged <5 years and their parents / guardians

The intervention

The intervention site received the Community-Led Total Sanitation (CLTS) intervention while the control site received no sanitation related intervention at all. In the Intervention site, the following activities were conducted; survey to establish the proportion of villages with evidence of open defecation, health education aimed at triggering community to adopt a positive behavior change in regard to sanitation – the aim was to stop community members from defecating in the open, and constructing latrines using locally available materials.

Data Collection Procedure

Baseline data was collected before intervention was initiated at the intervention site in both intervention and control sites. The intervention was then rolled out in the intervention site for six months. After 6 months, end term data was collected in both intervention and control Sites.

Data Collection Tools

This was part of a larger study in which the researcher administered questionnaire to collect social demographic characteristics of the study population. A Portable Haemoglobinmetre was also used to test blood serum of children under five years for anemia in both intervention and control sites.

Sample Size Determination

Sample size formula used was - Fleiss method [comparing 2 proportions of the target population) was used (Wang, 2007), thus;

$n = (Z\alpha/2+Z\beta) 2 * (p1(1-p1)+p2(1-p2)) / (p1-p2)2$,

Where:

n = Sample size in each group (assumes equal sized groups)

$Z\alpha/2$ = the desired level of statistical significance (typically 1.96 for 5% level of significance)

$Z\beta$ = the desired power (typically 0.84 for 80% power).

p1-p2 = effect size i.e. reduction in diarrhea due to CLTS, set at 10%.

$n = (1.96+0.84)2*(0.55(1-0.55) +0.45(1-0.45))/(0.1)2$

n = 388.08 (approximately = 388 HHs per arm) Plus 10% for non-response (39)

n=427 per arm (Intervention and Control sites), sum of 854

Actual data collected was 402 and 405 respondents in control and intervention sites respectively

Results

Prevalence of Anemia among Children Aged below Five Years

At baseline close to a quarter of the children in the control and intervention site respectively were sufferings from anemia. This is illustrated by the figure below.
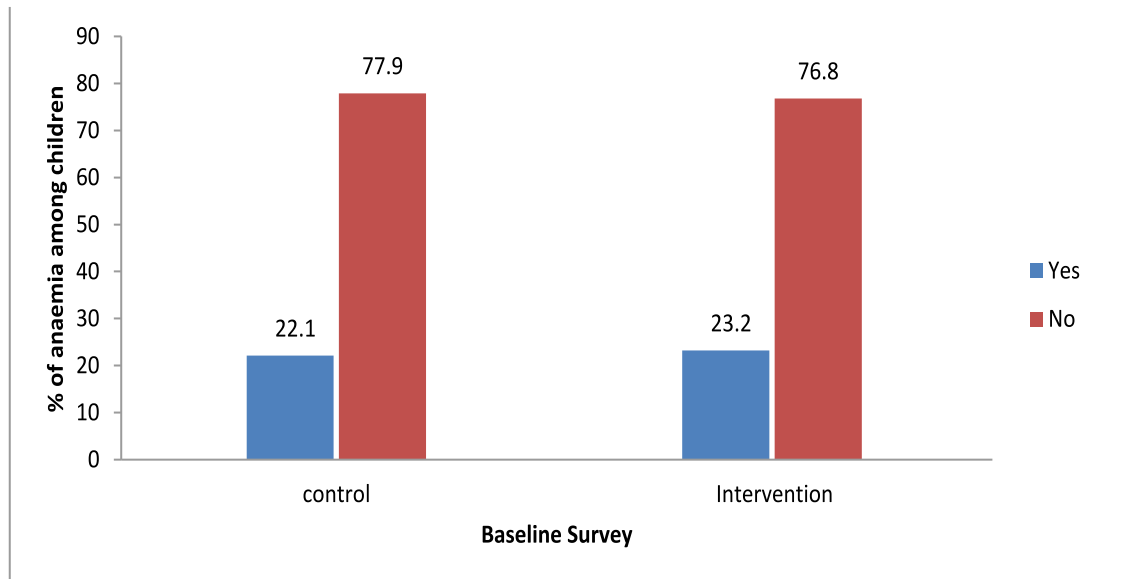

Figure 2: Prevalence of anemia among children below 5 years in Kwale County at baseline

At end term survey close to a quarter of the children in the control site had anemia while in the intervention site only 9.4% of the children had anemia.
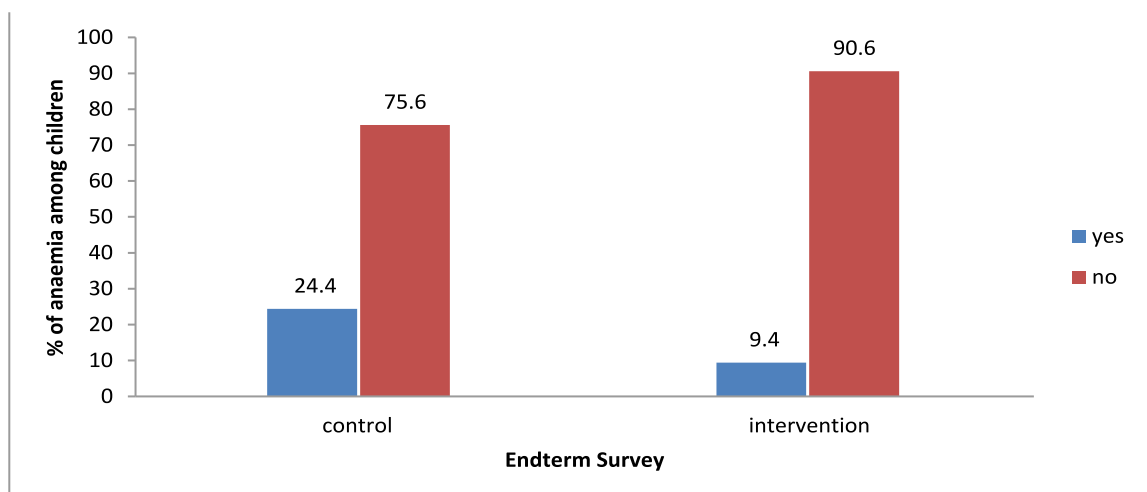

Figure 3: Prevalence of anemia among children below 5 years in Kwale County at end term

Based on the data above, a Difference in Differences (DiD) statistic indicated that CLTS reduced prevalence of anemia by 16.1% in intervention site compared to control site.

DiD = (23.2-22.1) - (9.4-24.4) = **16.1**

Effect of CLTS on Anemia status of children under 5 Years in Kinango Subcounty

The student T test showed that at baseline, there was no significant difference in means of children who had anemia between the control and intervention sites (t= 0.363, p> 0.05). However at end term survey, there was significance difference in means of children who had anemia between the control and intervention site (t =-5.8, p<0.05).

Regression Analysis testing the Odds of Occurrence of Anemia among Under Five Children in Intervention Site Compared to Control Site

Both the crude and adjusted odds ratio at baseline showed that there was no significant difference in occurrence of anemia among children under five years between the control and intervention sites [(*Crude* OR = 0.941, 95% CI = 0.677- 1.308, P> 0.05) and [(*Adj.* OR = 0.938, 95% CI = 0.652- 1.349, P> 0.05)]. However, end term survey indicated that both crude and adjusted odds ratio showed a significant difference in the odds of occurrence of anemia among children under five years between the control and intervention sites.[(Crude OR = 3.113, 95% CI = 2.078- 4.664, P< 0.05)] and [(*Adj.* OR = 3.064, 95% CI = 2.026- 4.634, P< 0.05)].

Table 1

Adjusted Crude Odds Ratio for Anemia at End Term

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Study Arm	1.120	.211	28.128	1	.000	3.064	2.026	4.634
	Age of respondent	.332	.206	2.604	1	.107	1.394	.931	2.088
	Number of children of respondent	-.208	.157	1.755	1	.185	.812	.597	1.105
	Level of education of respondent	-.181	.172	1.119	1	.290	.834	.596	1.167
	Primary Occupation of respondent	.155	.158	.959	1	.327	1.167	.857	1.590
	Marital status	-.200	.179	1.251	1	.263	.819	.577	1.162
	Average Monthly Income	.000	.000	2.504	1	.114	1.000	1.000	1.000
	Constant	1.259	.674	3.492	1	.062	3.523		

a. Variable(s) entered on step 1: Study Arm, Age of respondent, Number of children of respondent, Level of education of respondent, Primary Occupation of respondent, Marital status, Average Monthly Income .

Discussion

Effects of CLTS on Anemia among Children below 5 years

Studies have shown that children without adequate access to sanitation are at high risk to developing Anemia. This is largely because such children are at risk of infection from soil-transmitted helminths which are transmitted through soil contaminated with fecal matter. Helminths especially hookworms contribute to anemia because it induces iron deficiency in children and adults by chronic intestinal blood loss. Studies have shown that two species of hookworms *Ancylostoma duodenale* and *Necator americanus* cause about 0.2 mL and 0.15 mL blood loss per day respectively. Hookworms also release anti-clotting factors (i.e., coagulase, a blood thinner) which ensures continuous blood flow and loss of blood (Osazuwa *et al.*, 2011). This study shows that there is a significant difference in the risk of a child developing anemia in the control site compared to intervention. Adjusted Odds Ratios indicate that children in the control site are three

times more likely to develop anemia compared to intervention site (*Adj.* OR= 3.064, 95% CI of OR= 2.026-4.634, P<0.05). Those findings suggest that the CLTS intervention was effective in reducing open defecation in the intervention site which in turn led possibly to a reduction of helminthic infections and thus reducing the risk of developing anemia among children in the in the intervention site. This is so especially because data indicates that at the baseline survey, there was no difference in the odds of developing anemia in intervention site compared to control site (OR=0.938, 95% CI of OR=0.652-1.349, P>0.05).

This study is supported by several studies. A study contacted by (Freeman *et al.,* 2017) indicates the third direct pathway between poor sanitation and bad nutritional outcomes concerns soil-transmitted helminth (STH) infections, such as Hookworm, Ascaris Lumbricoides and Trichuris Trichiura. These infections result in the malabsorption of nutrients and growth retardation or failure. Malabsorption can lead to Anemia. However other studies have reported that CLTS have no significant impact anemia among children below the age of five years. Similarly in a study done in Philippines the rates of anemia in the CLTS villages were even higher as compared to the national rates (Belizario *et al.,* 2015). The differences in study findings could be due to confounding factors such as deworming and proper nutrition. The contrast in findings could be attributed to differences in program designs, contexts and implementation efficacy (Patil *et al.,* 2014).

Conclusion and Recommendations

CLTS was found to be effective in reducing the prevalence of Anemia in intervention site compared to control site. Children in intervention site were 3 times less likely to develop Anemia compared to children in the control site (*Adj.* OR= 3.064, 95% CI of OR= 2.026-4.634, P<0.05). To help reduce Anemia among children under five years, there is need to scale up implementation of CLTS in other parts of Kwale County and in Kenya. Studies linking reduction of Anemia with adequate sanitation are not common. Therefore, more studies are also recommended to help establish more evidence linking CLTS with reduced prevalence of Anemia among children under five years.

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