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# ASSESSMENT OF WATER SANITATION AND HYGIENE INTERVENTIONS IN THE PREVENTION OF DIARRHEAL DISEASE IN CHILDREN UNDER-FIVE YEARS IN BAMA LOCAL GOVERNMENT AREA OF BORNO STATE

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**Abstract**: The study was conducted to assess water sanitation and hygiene interventions in the prevention of diarrheal diseases in children under five years of age. Four hundred structured questionnaires were administered to a population of mothers/caregivers over an eight-week period 231 in Shehuri, 69 in Kasugula and 100 in Soye town. Sampling was randomly drawn from a multi-stage system with data obtained were analysed It is a descriptive analysis. In hygiene related practices over 96.0% respondents washed hands with or without soap, 83.0% washed children dish with soap and water and 44.5% practiced hand feeding. For sanitation interventions and increased access to clean water and proper household water storage and treatment significantly reduces diarrheal morbidity and thus prevent diarrhea among children aged below five years. The importance of sustained public health education campaign cannot be over-emphasized.

*Keyword*: Water, sanitation, hygiene, diarhhoea, children, under-five

## **1. Introduction**

Diarrhea is one of the commonest presentations in the paediatric age group especially in children less than five years in any part of the world. In Africa and other developing countries, it is the leading cause of morbidity and mortality among children wherein the under fives, an estimated 1.3 thousand episodes and 4 million deaths occur each year, worldwide. Children experience an average of 3.3 episodes each year, but in some areas the average exceeds nine episodes and where episodes are frequent young children may spend more than 15% of their days with diarrhea (WHO, 2000). Diarrhea originated from the Greek word "diapon" meaning to flow everywhere. It is the passage of loose or fluid stool more frequently than is normal for the individual. It is primarily the symptom of gastrointestinal infection

Acute diarrhea causes approximately three million deaths each year in the developing world and 80% of these occur in the first two years of life. The main cause of death from acute diarrhea is dehydration which results from loss of fluid and electrolyte in diarrheal stool. The predisposing factors contributing to the high incidence of diarrhea are a

depressingly familiar list of poor education, inadequate hygiene, poor water supply, poverty, inadequate sanitation and overcrowding. All these directly or indirectly result in faecal contamination of the child's water and food supply. Diarrheal also represent an economic burden for the developing countries. In many nations (especially developing countries) more than a third of hospital beds for children are occupied by patients with diarrhea. These patients are often treated with expensive intravenous fluids and ineffective drugs, WHO (n.d).

Ironically, diarrheal diseases are preventable and due to this it was included with some other preventable killer diseases such as malaria, malnutrition, measles, acute respiratory infections and HIV/AIDS to develop the programme of integrated management of childhood illnesses (IMCH). Integrated management of childhood illnesses (IMCH) was founded in 1995 by W.H.O. and UNICEF with the aim of reducing morbidity and mortality as well as to promote growth and development in children less than five years in a holistic manner using inexpensive, effective and affordable techniques.

IMCHI has 3 components or intervention areas which include:

- (i) Improving health workers skills
- (ii) Improving health system issues
- (iii) Community and family practices This is further sub-divided into:
- (a) Growth promotion and development
- (b) Home Management
- (c) Disease prevention
- (d) Care-seeking and compliance

With respect to this study, we are focusing on disease prevention under community and family practices. "Prevention is better than cure" is one of the prime messages of public health. It differentiates public health from the clinical disciplines that are primarily involved with the care of the sick.

Prevention was initially constructed narrowly in terms of protective measures like vaccinations and improved nutrition that target only healthy people with the aim of preventing the onset of disease. The concept was extended to cover the early diagnosis and prompt treatment of sick persons with the aim of preventing advanced disease and in the case of communicable disease preventing spread within the community. Further extension of the definition covers the limitation of disability and restoration of function as much as possible.

Diarrheal disease can be prevented by ensuring hygienic household practices such as proper disposal of faeces and refuse, proper hand washing after handling faeces and before feeding, health education, improving standard of living and increasing access to clean water. The impact of improved health care services on health outcomes of households and community cannot therefore be over-emphasized. The study will also go further to invariably look into the implication of diarrhea and the disease pattern to health planning and management among policy makers.

The concept of water resources is multi-dimensional. It is not limited only to its physical measure (hydrological and hydro-geological), the 'flows and stocks' but encompasses other more qualitative, environmental and socio-economic dimensions. Water according to Webster Dictionary (2005) is the liquid that descends from the clouds as rain, forms, streams, lakes and seas and is a major constituent of all living matter and that when pure is an odourless, tasteless, very slightly compressible liquid oxide of hydrogen H<sub>2</sub>O which appears

bluish in thick layers, freezes at 0°C and boils at 100°C, has a maximum density at 4°C and a high specific heat, is feebly ionized to hydrogen and hydroxyl ions and is a poor conductor of electricity and a good solvent. Furthermore, according to medical definition, it is the liquid that descends from the clouds as rain, forms streams, lakes and seas and is a major constituent of all living matter and that is an odourless, tasteless, very slightly compressible liquid oxide of hydrogen H<sub>2</sub>O which appears bluish in thick layers, freezes at 0°C (32°F) and boils at 100°C (212°F), has a maximum density at 4°C (39°F) and a high specific heat, is feebly ionized to hydrogen and hydroxyl ions and is a poor conductor of electricity and a good solvent (WHO, 2005).

Unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrheal disease annually, causing more than 1.5 million deaths, mostly among children less than 5 years of age (WHO, 2005). Because diarrheal diseases inhibit normal ingestion of foods and absorption of nutrients, continued high morbidity also contributes to malnutrition, a separate cause of significant mortality, it also leads to impaired physical growth and cognitive function, reduced resistance to infection and potentially long-term gastrointestinal disorders. Contaminated drinking water is also a major source of hepatitis, typhoid fever and opportunistic infections that attack the immune compromised especially persons living with HIV/AIDS. Outbreaks of acute water diarrhea (AWD) add to the disease burden and require costly diversion of scarce health and other resources to minimize fatalities. Diseases associated with contaminated water also exact a heavy economic load in the developing countries both on the public health care system for treatment and on persons affected for attendance and performance, particularly for girls and young women who must care for and assume the duties of ill parents and siblings. As part of its Millennium Development goals, the United Nations expressed its commitment by 2015 to reduce by one half the people without sustainable access to safe drinking water. Current estimates are that there are still 1.1 billion people without this access (WHO/UNICEF, 2006). Considerable progress is being made in expanding the coverage of "improved water supplies" such as protected wells and springs, boreholes and household connections. However, results from a recent assessment in six pilot countries, found that 31% of drinking water samples from boreholes exceeded WHO guideline values (GV) and national drinking water standards in the pilot countries for faecal contamination, the leading source of infection and disease (Rapid Assessment of Drinking Water Quality (RADWQ, 2006). At the house level, contamination of stored water is even more common. In one of the pilot countries, only 43.6% of samples from stored water were in compliance with the WHO guideline value and national standards, and more than half of households samples showed post-source contamination. This is consistent with a large body of research worldwide that has shown that even drinking water which is safe at the source is subject to frequent and extensive faecal contamination during collection, storage and use in the home (Wright, 2004). Treating water at the household level has been shown to be one of the most effective and cost-effective means of preventing water-borne diseases in development and emergency settings. Promoting household water treatment and safe storage (HWTS), helps vulnerable populations to take charge of their own water security by providing them with the knowledge and tools to treat their own drinking water.

Safe water is a precondition for health and development and a basic human right, yet it is still denied to hundreds of millions of people throughout the developing world. Water related diseases caused by insufficient safe water supplies coupled with poor sanitation and

hygiene cause 3.4 million deaths a year (WHO, 2006) mostly among children. Despite continuing efforts by governments, civil society and the international community, over a billion people still do not have access to improved water sources. The scale of the problem of water quality is even larger. It is increasingly clear that many of the existing improved sources in developing countries do not provide water of adequate quality for domestic purposes. A well-known example of this is the extensive contamination of tube wells with naturally occurring arsenic in Asia. As serious as this and other cases of chemical contamination are, the principal cause of concern is microbiological contamination, especially from faeces. While ground water is generally of much higher microbiological quality than surface water, an increasing number of sources and systems used by people for drinking and cooking water are not adequately protected from faecal contamination. This is due to a variety of factors including population pressure, urbanization and the inadequate construction, operation and maintenance of water systems. Even fully protected sources and well managed systems do not guarantee that safe water is delivered to households. The majority of the world's people do not have reliable household water connections and many of these must still physically carry water and store it in their homes. Studies show that even water collected from safe sources is likely to become faecally contaminated during transportation and storage. Safe sources are important but it is only with improved hygiene, better water storage and handling, improved sanitation and in some cases, household water treatment, that the quality of water consumed by people can be assured. An increasing body of evidence is showing that water quality interventions have a greater impact of diarrhea incidence than previously thought, especially when interventions are applied at the household level (or point-of-use) and combine with improved water handling and storage (Fewtrell et al. 2005; Clasen et al. 2007).

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Inadequate sanitation is a major cause of disease worldwide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and waste water disposal. Sanitation in its current US popular meaning is often (incorrectly) taken to be merely the hygienic disposal and treatment by the civic authority of potentially unhealthy human waste such as household garbage and sewage and the maintenance of the sewerage and drainage infrastructure. In the UK the term 'sanitation' has unfortunately come closer to meaning water and waste plumbing and disposal, and it is not used to include garbage collection and disposal.

The full and proper meaning of 'sanitation' is closer to the full meaning of 'hygiene' and includes the control of water and air quality. Vectors, healthful housing, safe products, safe food and working conditions. The more recent broad 'environmental health' equates to the original meaning of sanitation. It is also establishment of conditions favouable to health, especially with respect to infectious diseases. Includes disposal of infective materials, especially, carcasses, discharges and excrement, application of disinfectants and general cleaning to make disinfection effective, isolation of infective animals and improvement in ventilation of buildings, improving feeding and watering arrangements to avoid fecal and urinary contamination of food and water. Around the world, poor sanitation remains a major threat to development, impacting countries' progress in health, education, gender equity, and social and economic development.

Girls and women are made vulnerable by poor sanitation and hygiene. Lack of safe, separate and private sanitation can inhibit girls from attending school and increase the burden of caring for the sick, as well as the likelihood of disease during pregnancy. The benefits of improved water supply and sanitation are many, including prevention of disease, improved basic health care, better nutrition, increased access to institutions such as health centers and schools, improved water quality, increased quantity of and access to water, reduction in time and effort required for water collection, promotion of economic activity, strengthening of community organization, improvements in housing and ultimately improved quality of life.

Hygiene (which comes from the name of the Greek goddess of health, hygieia) is a set of practices performed for the preservation of health. Whereas in popular culture and parlance it can often mean mere 'cleanliness', hygiene in its fullest and original meaning goes much beyond that to include all circumstances and practices, lifestyle issues, premises and commodities that engender a safe and healthy environment. While in modern medical sciences there is a set of standards of hygiene recommended for different situations, what is considered hygienic or not can vary between different cultures, genders and sectarian groups. Some regular hygienic practices may be considered disgusting, disrespectful or even threatening. Hygiene is a science of preserving and promoting the health of both the individual and the community. It has many aspects: personal hygiene (proper living habits, cleanliness of body and clothing, healthful diet, a balanced regimen of rest and exercise); domestic hygiene (sanitary preparation of food, cleanliness and ventilation of the home), public hygiene (supervision of water and food supply, containment of communicable disease, disposal of garbage and sewage, control of air and water pollution), industrial hygiene (measures that minimize occupational disease and accident) and mental hygiene (recognition of mental and emotional factors in healthful living), the World Health Organization promotes hygienic practices on an international level.

Food borne illness is a significant public health issue recent research indicates that food borne disease is a significant cause of illness in the United States and is responsible for substantial economic costs (Mead et al. 1999; Frenzen et al. 1999). Research also indicates that eating outside the home is associated with food borne illness epidemiological research has found that over half of reported food borne illness outbreaks are associated with restaurants.

Diarrhea is one of the top three killer diseases in developing countries, claiming the lives of more than three million children a year. Improvements in water supply and sanitation in the last 20 years have helped to cut the incidence of diarrhea. But if these technologies have had an impact on health, it is because they make better hygiene possible. Whether modern facilities are available or not, the best way to protect a child from diarrheal diseases is to keep the child's living space free of the microbes that cause diarrhea that means adopting number a number of safe hygiene practices in and around the home.

Diarrhea accounts for 15 to 30% of total outpatient visits in most pediatric clinics. Throughout the world, it is said to be among the top 10 cases of morbidity while diarrhea may generally be mild, only a nuisance in the industrially developed countries, it is usually severe and lethal in less developed countries. In 80% of cases, death results from dehydration, those who survive the acute episode are likely to develop persistent diarrhea, mal-absorption syndrome and malnutrition. Diarrheal disease as a group remains a major cause of death in developing countries especially in pre-school children, children under 5

years of age may experience as many as 10 episodes of diarrhea per year. Diarrhea occurs worldwide and causes 4% of all deaths and 5% of health loss to disability. It is most commonly caused by gastrointestinal infections which kill around 2.2 million people globally each year, mostly children in developing countries.

## 2. Materials and Methods

#### 2.1. Study Design and Participants

Bama Local Government is made up of twelve districts namely: Bama A, Bama B, Abbaram, Durajamal, Galumba, Woloji (Kumshe), Nguru Soye, Ya biri (Banki), Kote Kumshe, Amchaka and Goniri districts. The Shehu of Bama is the traditional head of Bama Emirate Council. The districts in Bama Local Government area headed by an Ajiya, then they are subdivided and headed by Lawan and the villages and wards by Bulamas. The educated populace is less than 20% (according to National Census of 1991) with Quranic education predominantly. There are several primary schools, post primary school and one tertiary institution in the local government area. Bama Local Government Area is connected to the national grid of electricity supply. The water supply is through pipe-borne water, well water and boreholes. It has a federal trunk road that passes through Jere town to Banki town and Mubi town in Adamawa State, there are other feeder roads.

The health facilities in the local government area comprise of a general hospital in Bama town, a comprehensive health center, two maternal and child welfare clinics, preventive health office working with the primary health care section and many patent medicine stores.

The primary source of data was through the use of well structured close-ended questionnaire. This was designed in simple language and administered to caregivers of children under 5 years age within the household. The questionnaire will provide information on demographic details of respondents/caregivers: responses on use of common household/community practices such as toilet facilities and hygiene, hand washing practices, mode of feeding, mode of refuse disposal, etc.

With child	Frequency	Percentage (%)	Cumulative percentage
Elder	2	0.50	0.50
Father	8	2.00	2.50
Grandmother	11	2.80	5.30
Mother	374	93.50	98.80
Others	5	1.30	100
Total	400	100%	100%

 Table 4.1: Relationship of the caregiver

Table 4.2: Age of caregiver

With child	Frequency	Percentage (%)	Cumulative percentage
<20 years	95	23.80	23.80
>40 years	16	4.00	27.80
20-29 years	225	56.30	84.00
30-39 years	64	16.00	100)
Total	400	100%	100%

	Frequency	Percentage (%)	Cumulative percentage
Hausa/Fulani	35	8.80	8.80
Kanuri	254	63.50	72.30
Marghi	7	1.80	74.70
Shuwa	83	20.80	79.30
Others	21	5.30	100
Total	400	100%	100%

#### Table 4.3: Ethnic Group

# Table 4.4: Marital Status

Marital status	Frequency	Percentage (%)	Cumulative percentage
Divorced	1	0.30	0.30
Married	389	97.30	97.50
Single	5	1.30	98.80
Widowed	5	1.30	100
Total	400	100%	100%

#### Table 4.5: Occupation

Occupation	Frequency	Percentage (%)	Cumulative percentage
Civil servant	6	1.50	1.50
Farmer	101	25.30	26.80
Housewife	174	43.50	70.30
Trader	107	26.80	70.30
Others	12	3.00	100
Total	400	100%	100%

#### Table 4.6: Level of Education

Education	Frequency	Percentage (%)	Cumulative percentage
None	56	14.00	14.00
Primary	34	8.50	2.50
Quranic education	287	71.80	94.30
Secondary	18	4.50	98.90
Tertiary	5	1.30	100
Total	400	100%	100%

# **Hygiene Related Practices**

These practices include hand washing, dish washing and methods of feeding the child – all towards reducing contamination and hence diarrhea. In the methods of faeces disposal, 94.5% of the respondents dispose their faeces in pit latrine, 4% dispose their faeces in the nearby bush while 1.5% use water closet in the disposal of faeces.



Figure 1: Methods of faeces disposal

In hand washing, 98.0% of respondents do wash their hands after cleaning the child, 42.2% with soap and 50% using water only, 1.5% did not wash, whilst 0.5% did not respond (Figure 3).



Figure 2: hand washing after cleaning the child

On washing hands after visiting the toilet themselves, 96.5% of respondents practice this feat, 53.1% with soap, 46.6% with water only, and 0.3% with sand. Before preparing the feed of the child, 96.7% responded to washing their hands, 2.8% did not wash their hands and 0.5% did not respond. This indicated majority of the study population practiced hand washing with soap which reduces contamination and transmission of pathogens causing diarrhea thereby preventing or reducing incidence of diarrhea. This is evidenced in the low frequency of diarrhea in the study (Figure 3). Decreased episode of diarrhea leads to reduced susceptibility to persistent diarrhea.



Figure 3: Prevalence of diarrhea amongst the different methods of hand washing

Fewtrell *et al.* (2005) in their research work observed that hand washing programs as highly effective in reducing the prevalence of diarrhea especially among the under-five age group. Moyo et al. (2006) also reported that the prevalence of persistent diarrhea increases in children who had frequent attacks of acute diarrhea. These findings are reflected in our current study suggesting analogy with previous studies.

In the provision of household bathroom for the cleaning or washing of children, 55.8% of respondents clean their children (after passing stool) indiscriminately in the compound, 41.5% in the toilet and 0.8% in the dishwashing area.



Figure 4: Places where child is cleaned after defecating

The episodes of diarrhea tend to increase in children or respondents who clean their children (after defecation) in the main compound area and in the dish washing area. Among the caregivers cleaning their children in the toilet, diarrheal prevalence is found to be greatly reduced.



Figure 5: Prevalence of diarrhea in various cleaning places

Sheriff *et al.* (2003) observed the association of rotavirus with an important proportion of diarrheal cases among children under five years in eastern Nepal. The control of spread, they asserted, is by improved hygiene measures in both home and in hospital environment and possibly immunization in some instances. The fact that the current study found relationship between poor waste disposal and high prevalence of diarrheal disease and good waste proposal will reduce prevalence of diarrhea, reaffirm previous investigations that improved hygienic measures control spread of diarrheal morbidity. Fewtrell *et al.* (2005) also reported that a good waste disposal practice reduces episodes of diarrhea in children under five years.



Fig. 6: Hand washing after cleaning the child

In analyzing the attitude of mothers after cleaning the child when he defecates, 44% of the respondents use soap to clean their hands, while 52% of the responses use only water after cleaning their children, 1% of the respondents did not wash after cleaning and 3% did not respond to the interview.

In analyzing the attitude of the study population to dish washing, 83.0% of respondents wash children's feeding utensils with soap and water, 16.7% clean the utensils by rinsing and 0.3% by boiling. This is translated into the low prevalence of diarrheal episodes among the children whose feeding utensils were sterilized by boiling as against just rinsing in these target population/caregivers (Figure 6).



Figure 7: Dish washing

On the methods of feeding the child, majority (44.3%) of respondents feed the children by hand alone. Various combination of feeding methods were used as shown below:



Figure 8: Method of feeding the child/children

Hygiene related interventions, therefore, provide effective protection against prevalence of diarrheal disease among children under-five years of age. Hand washing, however, appears to be most effective in the reduction of diarrheal morbidity among the study population.

# **Sanitation practices**

These practices include household waste disposal, provision of household or communal latrines and provision of household bathrooms. Analysis of household waste disposal showed that 84.8% of respondents practiced open dumping, 11.2% dispose waste in open bin, 2.8% burn the waste, 1.0% dispose waste in pit whilst 0.2% dispose in closed bin.



Figure 9: Method of refuse disposal

The high incidence of open dumping (84.4%) among the respondents, followed by open bin disposal of wastes (11.2%) indicates the tendency of high incidence of diarrheal episodes among the children of this target group vis-à-vis the incidence of low diarrheal morbidity among the study population that dispose waste in bin, closed bin and by burning.



Figure 10: Prevalence of diarrhea in the different refuse disposal methods

The high incidence of diarrhea could be attributed to the increased contamination and transmission of diarrheal causing pathogens among the children of the target respondents or caregivers. Relating to the provision of household or communal latrines, 95.5% of respondents disposed faces in pit toilet, 4.0% in nearby bush with 1.5% using water closet. Majority of the respondents dispose their faces in pit latrines, followed by nearby bush and water closet – this greatly seems to reduce the prevalence of diarrheal disease.

# Water Quality and Water Supply-Related Practices

The practices refer to source water quality and household treatment of water. In the study regarding source of water quality, 57.0% of respondents obtained water from water vendors, 30.5% obtained from borehole/pipe borne, 12.0% from well, stream accounted for 0.3% and other sources of water 0.2%.



Figure 11: Source of water supply

Majority of respondents obtain water from vendors (57.0%) followed by water obtained from borehole/pipe borne (30.5%), well (12.0%), stream (0.3%) and finally other sources (0.3%). By this, prevalence of diarrhea appear to be low in borehole/pipe borne water sources and high in water sources from water vendors, well, stream and others.



Figure 12: Effect of source of water on prevalence of diarrhea

Analysis of household treatment of water showed that 56.05% of respondents do not treat their water before use, 43.8% of respondents treat water before use, whilst 0.2% did not respond.



Figure 13: Water treatment



Figure 14: Method of water treatment

Episodes of diarrhea tend to increase as the majority of caregivers (57.0%) obtained their water from water vendors and do not (56.0%) treat water before use – the children thus exposed to contamination. On the other hand, 43.8% of respondents who treat water before use prevented low prevalence of diarrheal disease. However, water source improvement alone, the study concluded, is less effective than the combination of household treatment and water source improvement.

# Discussion

Diarrhea is one of the commonest causes of morbidity and mortality in paediatric hospitals and clinics in Nigeria and other developing countries especially in children less than five years. Globally, it accounts for an estimated 1.6 million deaths in children under five years and is the third most important cause of death in 2002 (Wright et al. 2006) whilst it constitutes an immense burden, diarrheal disease can be prevented by simple and effective measures such as ensuring hygienic community, household practices – proper disposal of faeces and refuse, roper hand washing after handling faeces and before feeding, increase access to clean water, improved standard of living and promotion of health education campaigns.

The study was carried out with the broad objective of assessing household/ community practices and to educate on the modification of the practices towards preventing diarrheal diseases in children aged under five years in Bama Local Government Area of Borno State. World over, especially in developing countries and these factors vary depending on the population and their educational, cultural and ethnic background. It is observed that health education and improved health care services bear significant influence on the prevention, control and reduction of morbidity and global situation of the diarrheal disease burden.

The study design was that of a cross-sectional survey Bma A, Bama B and Soye districts drawn from a multi-stage sampling with data obtained from structured questionnaires administered to a population of mothers/caregivers. Four hundred questionnaires were administered within a period of 8 weeks. 231 in Bama A, 69 in Bama B and 100 in Soye. The calculated prevalence of diarrhea of the study population is 243/1000 children under five years of age.

# Conclusion

The following conclusions were drawn based on the observation made from the analysis of the study:

- Hygiene related practice majority of respondents (over 90%) are found to practice effective hygiene-related interventions (hand washing, dish washing, healthy feeding methods) and therefore presented low prevalence of diarrheal diseases among children under five years of age. However, hand washing especially with soap appears to be most effective in the reduction of diarrheal morbidity among the study group. Thus, hygiene related interventions are found to precede effective protection against diarrhea in children under five years.
- Sanitation/household practices 84.8% and 11.2% respondents practice open dumping and open bin disposal respectively. 94.3% of respondents dispose faeces in pit toilet, 55.8% of respondents clean children (after passing stool) in the compound area. There are increased incidences of diarrheal morbidity among respondents practising open dumping, open bin disposal and child cleaning in the compound for respondents prevalence. Therefore, poor sanitation is observed to contribute to high prevalence of diarrhea among children under five of the study population.
- Water quality and water supply related practice 57.0% of respondents obtain from water vendors and 30.5% from pipe borne/borehole, 56.0% do not treat. Diarrheal disease is found to increase in children of caregivers obtaining water from vendors and not treating the water. For those who treat the water, there is low diarrheal morbidity. Borehole/pipe borne water also presented low diarrheal prevalence. Therefore, improvement of source of water with household water treatment is found to be effective in the control of prevalence of diarrheal disease. Water source improvement alone, the study observed, is less effective than the combined household water treatment and water source improvement.

# Recommendations

Conclusions from the study therefore suggest that ensuring improved hygienic household/community practice, provision of better-quality sanitation interventions, increased access to clean water and proper household water storage and treatment and sustained public health education campaign would go a long way to reducing clean, quality water and improve the overall health care delivery services to the communities.

- Encouragement of inter-sectoral collaboration between local government, nongovernmental organizations and other stakeholders via PHC to provide essential health care services to the communities.
- Basic knowledge of diarrheal prevention and management should be made part of the curriculum in school/health education so that understanding can be imparted early in the minds of the future caregivers.
- Extension of public health campaigns should include the religious, traditional and opinion leaders to help disseminate the information.
- People should also be encouraged to pass the information to their friends, neighbours and relatives as this will promote a wider coverage.

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