

ASSESSMENT AND COMPARISON OF MICROBIAL QUALITY OF DRINKING WATER IN CHIKWAWA, MALAWI

BY:

George C. JABU
University of Strathclyde
Department of Civil Engineering
Glasgow G4 0NG.
E-mail: g.c.c.jabu@strath.ac.uk

ABSTRACT

An assessment and comparison of the microbial quality of stored drinking water was carried out in two villages in the rural district of Chikwawa in Southern Malawi. IDEXX Colilert® was used as a qualitative method for determining the presence/absence of coliforms and *Escherichia coli* (*E.coli*) a bacterial indicator of faecal contamination. All (100%) of the stored drinking water samples from both villages tested coliform positive. In Village A, 91% of water samples tested *E. coli* positive while in Village B, 80% of water samples tested *E. coli* positive. In addition, hands of women as primary collectors of water from both villages were examined for the presence of *E. coli*. In Village A, 55% women hands were found to be *E.coli* positive while in Village B, 58% were positive. The results highlight the need for improvements in the provision of wholesome drinking water, improved personal hygiene and environmental sanitation.

INTRODUCTION

Water is the essence of life and safe drinking water is a basic human right essential to all. Water is essential for the well being of mankind and for sustainable development. Though water is necessary for human survival, many are denied access to sufficient potable drinking water supply and sufficient water to maintain basic hygiene. The affects of drinking contaminated water results in thousands of deaths every day, mostly in children under five years in developing countries (WHO, 2004). In addition, diseases caused through consumption of contaminated water, and poor hygiene practices are the leading cause of death among children worldwide, after respiratory diseases (WHO, 2003). Thus lack of safe drinking water supply, basic sanitation and hygienic practices is associated with high morbidity and mortality from excreta related diseases. Diarrhoeal illness remains a major killer in children and it is estimated that 80% of all illness in developing countries is related to water and sanitation; and that 15% of all child deaths under the age of 5 years in developing countries result from diarrhoeal diseases (WHO, 2000, 2004; Thompson and Khan, 2003).

Globally, 1.1 billion people rely on unsafe drinking water sources from lakes, rivers and open wells (Photo 1a). The majority of these are in Asia (20%) and sub-Saharan Africa (42%). Furthermore, 2.4 billion people lack adequate sanitation worldwide (WHO/UNICEF, 2000; WHO/UNICEF-JMP, 2004). In Malawi, out of the total population of 11.8 million people, only 62% (95% urban and 58% rural) have access to safe drinking water and 64% (90% urban and 60% rural) have adequate improved sanitation (Malawi Demographic Health Survey, 2000).

The objective of the United Nations Millennium Development Goals (MDGs) is to reduce persistent poverty and promote sustainable development worldwide especially in developing countries. Improvement of drinking water supply and sanitation is a core element of poverty reduction. The MDG target for water is to 'halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation'. This MDG target will at least reduce the above numbers of people without potable water and adequate sanitation but the provision of water supply especially in developing countries may not be sufficient because of (a) high population growth, (b) conflict and political instability, and (c) low priority given to water and sanitation programmes. The WHO (2004) estimates that if these improvements were to be made in sub-Saharan Africa alone, 434,000 child deaths due to diarrhoea would be averted annually.

Boreholes as a low-cost technology option for domestic water supply in developing countries are generally considered as 'safe sources' of drinking water (Photo 1b). When properly constructed and maintained, they provide consistent supplies of safe and wholesome water with low microbial load and little need for treatment of the drinking water. However, it is the collection, transportation, storage and decanting of water that can lead to subsequent contamination (Howard *et al.*; 2003).



Photo 1a: Unprotected shallow well
(Chikwawa, Malawi)



Photo 1b: Borehole
(Chikwawa, Malawi)

AIM OF THE STUDY

This study investigated the hygienic handling practices of drinking water from source to point of use in two rural villages in Chikwawa, Malawi. It sought to compare the level of personal and domestic hygiene; and environmental sanitation as determinants of microbial drinking water quality at household level.

METHODOLOGY

Two villages (A and B) in Chikwawa were randomly selected for the study. The population for Village A was 1356 people with 300 households while the population for Village B was 603 with 105 households. In Village A, 127 (43.3%) households were recruited while in Village B, all 105 (100%) households were sampled for the study.

A survey, using a semi-structured questionnaire, focus group discussion and observation were research techniques employed to collect data. IDEXX Colilert® Presence/Absence test was used to determine microbiological quality of drinking water in the two villages. In addition, the hygienic standard of hands of 100 and 98 women in Villages A and B respectively was established by examining handwash water for the presence of *E.coli* (Jabu and Grimason, 2005).

RESULTS

The communities in the two study villages are of low socio-economic status and earn their living through subsistence farming. In general, housing is of poor and inadequate standard. With respect to sanitation, only 1 in 3 (n=44) households in Village A and 1 in 4 households in Village B (n=26) were found to have pit latrines. As the majority of households had no latrines, open defaecation is widely practised by the residents of both villages.

Both villages used boreholes as the main source of drinking water supply. Although, Village A had two boreholes, one had broken down and was abandoned (Photo 2a). This is a common problem in rural areas in Malawi, primarily due to the lack of spare parts and poor maintenance. Consequently, queues and congestion formed at the other functional borehole. As a result, 1 in 3 women (n=39) by-passed the functional borehole and collected their drinking water from the nearby Nasolo river (Photo 2b). This river is heavily polluted by a number of point and non-point sources of pollution. In contrast, Village B only had one borehole to supply the needs of the village and the nearby Shire river was never used due to orders sanctioned by the village chief.



Photo 2a: Abandoned borehole
(Chikwawa, Malawi)



Photo 2b: Nasolo river
(Chikwawa, Malawi).

The microbiological analysis of borehole abstracted water did not reveal the presence of either *E.coli* or total coliforms. While the results of all water samples taken from

every drinking water storage container from both villages were positive for total coliforms. The majority of water samples taken from both villages were also found to contain *E. coli*. Only 9% (n=12) and 20% (n=21) stored water samples from Villages A and B were *E.coli* negative respectively. All handwash water samples obtained from the women who collected the water tested positive for total coliforms. However, just over half of all women's hands were found to be faecally contaminated with *E. coli* in both villages (Villages A = 55%; Village B = 58%).

DISCUSSION

Health is determined by many factors, including income, environmental conditions like access to adequate sanitation and safe drinking water suppliers, behaviour change and availability of health services. More than half of the world's population lives in villages in rural areas and most of those without access to safe drinking water supply or basic sanitation are rural dwellers (Howard *et al.*, 2002). In Malawi, the majority of people (88%) reside in rural areas and depend on subsistence farming for a living.

The majority of diseases in developing countries are infectious diseases in nature caused by bacteria, viruses and other microbes, which are shed in human faeces and pollute water supplies which people use for drinking and washing purposes. Unsafe water supply is a major problem and faecal contamination of water sources and treated water is a persistent problem worldwide (WHO, 2002). Faecal indicator bacteria have been used to measure water quality and personal hygiene standards in a variety of settings (Kaltenthaler *et al.*, 1996). In this study, the bacterial faecal indicator *E. coli* was used to provide an insight into the water quality from source to consumption and hand hygiene levels in both villages.

Chikwawa is one of the poorest rural districts in Malawi with limited essential amenities. This was reflected by low sanitation coverage in Village A (35%) and Village B (25%). As a result diarrhoeal diseases including cholera are endemic in Chikwawa and pose a major health problem and challenge to health service providers in the district.

Groundwater is a relatively safe source of potable water in rural areas compared with other unprotected water sources e.g. river, spring, well water etc. Water samples taken directly from both boreholes in this study yielded neither coliforms nor *E. coli*. These results are similar to the findings of an earlier study undertaken in Chikwawa (Staines, 2000), which found no *E. coli* in water samples taken from 27 boreholes. In this study, it was found that contamination of collected and stored household drinking water is significant in both villages. *E.coli* was detected in 9 out of 10 (91%) stored water samples from Village A and 8 out of 10 (80%) samples from Village B. The presence of *E. coli* in drinking water denotes that the water has been faecally contaminated and therefore presents a potential risk of excreta related diseases. Safe drinking water should have nil *E. coli* in 100 ml of water (WHO, 1993, 1997; DeZuane, 1997). Contamination after collection and during transportation and storage is increasingly being recognised worldwide as an issue of public health importance (Lindskog and Lindskog, 1988; Genthe and Strauss, 1997).

In both villages, women and young girls are the primary collectors of drinking water. After collection, drinking water is transported to households and stored in various types of water containers. Containers used for collection and transportation of water

from boreholes to households were wide mouthed and without covers. It was observed that when lifting and balancing the collection vessel on the head, fingertip-dipping was common and unavoidable. In this study, just over half of the hands of the primary collectors of water were found to harbour *E. coli*. These findings are similar to an earlier study, which found between 67-75% of primary school children's hands in Chikwawa harboured *E. coli*. (Jabu and Grimason, 2005). Thus, fingertip-dipping may have resulted in the water becoming contaminated through contact with hands. Other studies have also found a similar deterioration in water quality between the source of drinking water and point of consumption/use (Lindskog and Lindskog, 1988; Genthe and Strauss, 1997). Thus contamination of drinking water after collection from the source may pose another risk for contracting diarrhoeal disease.

CONCLUSION

A combination of safe drinking water, adequate sanitation and hygienic practices like hand washing is a pre-requisite for morbidity and mortality rates reduction, especially among under five year old children in developing countries. To reduce the incidence and prevalence of diarrhoeal diseases, improvements in the availability, quantity and quality of water, improved sanitation, and general personal and environmental hygiene is required. The majority of people in developing countries do not have access to piped drinking water and must carry, transport and store water within their homes and in the process the quality of water may deteriorate.

In this study, the quality of groundwater supplied by each borehole was satisfactory with no faecal indicator bacteria detected. In contrast, the vast majority of collected and stored water; and primary collectors of water's hands were found to harbour *E. coli*. The presence of *E. coli* in water indicated that the drinking water had been faecally contaminated thereby presenting a potential health risk to the consumer. The source of microbiological contamination of the drinking water in this study is most likely due to poor hygienic water collection, transportation, storage and handling practices.

Hygiene is key to improved health. People can protect themselves from diarrhoeal diseases and other infections if they are provided with the appropriate information and if they are encouraged to change their behaviour. It is therefore important to promote and enhance continuous hygiene education programmes in water and sanitation in order to change behaviours. This may reduce the prevalence of diarrhoeal disease and promote the health of people in rural villages such as in Chikwawa.

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