

Minireview paper

DIARRHEA DISEASE: A CONCERN FOR DEVELOPING COUNTRIES

ABSTRACT

Diarrhea is a symptom associated with several gastro intestinal tract diseases. At initial stage of diarrhea illness, diarrhea often goes unnoticed and as it progresses diarrhea present with visible signs and symptoms. Diarrhea ranges from mild, moderate to severe. It can occur suddenly for just a short while (acute) and can likewise persist for a long period of time (chronic).

The rate of death among children under five due to diarrhea in developing countries is an issue of concern. This paper describes the prevalence of diarrhea, factors contributing to it and the manner of its management among mothers/caregivers in developing countries. Hence this paper will serves as a reference document for improving diarrhea prevention and management in developing countries.

Low socio economic status and lack of basic facilities such as safe water and appropriate waste disposal techniques of developing countries are responsible for prevalence of diarrhea in developing countries. In addition to this is the fact that many mothers/ care givers lack knowledge of diarrhea and its home management. Management of diarrhea should start at home in order to prevent the resultant complications which include dehydration, malnutrition and death. The recommended and effective way diarrhea can be well treated at home is through the use of Oral Rehydration Solution (ORS) and continuous feeding which includes breast feeding. Studies have reported several home management practices among mothers/care givers in developing countries which are based on religious and cultural factors. However preventing diarrhea is quite safer and cost effective than treating it. There is need for all stakeholders to join efforts together to put in place all preventive strategies in developing countries.

KEYWORDS

Diarrhea, Developing, Countries, Dehydration, Malnutrition, Oral –Rehydration – Solution (ORS)

1. INTRODUCTION

Diarrhea is a significant childhood disease which is also associated with some infections such as malaria, measles and upper respiratory tract infections and all these make it more deadly [1]. It is mostly first identified by mothers at home and if not treated promptly at home diarrhea can result into dehydration and malnutrition [2]. Diarrhea is a major killer disease amongst the poor especially in developing countries [3]. Globally an estimation of 2.5 billion cases of diarrhea occurs each year [4]. Many cases of diarrhea have been admitted into the hospital because of its consequences such as dehydration and malnutrition, which often result into death if not treated promptly and adequately [5].

Available reports indicated that more than 800,000 deaths of children under five years are recorded annually as a result of diarrhea disease despite global and local efforts in reducing it [6]. The rate is quite high in developing countries than the developed countries because of their low standard of living evidenced by nonavailability of basic facilities such as safe water and appropriate waste disposals techniques. Diarrhea is prevalent in developing countries due to poor socioeconomic development of this part of the world. Nigeria is ranked 54th among the 78 poorest countries of the world [7]. In addition Nigeria is among the first five poorest countries Worldwide. This is due to the poor standard of living, low literacy level and lack of essential facilities such as safe water and this contributes to high prevalence of diarrhea disease in most of the rural communities in this country [8].

2. WHAT IS DIARRHEA

Diarrhea is a symptom of a disease condition which affects people of all ages [9]. It is passage of three or more loose or liquid stools per day [10]. Common pathogens causing diarrhea are *Escherichia coli*, *Campylobacter jejuni*, *Vibrio cholerae*, *Shigella* spp., *Salmonella* spp., *Cryptosporidium parvum*, *Rota virus* and *Giardia lamblia* [6,11]. Diarrhea occurrence depends on predisposing factors such as poor sanitation, poor water among many others. Most often diarrhea is of sudden onset and of short duration. However it can become chronic in people with poor nutritional and low immune status [12]. Age is a strong determinant of severity of diarrhea. Severe diarrhea affects children below the age of two years than those above two years. The reason for this is that children aged less than two years have less

immunity against any disease and could be easily susceptible to infection than older ones [13]. Diarrhea can be categorized into acute, persistent and chronic. Acute diarrhea is a type of diarrhea that lasts less than 14 days [14]. Diarrhea which starts acutely but lasts at least 14 days is considered as persistent diarrhea [15]. Chronic diarrhea lasts longer than 14 days and may extend to 28 days [14].

Generally diarrhea affects children than adults in terms of dehydration which is one of its major complications since water constitutes the largest proportion of children's body-weight [16]. Another significant complication of chronic diarrhea in children under five years is malnutrition and this depends on the duration of diarrhea, the cause of diarrhea and the state of the gastro intestinal tract [17]. It is important to know that malnutrition does not only accompany diarrhea, it can also precede diarrhea. A malnourished child has high tendency to develop diarrhea. The state of a child nutritional status does not impact only diarrhea but also other diseases. The major underlying cause of deaths due to childhood illness is malnutrition [18]. Malnutrition causing diarrhea or resulting from diarrhea whichever form it takes affects child's physical growth and development, and may lead to long term disability and morbidity in the future. Hence the need to emphasize through health education the benefits of continuous feeding during episodes of diarrhea [19].

3. WHY DIARRHEA IS A CONCERN IN DEVELOPING COUNTRIES

Despite several interventions that have brought about serious drop in diarrhea morbidity and mortality rate in developed countries, diarrheal diseases still remains a public health concern of developing countries. Such interventions include treating diarrhea using ORS, counseling mothers on how to prepare homemade remedies, advising mothers/care givers on need to continue feeding child when child has diarrhea to mention but a few. With all these it has been observed that the prevalence of diarrhea in developing countries has not changed much since 1990s till 2003 with 3.5 episodes per child per year in 1993 and 3.2 episodes per child per year in 2003 [20]. Although on the average across the nations of the world, deaths due to diarrhea has reduced from 4.6 million in the 1980s to 3.3 million in the 1990s and to 2.5 million in the year 2000 [21] and by 2011 diarrhea accounted for 750,000 deaths [22]. However there has not been serious reduction in mortality rate in developing countries. In the 1990 it was

2.1 million deaths per year and by 2000 it reduced to only 1.6 million deaths per year. It is worth noting that diarrhea still remains one of the diseases responsible for death among children less than five years in developing countries. The continuity of any society depends on child bearing and child rearing. Any disease that can affect this process needs to be taken care of [20].

Children are the most vulnerable group susceptible to diverse form of illnesses due to their level of immunity and developmental changes. Poor socio economic status and some socio cultural beliefs and practices in developing countries are the leading causes of malnutrition among children under five years [23].

Diarrhea if not treated early easily leads to dehydration and malnutrition which are life threatening [10]. The rate of hospital admission due to these complications is still on the increase and many of such has led to death among children under five years in developing countries [24]. The relationship that exists between nutritional status and diarrhea is very significant and an important factor to be considered [25]. The impact of repeated or persistent diarrhea on nutrition and the effect of malnutrition on making children to be susceptible to diarrhea are interwoven. It is thus crucial children under five years are well nourished to prevent episode of diarrhea and when there is diarrhea, children nutritional status should be enhanced so as to prevent malnutrition [26].

4. FACTORS RESPONSIBLE FOR PREVALENCE OF DIARRHEA IN DEVELOPING COUNTRIES

Diarrhea is a disease of the rich and poor, the old and the young people in developed countries and those in developing countries alike, yet a strong relationship exists between diarrhea and the following interacting factors Socio economic factor, sanitation and water related factor, behavioural factor, host factor, mothers/caregivers knowledge and management of diarrhea to mention but a few [5,20, 27].

4.1 Socio Economic factor/poverty

Socioeconomic status of any group people is a strong determinant for their standard of living. Poor housing, unhygienic environment, inadequate safe water, cohabitation with domestic animals that may carry human pathogens and lack of storage facilities for food with resultant diarrhea diseases are due to poverty in most developing countries [20]. The prevalence of this disease is attributed to its sensitive mode of spread which is mainly through drinking or cooking with contaminated water and poor hygienic condition [28]. Accessing safe water and ensuring a healthy environment have been a problem of the poor populace in developing countries [29]. Poverty does not only impact these set of people living environment, it also impacts the way and manner they daily feed children and the quality of care they give children with diarrhea disease [20].

4.2 Sanitation and Water related factor

Poor hygienic environment and access to safe water are major factors responsible for prevalence of diarrhea in developing countries. The incidence of diarrhea in developing countries is high in communities and households where toilet and basic sanitation facilities are lacking [5,27,29]. Globally, It has been estimated that an average of 700 million people lack access to clean water and 3 billion people are living in an unclean environment. However this is mostly predominant in developing countries. Many households dispose refuses and faeces indiscriminately, and obtained water from unprotected sources [29-30]. Water obtained from these sources is used for either cooking or drinking hence resulting into diarrhea [31-32]. In addition lack of water often makes many to eat with and feed children with unwashed hands [28].

4.3 Behavioural factors

There are many behavioural practices common among caregivers/mothers of underfive children in developing countries [33]. Breast feeding practices in developing countries among mothers is a serious issue of concern. Many mothers either partially breast feed or do not breast feed their children at all [29]. Both categories of mothers put their children at risk of diarrhea. Such children are exposed to diarrhea

infection easily basically through contaminated feeding bottles or utensils because their immunity level is low [33]. Breast feeding exclusively for the first 6months of life have been the recommended way of feeding infants. It does not only offer maternal benefits more significantly are the benefits for young children. Apart from the fact that it helps in children growth and development specifically it reduces the risk of diarrhea in babies [34]. The act of storing water in dirty containers, exposing stored water even when such water is safe and preserving food at room temperature are part of wrong practices common among mothers in developing countries [33]. In addition food sold by street vendors is another major source of diarrhea in developing countries. Due to poverty many people cannot afford to prepare their food, hence they purchase food from food vendors. Furthermore behavioural practices common among mothers/care givers in developing countries especially among rural dwellers include poor or no hand washing after using toilet or cleaning up children faeces, eating with unwashed hands, eating raw foods, cooking in an unhygienic environment and using dirty utensils to drink or eat among many others [28].

4.5 Host factor

Children in developing countries are affected by preventable diseases such as measles, pneumonia, and malaria than children residing in developed countries [35]. This couple with malnutrition affects children immune status in developing countries. Hence such affected children lack the ability to resist and fight invading micro organism [36-37]. It is important to note that malnutrition itself alone is enough to make child immunity low, thus giving room for infection such as diarrhea. Malnutrition does not only give room to infections such as diarrhea, it also increases its severity and mortality [38]. Diarrhea likewise is an important cause of malnutrition in children underfive in developing countries. This is because such affected children intestinal wall ability to absorb nutrient has reduced and most often there is also loss of appetite. Furthermore Children with history of repeated diarrhea infection have high chances to be easily re-infected with diarrhea due to their poor immune resistant status [33].

Diarrhea is one major clinical manifestation and complication of HIV infection in all age group with worst cases among children under five in most countries of the World [33]. However this is more serious in developing countries where there are inadequate basic facilities such as good disposal system, safe

water, prompt medical services and the like. Diarrhea is more likely to occur in children with HIV/AIDS than non infected children. It is the main cause of death among children living with HIV/AIDS [39].

4.6 Mothers/caregivers knowledge and management of diarrhea

Poor knowledge has been one major factor responsible for the prevalence of many diarrhea diseases in developing countries. Many mothers/caregivers don't have adequate knowledge of diarrhea, its causes, complications and management [40-41]. This is however common among people living in rural setting than urban setting [13]. Furthermore it has been reported that children whose mothers did not attend formal education were more likely to develop diarrhea compared to children whose mothers attend any formal education [5, 41]. Generally, mothers' education, occupation, economical status, and experience have been observed to have significant relation with knowledge of diarrhea in developing countries [42].

Apart from the conventional methods of managing diarrhea, mothers have used different remedies and traditional therapies in managing diarrhea. This includes oral and topical medicines made from plants (leaves, stems, and roots) and amulets placed around the waist or wrist [43]. Some mothers believe that diarrhea should be managed by both traditional and modern approaches. The local available foods commonly used in the management of diarrhea include loose soft rice and pulse water [9]. In addition some mothers in developing countries are of the opinion that certain foods are to be avoided such as spicy, oily and rotten foods and that milk are harmful and should be stopped whenever a child experiences diarrhea [24].

Quick and safe recovery from diarrhea will require prompt and appropriate treatment of diarrhea at home by caregivers/mothers hence the need for them to have knowledge on the use of appropriate home remedies in treating diarrhea. Such readily available homemade remedies and interventions for treating childhood diarrhea include fresh fruit juices, fluid based foods, milk, salt sugar solution, and breast milk. The treatments of diarrhea should be right from its mild stage with focus on restoring lost fluids via oral rehydration solution and continuous feeding [13,44-45]. Continuous feeding is important for reducing the nutritional consequences of diarrhea illness. Meanwhile continuous breast feeding should be highly promoted among children in low income countries, where the burden of diarrhea and malnutrition is

greatest [3]. In addition continuous feeding with locally available foods should be promoted for all diarrhea cases in children already on complementary feeding in developing countries. This continuous feeding helps in maintaining body immune status [13]. The use of ORS has been advocated for in the management of diarrhea. It is highly effective, cheap and easy to prepare. It is very effective in preventing and reducing dehydration and diarrhea mortality. However, its use depends on mothers/caregivers knowledge and attitude towards it [41].

5 FACTORS INFLUENCING THE MANAGEMENT OF DIARRHEA IN DEVELOPING COUNTRIES

Inadequate knowledge of diarrhea process is one key factor responsible for the poor management of diarrhea among mothers/caregivers in developing countries. This is high among the illiterate than the literate counterpart of mothers/caregivers in developing countries [24]. Literate mothers are believed to have better opportunity for information as regards the management and prevention of diarrhea diseases [13]. Diarrhea is defined and given diverse interpretation by many mothers/ care givers of children under five in developing countries. This has its root in their cultural and religious belief [12]. Some of the beliefs as regards the causes of diarrhea are God's will, the breach of a taboo, eating of forbidden food and/or witchcraft attack [46].

The perceptions of mothers as regards diarrhea have given rise to several local classifications of diarrhea which informed the way each has been managed. In most African countries many mothers treat diarrhea based on the characteristics of the stool, and circumstances surrounding it [24].

6 CALL FOR ACTION

Reducing the prevalence of diarrhea has for a long time been a global concern. There is need for stake holders in developing countries to take more actions towards preventing and prompt treatment of this disease. Actions that can be taken include provision of better access to clean water, provision of low cost good sanitation system, improving health education program, improving the availability of Oral

Rehydration Solution (ORS) and Zinc supplement, Improving Complementary Feeding Practices, improving the availability of vaccines, and prompt treatment of diarrhea in children with HIV/AIDS among many others [10,21,27,46-47].

6.1 Provision of better access to safe water

Unsafe water and poor sanitation are the main sources of diarrhea disease in developing countries. Providing access to safe water together with good sanitation is an important factor in reducing prevalence of diarrhea. It is crucial government invest in project that will ensure people have consistent access to safe drinking water [22]. One major way government can ensure there is supply of safe water to every household is by constructing piped - in - system. However some countries may have financial constraints in achieving this, hence such may involve private bodies. This intervention is very cost effective at the long run as families spent less on hospital bills. Apart from the build in pipe system other interventions that can be carried out in rural areas include construction of boreholes and deep wells [48].

6.2 Provision of low cost good sanitation system

Improving access to safe water at communities' level can only have impact when families and community at large live under good sanitary conditions. This requires all households' participation with the use of simple available and appropriate technology acceptable to the people. Such interventions include construction of household latrines, provision of households waste disposal bins, public incinerators and schools sanitation. Implementing this cannot be achieved only by the government there is need for collaboration with interested private organizations [49].

6.3 Improving health education program

Studies have identified the effort of health care providers on health educating mothers and care givers on importance of hygiene and safe water in preventing diarrhea. Despite this, the prevalent rate in developing countries is still relatively high [22]. Beliefs held tenaciously by the mothers/care givers in developing countries as regards diarrhea are responsible for the reason they cannot see the link between poor water/hygiene and diarrhea disease. Comprehensive health education program that focuses not only

on issues on hygiene and safe water will help in correcting misconceptions surrounding diarrhea. Governmental and non governmental health organizations should employ various means such as mass media, telecommunications, and internet to health educate the public especially mothers/care givers of children under five years on diarrhea and its process of infection, use of ORS in managing diarrhea at home, administration of supplements such as Zinc and Vitamin A, benefits of exclusive breast feeding, and importance of continuous feeding/ breast feeding [28]. Cogent hygiene education that requires more emphasis is providing information on how best to handle food, store and purify drinking water [22]. One of the major ways children under five get infected by micro organism causing diarrhea is through contaminated hand either by the child or by the care giver [50]. Mothers and caregivers in developing countries should be taught simple act of frequent hand washing with soap which will go a long way in preventing diarrhea and also in reducing its course in already infected children [51]. Hand washing should not only be before eating especially for care givers for children under five years it also include following defecation, after handling child feces or cleaning a child's anus, before preparing food and before feeding a child [52]. The information received via this enlightenment program can be strengthened by health education from health care providers in the community or at the health care centers [53].

ORS is the first line home treatment regimen for diarrhea. This is the initial important information mother/care givers of children under five years must know [54]. It is essential emphasis is laid on continuous administration of ORS until diarrhea subsides. ORS is in two forms, the pre mix sachet form obtainable in pharmaceutical stores and Salt Sugar Solution (SSS) that can be prepared at home [27]. Effective health education program entails getting appropriate educational materials according to set priority. The contents of the health education should encompass information on the preparation and administration of ORT solutions and importance of continued feeding during diarrhea episode. Practical demonstration on how to prepare the pre mix ORS or Salt Sugar Solution (SSS) and individual mother/care giver demonstration is essential. This is to strengthen the health education and ascertain knowledge has been impacted. However this ought not to be a onetime activity but continuous education so as to sustain the knowledge acquired [44]. Preparing Salt Sugar Solution (SSS) entails getting eight

teaspoon of sugar, half level teaspoon of salt, 1 litre boiled water, mix it well and store covered in a cool place. This is to be prepared afresh every day [39].

Apart from the use of ORS at the initial stage of diarrhea, zinc supplement use is currently part of the initial management of diarrhea at home [5,12]. Information on benefits of zinc supplement to children under five years must be given to mothers/caregivers. Its used together with ORS has proven effective in reducing diarrhea morbidity and mortality rate among children under five years globally [54-55]. Mothers should be made to know that the use of ORS will not in any way reduce the frequency, duration and volume of diarrhea [18,56]. Administration of zinc supplement in episode of diarrhea specifically helps in the reduction of duration and severity of diarrhea. The use of 20 milligrams per day for children older than six months or 10 mg per day in those younger than six months, for 10–14 days is recommended. Zinc supplement has been found to contain vital micro nutrient required for protein synthesis, cell growth, immune function and movement of fluid and electrolytes hence its administration with ORS [54-56]. Studies from developing countries have found that vitamin A supplementation also helps in reducing the severity of diarrhea in children under five years. Its use has also been proven effective in maintaining intestinal resistant to micro organism function [18].

Due to the problem of malnutrition among children under five in developing countries emphasis should be laid on exclusive breast feeding for all infants for the first six months of life. Also the need to stretch importance continuous feeding and breast feeding of any children under five years having diarrhea [18].

History has revealed the effectiveness of health education in causing a behavioural change or improvement. Mothers with decision making power and with formal education are more likely to take yield to educational interventions. However some studies revealed that older women with formal education are able to make decision better than the younger mothers. Hence the health education must be designed in such a way to meet the need of all different categories of mothers. Nevertheless irrespective of the level of education and age of the mother, there is need for health care providers to make mothers to first understand the benefits of keeping their children healthy. This will change their attitude towards educational interventional program [56].

6.4 Improving the availability of Oral Rehydration Solution (ORS) and Zinc supplement

Prompt recognition and treatment of diarrhea at home is very important for effective management of diarrhea. Over the years replacement of fluid remains the mainstay in the treatment of diarrhea. Among various home remedies used in managing diarrhea, ORS and zinc supplement are the most effective of all the interventions [25,55]. ORS is a simple, cheap and proven intervention that can be used in treating diarrhea and its complications [42,46]. However due to economic problem of some developing countries, many mothers/caregivers cannot access and afford it [27]. Improving the availability of ORS will require the contributions of private and public sectors, including pharmaceutical companies in making ORS and zinc supplement readily available at affordable cost at households' level [46].

6.5 Improving Complementary Feeding Practices

Children on breast milk are to be introduced to complementary food at the age of six months. Inappropriate and contaminated complementary food is part of the predisposing factors for malnutrition in children less than one year. The relationship between malnutrition and diarrhea is one major reason for need to improve children less than one year complementary food. The contamination of the complementary food can be reduced by health educating mothers and care givers on hygienic practices, food storage practices and the benefits of probiotics in preventing diarrhea that can subsequently lead to malnutrition [20]. The nutrients value of complementary food can be improved by adding essential micro nutrients like vitamin A and zinc [39]. Probiotics micro organisms have both preventive and curative effects. Intake of probiotic milk products or supplementing formulas with probiotics is essential for all forms of diarrhea most especially children with lactose intolerance and on complementary foods [57].

6.6 Improving the availability of vaccines

Vaccines offering protection against childhood diarrhea have the potential in reducing the prevalence of diarrhea disease in developing countries. Rota virus vaccine, measles vaccine and cholera vaccine are important vaccines for children under five years. Rota virus is one important viral infection responsible for severe diarrhea. It accounts for most diarrhea related hospitalization and an average of 37% diarrhea related childhood death every year primarily in developing countries [20,46]. Measles

infection is usually accompanied by diarrhea [27]. Cholera disease is a disease of global concern especially in the developing countries. Like rota virus, vaccines have been proven effective in preventing cholera and measles and their accompanied burdens. However problem of costs and accessibility are the major barrier towards the effective use of vaccination in developing countries. Government with support of private agencies should make these vaccines available, accessible and affordable for the poor [46].

6.7 Prompt treatment of diarrhea in children with HIV/AIDS

HIV/AIDS has added to the burden of diarrhea disease both in young and old most especially in developing countries. The rate at which children under five living with HIV/AIDS die as a result of episodes of diarrhea in developing countries is high than the developed countries. Urgent intervention using the common recommended anti retro viral drug (ART) is required. ART has been used over the years in treating HIV/AIDS. It does not only reduces viral load, it also reduces other accompany symptoms diarrhea inclusive. However its effectiveness is low in developing countries due to problems of poor nutrition and sanitation. Proper nutrition will help in supporting the chances of ART treatment reducing diarrhea disease burden in developing countries [38].

6.8 PROMOTING POLICIES

Promoting national policies that support the prevention and management of diarrhea and its complications is another important interventional strategy in reducing the prevalence of diarrhea in developing countries. Such policies should address increasing access to safe drinking-water and sanitation in developing countries. Environmental laws in most developing countries are not well implemented. In order to have hygienic environment there is need for environmental law enforcement through appropriate environmental maintenance agencies [31-32].

CONCLUSION

Diarrhea is one major illness of concern among children under five especially in developing countries. The state of development of most low income countries makes its eradication a bit difficult couple with strong cultural and religious beliefs held by the care givers in this part of the World. Eradication of this disease will require efforts of all that are involved in issue related to children health and care.

REFERENCES

1. Mugeni C, Levine AC, Munyaneza RM, Mulindahabi E, Cockrell HC, Glavis-Bloom J, et al. Nationwide implementation of integrated community case management of childhood illness in Rwanda. *Global Health: Science and Practice*. 2014; 2(3): 328-341. Accessed 5 Aug. 2014. Available: doi: [10.9745/GHSP-D-14-00080](https://doi.org/10.9745/GHSP-D-14-00080). PMID: [PMC4168626](https://pubmed.ncbi.nlm.nih.gov/24168626/)
2. World Health Organization. Treatment of diarrhea at home. Rehydration Project. 2014. Available: rehydrate.org/diarrhoea/tmsdd/4med.html
3. Gaffey MF, Wazny K, Bassani DG, Bhutta ZA. Dietary management of childhood diarrhea in low- and middle-income countries: a systematic review. *BioMed Central*. 2013; 13:(3) 7. Accessed 17 Sept. 2013. Available: doi: [10.1186/1471_2458-13-S3-S17](https://doi.org/10.1186/1471-2458-13-S3-S17). PMID: [PMC3847348](https://pubmed.ncbi.nlm.nih.gov/23847348/)
4. UNICEF. Diarrhea: Why Children are still dying and What can be done. Accessed 2009. Available: www.unicef.org/.../Final_Diarrhoea_Report_October_2009_fina...UNICEF
5. Mohammed S, Tamiru D. The Burden of Diarrheal Diseases among Children under Five Years of Age in Arba Minch District, Southern Ethiopia, and Associated Risk Factors: A Cross-Sectional Study. *International Scholarly Research Notices*. 2014; (2014) 6 pgs. Accessed 18 Nov. 2014. Available: <http://dx.doi.org/10.1155/2014/654901>
6. Ogbu O, Agumadu N, Uneke C, Amadi E. Aetiology of Acute Infantile Diarrhoea in the south-Eastern Nigeria: An Assessment Of Microbiological And Antibiotic Sensitivity Profile. *The Internet Journal of Third World Medicine*. 2007;7 (1). Accessed 2007. Available: ispub.com/IJTWM/7/1/4460
7. Ali-akpajiak SCA, Pyke T. Measuring poverty in Nigeria. London: Oxfam working papers Publish. Accessed 2003. Available: <https://books.google.com/books?isbn=085598502X>
8. Udo B. Premium times. Accessed 11 April 2014. Available: www.premiumtimesng.com/.../158554nigeria_ranks-third-among-count
9. Mwabete KD, Joseph R. Knowledge and perception of mothers and caregivers on childhood diarrhea and its management in Temeke Municipality, Tanzania. *Tanzania Journal of Health Research*. 2010;12 (1). Accessed January 2010. Available: www.ponline.org/node/220425
10. O'Reilly CE, Jaron P, Ochieng B, Nyaguara A, Tate JE, Parsons MB et al. Risk Factors for Death among Children Less than 5 Years Old Hospitalized with Diarrhea in Rural Western Kenya, 2005–2007: A Cohort Study. *Public library of Science*. 2012; 9(7). Accessed 3 July 2012. Available: doi: [10.1371/journal.pmed.1001256](https://doi.org/10.1371/journal.pmed.1001256) PMID: [PMC3389023](https://pubmed.ncbi.nlm.nih.gov/23389023/)
11. Kotloff KL, Nataro JP, Blackwelder WC, Nasrin D, Farag TH, Panchalingam S, et al. Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): a prospective, case-control study. *The Lancet Journals*. 2013; 382(9888): 209-222. Accessed 20 July 2013. Available DOI: [http://dx.doi.org/10.1016/S0140-6736\(13\)60844-2](http://dx.doi.org/10.1016/S0140-6736(13)60844-2)
12. Njume C, Goduka NI. Treatment of Diarrhea in Rural African Communities: An Overview of Measures to Maximise the Medicinal Potentials of Indigenous Plants. *International Journal*

of Environmental Research and Public Health. 2012; 9(11): 3911-3933. Accessed 26 Oct. 2012. Available: <http://www.mdpi.com/1660-4601/9/11/3911>. PMID: PMC3524604

13. Merga N, Alemayehu T. Knowledge, Perception, and Management Skills of Mothers with Under-five Children about Diarrhea Disease in Indigenous and Resettlement Communities in Assosa District, Western Ethiopia. Journal of Health Population and Nutrition. 2015; 33(1): 20-30. Accessed Mar 2015. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4438645/>.
14. Ochoa B, and Surawicz CM . Diarrheal Diseases – Acute and Chronic. American College of Gastroenterology. Accessed December 2012. Available: patients.gi.org/.../diarrhea-acute-a...American College of Gastroenterology
15. Rehydration Project. Persistent Diarrhoea. Clinical Update: A supplement to Issue no. 48. Accessed 4 March, 2016. Available: [rehydrate.org > Dialogue on Diarrhoea Online](http://rehydrate.org/Dialogue on Diarrhoea Online)
16. Abdel-Aziz SB , Maha A. Mowafy MA & Yasmine S. Galal YS. Assessing the Impact of a Community-Based Health and Nutrition Education on the Management of Diarrhea in an Urban District, Cairo, Egypt. Global Journal of Health Science. Accessed 5 June 2015. Available: [doi:10.5539/gjhs.v8n2p46](https://doi.org/10.5539/gjhs.v8n2p46) URL: <http://dx.doi.org/10.5539/gjhs.v8n2p46>
17. Gorospe EC, Oxentenko AS. Nutritional consequences of chronic diarrhea. Best Practice and Research Clinical Gastroenterol. 2012; 26(5):663-75. Accessed October 2012. Available: <http://www.ncbi.nlm.nih.gov/pubmed/23384810>
18. Nel ED. Diarrhea and malnutrition. S Afr J Clin Nutr. 2010; 23(1): S15-S18. Accessed 2010. Available: www.ajol.info/index.php/sajcn/article/viewFile/52763/41365
19. Ferdous F, Das SK , Ahmed S, Farzana FD, Latham JR, Chisti MJ et al. Severity of Diarrhea and Malnutrition among Under Five-Year-Old Children in Rural Bangladesh. The American Journal of Tropical Medicine and Hygiene. 2013; 89 (2):223-228. Accessed 7 Aug. 2013, Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3741240/>
20. Keusch GT, Fontaine O, Bhargava A, Boschi-Pinto C, Bhutta ZA, Gotuzzo E et al. Disease Control Priorities in Developing Countries. 2nd edition. The World Bank Group. Accessed 2006. Available: www.ncbi.nlm.nih.gov/...National Center for Biotechnology Information. PMID: 21250309
21. Boschi-Pinto C, Lanata CF, Mendoza W, Habte D. Disease and Mortality in Sub-Saharan Africa. 2nd edition. Chapter 9 Diarrheal Diseases. Accessed 2006. Available: www.ncbi.nlm.nih.gov/...National Center for Biotechnology Information
22. Diouf K, Tabatabai P, Rudolph J, Marx M. Diarrhea prevalence in children under five years of age in rural Burundi: an assessment of social and behavioural factors at the household level. Global Health Action. 2014; 17. Accessed 2014. Available: [www.globalhealthaction.net > Home > Vol 7 \(2014\) > Diouf](http://www.globalhealthaction.net/Home/Vol7(2014)/Diouf)

23. Nielsen M, Hoogvorst A, Konradsen F, Mudasser M, Hoek W van der. Childhood Diarrhea and Hygiene: Mothers' Perceptions and Practices in the Punjab Pakistan. International Water Management Institute. Accessed 2001. Available: www.ircwash.org/sites/default/files/Nielsen-2001-Childhood.pdf
24. Ansari M, Ibrahim MIM, Hassali MA, Shankar PR, Koirala A, Thapa NJ. Mothers beliefs and barriers about childhood diarrhea and its management in Moran district, Nepal. BioMed Central. 2012; 5:576. Accessed 24 Oct. 2012. Available: doi: [10.1186/1756-0500-5-576](https://doi.org/10.1186/1756-0500-5-576) PMID: PMC3517331
25. Walker CLF, Perin J, Aryee MJ, Boschi-Pinto C, Black RE. Diarrhoea incidence in low- and middle-income countries in 1990 and 2010: A Systematic Review. Bio Med Central. 2012;12:220. Accessed 21 March 2012. Available: <http://www.biomedcentral.com/1471-2458/12/220>
26. Mugeni C, Levine AC, Munyaneza RM, Mulindahabi E, Cockrell HC, Glavis-Bloom J et al. Nationwide implementation of integrated community case management of childhood illness in Rwanda. Global Health: Science and Practice. 2014; 2(3): 328-341. Accessed 5 Aug. 2014. Available: doi: [10.9745/GHSP-D-14-00080](https://doi.org/10.9745/GHSP-D-14-00080). PMID: PMC4168626
27. Papikyan S. The Association of Maternal Knowledge and Management With Prevalence and Duration of Childhood Diarrheal Disease in Yerevan. Accessed 2009. Available: aau.am/chsr/PDF/MPH/.../Papikyan,%20Satenik.pdfAmerican University of Armenia
28. Hung BV. The most common causes of and risk factors for Diarrhea among children less than five years of age admitted to dong Anh Hospital, Hanoi, Northern Vietnam. 2006. Available: <https://www.duo.uio.no/handle/10852/30133>
29. Ayele M, Hailu W. Assessment of Prevalence and Related Factors of Diarrheal Diseases among Under-Five Year's Children in Debrebirehan Referral Hospital, Debrebirehan Town, North Shoa Zone, Amhara Region, Ethiopia. OALib. 2014;1: 1-14. Accessed April 2014. Available: <http://www.oalib.com/journal>
30. Mengistie B, Berhane Y, Worku A et al. Prevalence of diarrhea and associated risk factors among children under-five years of age in Eastern Ethiopia: A cross-sectional study. Open Journal of Preventive Medicine. Open Journal of Preventive Medicine. 2013;3(7): 446-453. Accessed 21 September 2013. Available <http://dx.doi.org/10.4236/ojpm.2013.37060>
31. World health organization. Diarrhea disease. World Health Organization. Accessed 2013. Available: www.who.int/mediacentre/factsheets/.../en/World Health Organization
32. World Health Organization. Water-related diseases Diarrhea. World Health Organization. Accessed 2013. Available: www.who.int/water_sanitation.../diarrhoea/en/World Health Organization
33. World Health Organization. Unit 1 - The Epidemiology and Etiology of Diarrhea Medical Education: Teaching Medical Students about Diarrhea Diseases. Rehydration Project.

Accessed 10 November, 2014. Available: http://www.who.int/child-adolescent-health/New_Publications/CHILD_HEALTH/Meded/1med.htm

34. World Health Organization. Exclusive breastfeeding for six months best for babies everywhere. Accessed 15 Jan. 2011. Available: [www.who.int/mediacentre/news/.../breastfeeding.../en/World Health Organization](http://www.who.int/mediacentre/news/.../breastfeeding.../en/World_Health_Organization)
35. Ezeonwu BU, Chima OU, Oguonu T, Ikefuna AN, Nwafor I. Morbidity and Mortality Pattern of Childhood Illnesses Seen at the Children Emergency Unit of Federal Medical Center, Asaba, Nigeria. *Annals of Medical & Health Sciences Research*. 2014;4(Suppl 3): 239–244. Accessed Sep-Oct 2014. Available: doi: [10.4103/2141-9248.141966](https://doi.org/10.4103/2141-9248.141966) PMID: PMC4212384
36. Palmer AC. Nutritionally Mediated Programming of the Developing Immune System. *Advances in Nutrition: An International Review Journal*. 2011;2: 377-395. Accessed Sept 2011 Available: doi: [10.3945/an.111.000570](https://doi.org/10.3945/an.111.000570)
37. Herrador Z, Sordo L, Gadisa E, Moreno J, Nieto J, Benito A et al. Cross-Sectional Study of Malnutrition and Associated Factors among School Aged Children in Rural and Urban Settings of Fogera and Libo Kemkem Districts, Ethiopia. *PLOS*. Accessed 29 September 2014. Available: <http://dx.doi.org/10.1371/journal.pone.0105880>
38. Elfstrand L., Claes-Henrik F. Management of chronic diarrhea in HIV-infected patients: current treatment options, challenges and future directions. *HIV /AIDS Research and Palliative care*. 2010;2: 219-224. Accessed 10 Nov. 2010. Available: doi: [10.2147/HIV.S13191](https://doi.org/10.2147/HIV.S13191) PMID: PMC3218691
39. Smart T. Diarrhoea in children with HIV: a clinical review. Accessed 15 April 2010. Available: www.aidsmap.com/Diarrhoea-in-children-with-HIV-a-clinical-review/.../140...Aidsmap
40. Mumtaz Y, Zafar M, Mumtaz Z. Knowledge Attitude and Practices of Mothers about Diarrhea in Children under 5 years. *Journal of the Dow University of Health Sciences Karachi* 2014; 8 (1): 3-6. Available: www.duhs.edu.pk/download/jduhsvo...DowUniversity of Health Sciences
41. Rasanias SK, Singh D, Pathi S, Matta S, Singh S. Knowledge and Attitude of Mothers about Oral Rehydration Solution in few Urban Slum of Delhi. *Health and Population - Perspectives and issues*. 2005;28(2): 100-107. Accessed 2005. Available: medind.nic.in/hab/t05/i2/habt05i2p100.pdf
42. Ghasemi AA, Talebian A, Alavi NM, Mousavi GA. Knowledge of Mothers in Management of Diarrhea in Under-Five Children, in Kashan, Iran. *Nursing and Midwifery Studies*. 2013; 1(3): 158-62. Accessed March 2013. Available: nmsjournal.com/?page=article&article_id=10393
43. Wilson SE, Ouédraogo CT, Prince L, Ouédraogo A, Hess, S .Y., Rouamba, N et al. Caregiver Recognition of Childhood Diarrhea, Care Seeking Behaviors and Home Treatment Practices in Rural Burkina Faso: A Cross-Sectional Survey. *BioMed Central*. 2012; 7(3):13. Accessed 13 Mar. 2012. Available: doi: [10.1371/journal.pone.0033273](https://doi.org/10.1371/journal.pone.0033273)

44. Vyas S. Impact of Education on Rural Women about Preparing ORS and SSS: A Study of the Primary Health Centre, Uvarsad, Gandhinagar. Available: medind.nic.in/hab/t09/i3/habt09i3p124.pdf
45. World Health Organization. Treatment of diarrhea at home. Rehydration Project. Accessed 23 April 2014. Available http://www.who.int/childdadolescenthealth/New_Publications/CHILD_HEALTH/Meded/4med.htm
46. Merten S, Schaetti C, Manianga C, Lapika B, Hutubessy R, Chaignat C et al. Socio cultural Determinants of Anticipated Vaccine Acceptance for Acute Watery Diarrhea in Early Childhood in Katanga Province, Democratic Republic of Congo. The American Journal of Tropical Medicine and Hygiene. 2013;89(3): 419-425. Accessed 4 Sep 2013. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3771276/>
47. Zwane AP, Kremer M. What Works in Fighting Diarrheal Diseases in Developing Countries? A Critical Review. 2009; 1-47. Harvard University Brookings Institution and NBER. Available: <http://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers>
48. Michael Kremer, Amrita Ahuja and Alix Peterson-Zwane. Providing Safe Water: Evidence from Randomized Evaluations. Harvard environmental Economics Program. Harvard Kennedy School. Accessed 7 April 2010. Available: http://heep.hks.harvard.edu/files/heep/files/dp23_kremer-ahuja-petersonzwane.pdf
49. Cheraghi Z, Okhovat B, Irani AD, Talaei M, Ahmadnezhad E, Gooya M M et al. 2013. Knowledge, Attitude, and Practice regarding Food, and Waterborne Outbreak after Massive Diarrhea Outbreak in Yazd Province, Iran, Summer. Internationally Scholarly Research Notices. 2014; 7pgs. Available: <http://dx.doi.org/10.1155/2014/403058s>
50. Harper J. 5 Common Ways Germs are Spread. Minneosta Department of Health. Accessed 2005. Available: www.health.state.mn.us/handhygiene/why/5ways.html
51. Curtis V, Cairncross S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. Lancet Infectious Diseases. 2003;3(5):275-281. Accessed 2003 May. Available: [www.ncbi.nlm.nih.gov/...National Center for Biotechnology Information PMID:12726975](http://www.ncbi.nlm.nih.gov/...National%20Center%20for%20Biotechnology%20Information%20PMID%3A12726975)
52. Luby SP, Halder AK, Huda T, Unicomb L, Johnston RB. The Effect of Handwashing at Recommended Times with Water Alone and With Soap on Child Diarrhea in Rural Bangladesh: An Observational Study. PLOS. Accessed 28 June 2011. Available: <http://dx.doi.org/10.1371/journal.pmed.1001052>
53. Centers for Disease Control and Prevention. Diarrhea: Common Illness, Global Killer. Accessed 17 Dec. 2015. Available: [www.cdc.gov/.../global/diarrhea-burden.ht...Centers for Disease Control and Prevention](http://www.cdc.gov/.../global/diarrhea-burden.ht...Centers%20for%20Disease%20Control%20and%20Prevention)
54. Khan WU, Sellen DW. Zinc supplementation in the management of diarrhea: Biological, behavioural and contextual rationale. Accessed April 2011. Available: [www.who.int/elena/titles/bbc/zinc_diarrhoea/World Health Organization](http://www.who.int/elena/titles/bbc/zinc_diarrhoea/World%20Health%20Organization)

55. Mazumder S, Taneja S, Bhandari N, Dube B, Agarwal RC, Mahalanabis D, Fontaine O, Black RE. Effectiveness of zinc supplementation plus oral rehydration salts for diarrhoea in infants aged less than 6 months in Haryana state, India 2010. Bulletin of the World Health Organization. 2010;88:754-760. Accessed 28 May 2010. Available: [doi: 10.2471/BLT.10.075986](https://doi.org/10.2471/BLT.10.075986)
56. Liu, J. 2009. Maternal beliefs and behaviors in the prevention of Childhood diarrhea in Dar Es Salaam, Tanzania 1-104. Available: <https://studentaffairs.stanford.edu/sites/default/files/haas/files/Jessie%2520Liu%2520Thesis.pdf>
57. M de Vrese, Marteau PR. Probiotics and Prebiotics: Effects on Diarrhea. The Journal of Nutrition. Accessed 28 June 2014. Available: www.innocua.net/web/download.../j.-nutr.-2007-de-vrese-803s-11s.pdf