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Behavioural and environmental determinants of childhood diarrhoea in Chikwawa, Malawi

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Abstract

The Scotland Chikwawa Health Initiative (SCHI) is carrying out health interventions aimed at achieving measurable results in major causes of disease and death in four villages in Chikwawa, a southern district in Malawi. A baseline survey was carried out in July 2006 in which, among other areas of interest, diarrhoea risks, water sources and use, sanitation and hygiene practices were investigated. This paper analyses domestic water sources, sanitation, and hygiene practice and their impact on child diarrhoea. 97% of the households reported having access to improved water supply surpassing the Millennium Development Goals (MDGs) of 70% by 2015. In contrast, only 48% reported having access to improved sanitation thus lagging behind the MDGs targets of 74% by 2015. A Bayesian logistic regression analysis showed that children from households with no toilet facilities were more likely to have suffered from diarrhoea than those who own such facilities (odds ratio (OR):1.72, 95% CI: 1.18, 2.51). On the other hand children from households that use private taps were less likely to have suffered diarrhoea than those that use public taps (OR = 0.16, 95% CI: 0.08, 0.32). Those where each member uses own basin (OR = 0.37, 95% CI: 0.20, 0.70) or running water on a tap (OR = 0.10, 95% CI: 0.02, 0.53) for washing hands were less likely to have suffered diarrhoea than those that use cups to pour water from containers.

Keywords: Malawi; Water; Sanitation; Diarrhoea; Bayesian logistic regression

1. Introduction

Studies have shown that unsafe water, sanitation and hygiene remain major causes of mortality and

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morbidity in the world through infectious disease with estimated deaths of about 1.7 million per annum. Nine out of ten deaths are amongst children and almost all are in developing countries [1,2]. In the poorest countries and neighbourhoods, unsanitary living conditions account for at least half of the total burden of ill health. The water and sanitation-related health burden for children under the age of five in Africa, for instance, is up to 240 times higher than that of high-income nations [3,4].

In Malawi, only 62% (95% urban, 58% rural) have access to safe drinking water and 64% (90% urban, 60% rural) have adequate improved sanitation [5,6]. Therefore, a significant number of people in Malawi do not have access to "improved" sources of water for drinking. There is also a good chance that those that use "improved" water sources drink water which is unsafe due to contamination at source or unhygienic handling and usage at home [7–9].

It has been observed that multiple interventions consisting of water supply, sanitation provision and hygiene education in developing countries can reduce diarrhoeal illness [4,10–13].

This paper reviews a baseline survey that was carried out by the Scotland Chikwawa Health Initiative (SCHI) in four villages in Chikwawa, Malawi. It analyses and makes recommendations on current water sources, sanitation and hygiene practices and their implication for child diarrhoea.

2. Methods

A baseline survey was conducted in four randomly selected villages of Namila, Sekeni, Mwanayaya, and Mwalija in Chikwawa District from which self reported household data was collected. Out of all the households interviewed only those with children were included in this study. In total there were 1014 households.

A diarrhoea prevalence outcome was modelled to allow examination of water sources, sanitation and hygiene as determinants of child diarrhoea.

The variable derived for diarrhoeal prevalence outcome is *reported diarrhoeal illness* in the last six months (1 = illness reported, 0 = no reported illness). Only those indicator variables whose independent relationships with diarrhoeal prevalence were statistically significant at $p \leq 0.25$ were included in the logistic regression model.

The binary regression model (Souza et al., 2004) [29], is used to explain the probability of a binary diarrhoeal prevalence outcome for children as a function of water sources, sanitation, and hygiene practice after controlling for some demographic and socio-economic variables. If a senior woman representing household i reported child illness due to diarrhoea in her household in the last six months since the day of the survey, then

$$y_i = \begin{cases} 1 & \text{if } i\text{th household reported diarrhoea sickness} \\ 0 & \text{otherwise} \end{cases}$$

Such that $y_i|\pi_i = \mathrm{Ber}(\pi_i)$, $\pi_i = \Pr(y_i = 1) = F(X_i^T\beta)$, where π_i is the probability that the ith household has reported diarrhoeal illness. β is a K vector of fixed regression coefficients corresponding to a set of household level covariates in vector $X_i^T = (x_{i1}, \ldots, x_{iK})$.

A logistic link function was used and model estimation was achieved using a Bayesian approach. MLwiN 2.02, Minitab 15 and Microsoft Office Excel 2003 were used for analysis.

3. Results

Fig. 1 compares percentages of diarrhoea prevalence, improved water sources[1] and improved sanitation[2] between four villages with the National figures of 2004 and Millennium Development Goals (MDGs) targets of 2015 [14]. All the four villages have surpassed the 2015 MDG-Targets and the 2004 national average on improved water sources. However, Mwanayaya village has a high proportion of unsafe water supply when compared to all other villages. On improved sanitation, the three rural villages of Namila, Mwanayaya and Mwalija are lagging behind the 2015 MDG-Targets and the 2004 national averages. The situation is worse mostly in Namila and Mwalija with over 70% without improved sanitation. Only the peri-urban village of Sekeni has its targets well above the national averages and those of the 2015 MDG-Targets [28].

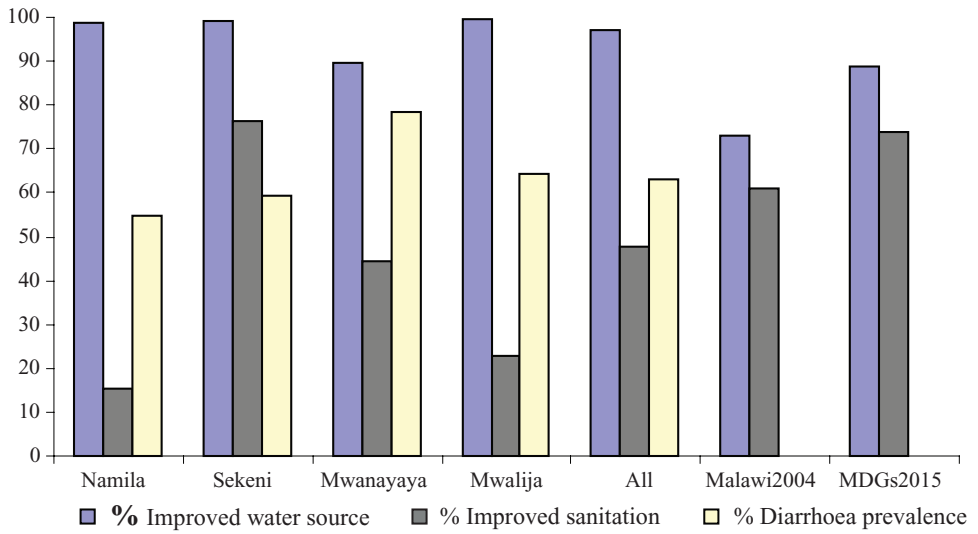

Fig. 1. Diarrhoeal prevalence, improved water sources and sanitation.

On diarrhoeal prevalence, Mwanayaya has the highest diarrhoeal prevalence (78%) followed by Mwalija (64%) and the peri-urban village of Sekeni (59%). Mwanayaya has the highest proportion of households without improved water sources and lies along the river bank marshes that may be providing sanctuary to water borne diseases. Although Sekeni and Mwalija have the highest proportion of people with improved water sources, they also have slow moving streams and standing water bodies near them that are used for other household chores such as washing, bathing, and even drinking (see Fig. 2).

Bayesian logistic regression results of reported diarrhoeal sickness amongst children in the last six months are reported in Table 1. After controlling for all other variables, children from Mwanayaya were statistically more likely to have been reported sick with diarrhoea than those from Namila (OR = 2.58, 95% CI: 1.53, 4.34). Diarrhoeal prevalence rates from Mwalija and Sekeni were not significantly different from those of Namila in spite of having higher rates.

Children belonging to households with mothers above the age of 40 years were less likely to have been reported sick with diarrhoea (OR = 0.33, 95% CI: 0.17, 0.63) in the last six months than children from households with mothers of ages 15 years or less. There was no significant difference between households with mothers between the ages of more than 15–40 years and those with ages of 15 or less.

Households with five or six members were more likely to have childhood diarrhoea than those with two members only (OR = 1.83, 90% CI: 1.01, 3.32). The likelihood of diarrhoeal prevalence increased with increasing number of household members.

Households with secondary school educated women were less likely (OR = 0.58, 90% CI: 0.35, 0.96) to report diarrhoea sickness of children than those households with women that had no formal education. There was no significant difference in childhood diarrhoea between households with primary school educated women and those that had not attended any school.

Households with no toilet facilities were more likely to have reported diarrhoeal sickness amongst their children (OR = 1.72, 95% CI: 1.18, 2.51) than those with an own toilet facility. However, there was no statistical difference between those using public toilet facilities and those with no toilet facilities.

Fig. 2. Slow filthy moving stream Near Sekeni village.

Respondents that reported using private taps were less likely to have reported childhood diarrhoea than those using public or compound piped water (OR = 0.16, 95% CI: 0.08, 0.32). There was no statistical difference between those using boreholes or wells and those using public or compound piped water.

Lastly, those women that reported using either running water on a tap or each person using their own basin when washing hands were less likely to have reported childhood diarrhoea than those women that reported using a cup to pour water from a container (OR = 0.10, 95% CI: 0.02, 0.53 and OR = 0.37, 95% CI: 0.20, 0.70 respectively). There was no significant difference between households washing their hands using a cup and those that use one basin for all members for washing hands.

4. Discussion and recommendations

Although there is adequate provision of improved water sources in the villages under study based on the 2015 MDG-targets and 2004 national averages, there is need to focus attention on Mwanayaya village which has a higher proportion of households without improved water sources. A good number of households from Mwanayaya use unprotected wells as sources of their water. It seems more likely that the high prevalence rate of diarrhoea amongst children from this village is partly due to this problem apart from its being located along the marshes of a river bank. Table 1 confirms that those using wells (which are mostly unprotected) are more likely to have childhood diarrhoea in their households.

In spite of boreholes and protected wells qualifying as improved water sources based on WHO definition, there is need to teach households and more especially children about safe water usage and management at the water sources. It has been observed that poor hygiene practices at water sources may be caused by a number of reasons that include lack of knowledge on sanitary principles, water costs, inadequate safe water sources and problems of distance [15]. In the case of the four villages, overcrowding, animals, garbage, poor water usage, and management may be the reason why households using boreholes (although not significant) were more likely to have childhood diarrhoea (Table 1). Cost of water and easy proximity to contaminated water sources such as the case in Sekeni and Mwalija (see Fig. 2) is another important contributor to childhood diarrhoeal prevalence. Although Sekeni is

Table 1
Bayesian logistic regression model fitted for reported child diarrhoea prevalence at household level in 6 months.

Variable	Category	Odds ratio	Credible interval (CI)	
			95%	90%
Village	Namila	1.00		
	Sekeni	2.42	(0.82, 7.18)	(0.97, 6.01)
	Mwanayaya	2.58	(1.53, 4.34)*	(1.67, 3.99)*
	Mwalija	1.48	(0.95, 2.39)	(0.99, 2.21)
Maternal age	Below 15	1.00		
	15–25	1.08	(0.52, 2.22)	(0.59, 1.98)
	25–40	0.94	(0.52, 1.69)	(0.57, 1.53)
	Above 40	0.33	(0.17, 0.63)*	(0.19, 0.56)*
Size of membership	2 people	1.00		
	3 or 4	1.47	(0.74, 2.91)	(0.83, 2.60)
	5 or 6	1.83	(0.90, 3.73)	(1.01, 3.32)*
	7 or more	1.84	(0.85, 3.99)	(0.96, 3.51)
Education	None	1.00		
	Primary	1.01	(0.72, 1.42)	(0.76, 1.36)
	Secondary	0.58	(0.32, 1.06)	(0.35, 0.96)*
Sanitation	Own toilet	1.00		
	Public toilet	1.14	(0.79, 1.65)	(0.84, 1.55)
	No toilet	1.72	(1.18, 2.51)*	(1.25, 2.36)*
Water source	Public water	1.00		
	Well	1.81	(0.67, 4.87)	(0.79, 4.14)
	Borehole	1.66	(0.58, 4.72)	(0.69, 3.98)
	Private taps	0.16	(0.08, 0.32)*	(0.09, 0.29)*
Hand washing	Uses cup to pour water from container	1.00		
	One member one basin	0.37	(0.20, 0.70)*	(0.22, 0.63)*
	All members one basin	0.80	(0.46, 1.38)	(0.50, 1.27)
	Running water on tap	0.10	(0.02, 0.53)*	(0.03, 0.41)*

*Significant.

registered with highest improved water sources (99.23%), this may be misleading as many households collect water from a compound tap in the sugar plantation staff housing. This water is directly drawn from the Shire River with no treatment and so acts as a high risk water source. Furthermore, water has to be carried from the compounds. This is a prohibitive scenario and many households especially children prefer to use other nearby contaminated water sources. This may explain the high prevalence of diarrhoea in Sekeni village in spite of using piped water for drinking.

There is a significant problem in relation to the availability of toilet facilities. All the rural villages of Namila, Mwanayaya, and Mwalija have sanitary proportions that are way below the 2004 national averages and the 2015 MDG-Targets (Fig. 1). Logistic regression results in Table 1 show that those with no toilet facility are more likely to have childhood diarrhoea

in their households. This is consistent with studies in Eritrea [16] and Ghana [17] that observed that the risk of having diarrhoea is significantly associated with a toilet facility. The studies further demonstrated that children living in houses with toilet facilities were less likely to contact diarrhoea than children living in houses without such facilities. However, this study did not find any significant relationship between disposal of young children's faeces and diarrhoea. An earlier study in Blantyre, Malawi [18] found that a potential exists for widespread contamination of the surrounding environment and transmission of faecal–oral disease due to lack of attention afforded to the disposal of young children's faeces. It is essential; therefore, that emphasis should be put on improving sanitation especially in the three rural areas.

Currently the SCHI project has introduced eco-sanitation[3] latrines in the four pilot villages of Chikwawa with the aim of empowering households to use local resources to construct improved toilet facilities. Improvements on sanitation have already been registered using other versions of eco-sanitation in other parts of Malawi [19].

The results of the Bayesian logistic regression analysis for reported childhood diarrhoeal prevalence of Table 1 show that childhood diarrhoea is high among households with young mothers who have not attended higher education. Experience may explain the difference in childhood diarrhoea amongst households with women who have not attended any formal education. Young mothers with no education may have no or little knowledge or experience in caring for children compared to older women who acquire their knowledge through years of child rearing and learning. This is consistent with another study in Malawi [20] which found that lack of education at household level is an implicating factor in the contraction of cryptosporidiosis. Other studies [21–24] have observed that education translates to better skills and knowledge that are essential in understanding and using existent healthcare resources. Thus short-term health planning should include educating young mothers on the benefits of proper hygiene practices, sanitation, proper stool disposal and use of treated water. For long term goals, emphasis should be placed on community awareness and benefits of sending a girl child to school.

Results also show that households with more members are more likely to have childhood diarrhoea than those with fewer members. These results are in line with a study in Eritrea [16] which observed that diarrhoeal prevalence increases with increasing number of children living in a household.

The increased likelihood of childhood diarrhoea amongst households that either wash their hands using a cup by drawing water from a container or those that use one basin for all household members is an indication of underlying poor hygiene practices. Use of a cup to draw water from a container provides a number of avenues for contamination. Members of the household with dirty hands, particularly children, may dip their hands into containers or may leave cups on unprotected surfaces and this may contribute to contamination. Similarly household members who may have used a latrine, changed a nappy, or that may have been in contact with any faecal matter and may not have properly washed their hands thereafter provide opportunities for contamination. A number of authors have already demonstrated or observed that hand washing can help reduce diarrhoea [4,10,15,25–27]. It is important, therefore, in all education messages to emphasise the good hygiene practice of using water for washing hands before taking any food, after using the toilets, and on other occasions when hands have been soiled.

Finally, this study sought to investigate childhood diarrhoeal prevalence in relation to environmental and behavioural factors in four pilot villages in Chikwawa District, Malawi. The results are based on retrospective reporting from cross-sectional data. This may result in possible biases due to incomplete and unrepresentative data. Furthermore, only information from surviving women that were present during interviews was recorded implying that no data was available for households of women who died or were not available. During the survey the mothers were not given a precise definition of what constitutes an episode of childhood diarrhoea. Therefore, the questions relied on the mother's perception other than clinical or actual definitions or estimates. This may create variations among different households and villages because perception of childhood diarrhoea is not the same across different groups of people. To reduce the effect of these methodological limitations, questionnaires from each enumerator were carefully audited and data was screened

to ensure consistency and to determine if the data conforms to expected patterns. Cross-sectional data remains an important tool of examining health issues that may be of relevance to health development programmes in Malawi. This is more so in the absence of proper individual records (as is common in many developing countries), or in the absence of detailed longitudinal or clinical surveys.

NOTES

1. According to the World Health Organisation (WHO, 2003) improved water source includes any of the following types of drinking water sources: household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collection.
2. Improved sanitation includes any of the following: connection to a public sewer, connection to a septic tank, pour-flush latrine, simple pit latrine and ventilated improved pit latrine.
3. Eco-sanitation technologies are shallow pit latrines (about 1m) with locally woven baskets placed inside the pit and a movable superstructure placed on top of the latrine (see plates 2(a) and 2(b). The basket is meant to protect the sandy soil (common in Chikwawa) from collapsing. Every time a household member uses the latrine he/she adds a mixture of soil and ash to the pit. When it is almost full the superstructure is moved to another pit and the latrine is filled with soil. A tree or vegetables such as pumpkins are then planted utilising the composite on the filled latrine. After a few years of latrine movement the result can be a healthy orchard with an economic value to the household and community.

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