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Effects of Water and Sanitation Crisis on Infants and Under-five Children in Africa

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ABSTRACT

Dwindling municipal water supply leads to water and sanitation crisis. For their domestic needs, people fall back on dubious water sources, many of which contain dangerous contaminants. Since, they cannot afford the high expense of water treatment, people helplessly take the contaminated water. They get sick with water-related diseases, leading to miscarriages, birth defects and infantile deaths, as well as loss of work and school days equivalent to 3-5% GDP due to water related ailments. This review critically examines secondary information and data on sources of water contamination and the effects of water and sanitation crisis on infants and under-five children in Africa. Methaemoglobinemia, dehydration, malnutrition and loss of parents associated with high MMR and water and sanitation related low life expectancy afflict children, leading to high mortality rate and morbidity of infants and under-five children. Recommendations include emphasis on preventive healthcare and pro-poor health policies to ensure the quality and availability of safe water.

Key words: Sanitation, contamination, water treatment, mortality rate

INTRODUCTION

The human body is composed of 65% water. Plants-needed for human food-contain even more. For example, maize is 80% water. A person can live for weeks without food, but only a few days without water. Planet Earth is literally awash with water. About 70% of the globe is covered by water. About 0.00017% of the volume of this water is in freshwater lakes and inland seas. The most important need for water is drinking by man, followed by use for agriculture to produce man's food and this consumes around 70% of available fresh water. In condensing, evaporated water dissolves rocks to become saline solution, particularly rich in sodium chloride. About 100 trillion tones of rain falls every year, but geographically unevenly distributed. Even when water is available, it may be a life threatening resource because of its contamination. Every year, more than 5 million people die from water-related diseases. And, 84% of them are children aged 0-14 (Dunbar and Emsley, 2009).

This grim situation is more pronounced in Africa. This review critically examines secondary information and data on sources of water contamination and the effects of water and sanitation crisis on infants and under-five children in Africa.

LITERATURE REVIEW

Africa is certainly not on track to meet the Millennium Development Goal for drinking water and sanitation. Rather, it is heading for a continuous, endemic water and sanitation crisis that debilitates and kills huge numbers of people, threatens the health of the workforce, stands in the

way of economic growth and limits access to education and, therefore, life opportunities. Every year, an estimated one million Africans die from diseases related to unsafe drinking water, poor sanitation and poor hygiene. Health, dignity and development are at stake- for millions of individual Africans and Africa as a whole (Alexander, 2008).

Of the nearly one billion Africans, only 602 million (60.2%) have access to improved drinking water source and 360 million (36%) have access to improved sanitation facilities. Only 15 million Africans gain annually access to improved drinking water sources, while 10 million gain annually access to improved sanitation facilities. To meet the Millennium Development Goal 7 target 10 for drinking water and sanitation, Africa will need to provide annually from 2008 to 2015 access to improved drinking water source for at least 33 million people and improved sanitation facilities for 45 million people. At the current rate of 15 million people that annually gain access to improved drinking water source, efforts must be more than doubled. And, at the current rate of 10 million people that annually gain access to improved sanitation facilities, five-fold increase on current rate is demanded (Earthwatch, 2008).

Too many Africans live in poverty and hunger because they have no access to water and sanitation. Africa faces food crisis, fuel crisis and water crisis. But, water is a common factor. The solution to many problems is basically a matter of good water management. Water is one of the main keys to sustainable development in Africa. About 94% of Africa's hydropower potential is unused. Harnessing this energy will create food through enough storage capacity to multiply irrigated farmland many times over. Access to water is a prerequisite to help Africans escape dehumanizing effects of mass poverty, to give them a future and to advance the development of the African continent (Alexander, 2008).

Preventive healthcare is ten times cheaper than curative care. Sustained access to adequate sanitation is the best conceivable preventive healthcare. People suffering from illnesses related to poor sanitation occupy 50% of hospital beds in sub-Saharan Africa. And, these illnesses account for a massive 12% of the health budget. Work and schooldays are lost to these illnesses, leading to 3-5% losses in Gross Domestic Product, GDP (Earthwatch, 2008).

Sources of water contamination: In its pure form, water, H₂O, is a compound of two hydrogen atoms and one oxygen atom. But, as a universal solvent, water dissolves many materials coming in contact with it. Thus, all sources of water contain naturally occurring microbiological and chemical contaminants arising from domestic and industrial activities amidst increasing urban population.

Human and animal faeces can contaminate underground water. The good old 'typhi' lives in human and animal excreta as its normal habitat. It flows through the septic tank to the suck-away, where it reproduces at millions per second. Nitrogen from fertilizers not used by plants forms soil nitrates, which may also result from seepages in groundwater, from septic tanks and from surface water run-offs. Pesticides from agricultural activities pollute underground water. Chemicals and heavy metals from industrial activities and disposal sites can pollute both ground water and surface water. Rain washes run-off water from these sites to water sources (Earthwatch, 2009).

These contaminants do not exactly pose a risk at low concentration levels. Sometimes, they improve the taste of and add some nutritional and medicinal values to, water. However, when the concentrations of contaminants increase above the levels prescribed by the World Health Organization (WHO) and other local and global bodies, the water becomes unfit for human consumption. Table 1 shows the maximum acceptable levels of different contaminants in drinking water.

Table 1: Maximum acceptable levels of different contaminants in drinking water

Parameter	Maximum acceptable concentration level
Inorganic parameters	
Total solids	1,000 mg L ⁻¹
Total alkalinity	100 mg L ⁻¹
Phenolphthalein alkalinity	100 mg L ⁻¹
Iron (Fe)	0.05 to 0.3 mg L ⁻¹
Sulphate (SO ₄)	200 mg L ⁻¹
Magnesium (Mg)	50 mg L ⁻¹
Calcium (Ca)	50 mg L ⁻¹
Chloride (Cl)	200 mg L ⁻¹
Fluoride (F)	150 mg L ⁻¹
Zinc (Zn)	1.0 mg L ⁻¹
Copper (Cu)	1.0 mg L ⁻¹
Aluminum (Al)	0.5 mg L ⁻¹
Manganese (Mn)	0.5 mg L ⁻¹
Nitrate (as NO ₃)	50 mg L ⁻¹
Nitrite (as NO ₂)	3 mg L ⁻¹
Potassium (K)	1 to 2 mg L ⁻¹
Arsenic (As)	0.01 mg L ⁻¹
Barium (Ba)	0.7 mg L ⁻¹
Cadmium (Cd)	0.02 mg L ⁻¹
Chromium (Cr)	0.05 mg L ⁻¹
Cyanide (CN)	0.07 mg L ⁻¹
Lead (Pb)	0.01 mg L ⁻¹
Selenium (Se)	0.01 mg L ⁻¹
Silver (Ag)	-
Mercury (Hg)	0.001 mg L ⁻¹
Silica (Si)	100 mg L ⁻¹
Carbon dioxide (CO ₂)	50 mg L ⁻¹
Organic parameters	
Vinyl chloride	0.005 mg L ⁻¹
Endrin	-
Lindane	0.002 mg L ⁻¹
Methoxy chloride	0.02 mg L ⁻¹
Toxaphene	-
Chlorophenoxy	-
2,4-Dichlorophenoxy	0.03 mg L ⁻¹
2,4,5-Trichlorophenoxy acetic acid	0.009 mg L ⁻¹
Microbiological parameters	
Aerobic mesophylic count/mL	-
Coliform count/mL	Must not be detectable in any 100 mL per sample. Must not be present in 95% of samples taken throughout any 12 months period
<i>E. coli</i> enumeration/mL	Must not be detectable in any 100 mL per sample

Source: NPC and UNICEF (2001)

WATER TREATMENT

In Africa, public health receives inadequate attention. The government fails to provide water purification to ensure the people's protection from the high risks of water-borne diseases.

People take water purification into their hands to protect their lives from terrorists lurking in their drinking water. Purifying drinking water has become a safety measure to preserve one and one's family. Boiling, disinfection, filtration and analysis of water are measures taken in this regard (Earthwatch, 2009; Eneh, 2007).

Boiling: Boiling water is a time-tested method of water purification. But, some micro-organisms can withstand heat and survive in boiling water. Protozoa, like giardia and cryptosporidium, form cyst to enable them survive harsh conditions. The cysts can also be powerful pathogens.

Besides, nitrate concentration increases in boiling water and excessive levels of nitrates in drinking water can be fatal.

Disinfection: Disinfection kills or inactivates pathogens or disease-causing microorganisms in drinking water. Chemical disinfectants, such as chlorine, are injected into water to make it fit for drinking. However, pathogens, like giardia and cryptosporidium, may survive disinfection in sufficient numbers to cause potential health risks. Again, when injected in water, chlorine can cause eye, nose and sinus irritation and stomach problems. Chlorine gives drinking water a bad taste and can cause asthma when inhaled. Besides, chlorine byproducts are even more dangerous than chlorine itself. Chlorinated drinking water has been found to contain deadly chloroform, bromates, chlorite haloacetic acid and trihalomethanes as byproducts. Bladder, colon and rectal cancer, anaemia in infants and young children, nervous system problems, liver and kidney problems and even spontaneous abortion problems have been related to chlorination of water. These harms to health done by chlorine as a water disinfectant must be viewed with the seriousness they deserve, especially as this disinfectant is affordable and commonly used.

Filtration: Filtration is a physical process that removes contaminants, to make water fit for drinking. Filters help weed out things like chlorine and heavy metals.

Regular tap water contains bacteria and minerals that can clog skin pores, leading to dull skin over time. Cleaner and clearer water attributes to clearer and softer skin. Heavy water can irritate the skin, even making it red. Reverse osmosis filters make water molecules smaller, enabling them to penetrate and hydrate the skin better. Being hydrated always helps the skin glow as well. Filtered water is far better for keeping a beautiful complexion. With filtered water system at home, cleansing the face in one's own sink can have the same radiant effect on the skin. The trend of filtered water aiding skin care has been extended to water sprays, claimed to refresh and rejuvenate skin a product that appeals to jetsetters or office workers, whose faces and skins may get dry from the cabin or cubicle air, as well as athletes needing to soothe the sun or cool perspired faces.

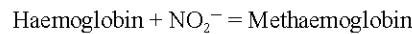
Installing water filters in homes has been prescribed for addressing water crisis (Health Information, 2009).

Analysis: Water sources are tested periodically to find out the level of contamination and the necessary measures to take in order to make the water fit for drinking. Other measures to ensure safety of drinking water include ensuring the quality of packaged water before consumption. For rain water, boil, filter and store it for drinking for only the appropriate period. The harvesting should be done carefully to reduce the contamination level.

Effects of water and sanitation crisis on infants and under-five children: The effects of water and sanitation crisis on infants and under-five children include methaemoglobinemia (blue baby syndrome), dehydration, high infant mortality rates (IMRs), high under-five mortality rates (U-5MR), malnutrition, dull skin and low life expectancy and loss of parents.

Methaemoglobinemia (Blue baby syndrome): Breathing ventilates, i.e., renews the air in the lungs. Inhalation involves the diffusion of air into the lungs. Oxygen from inhaled air diffuses into the blood capillaries. Exhalation involves the removal of carbon dioxide from the lungs. Once in the blood, oxygen combines with haemoglobin of the red blood corpuscles to form oxy-haemoglobin, which is transported in the cells of the body. Oxy-haemoglobin gives up its oxygen when it reaches tissues with a low concentration of oxygen (Stone *et al.*, 2001).

Nitrate in water is particularly dangerous to babies and children, who, in proportion to their body weights, consume much more water than adults. Until an infant reaches about 6 months of age, its digestive system secretes lower amounts of gastric acid, leading to low acid concentration or higher pH level and attendant proliferation of bacteria, which transform nitrate to nitrite. Thus, when water with excessive nitrate concentration is used for preparing baby food or as baby drinking water, the baby's immature digestive system, with its lower concentration of gastric acid and the attendant higher concentration of bacteria, facilitates the reduction of the nitrate to nitrite. The nitrite ions (NO_2^-) react with haemoglobin and oxy-haemoglobin to form methaemoglobin, which cannot carry oxygen and thereby, making oxygen transfer difficult.



This leads to asphyxia (difficulty in breathing), which may result to death. This blood disorder is called methaemoglobinemia (blue baby syndrome). It occurs mostly in babies, pregnant women and people with weak immune system.

Babies have lower concentration (about 60% of adult's) of the enzyme that converts methaemoglobin to haemoglobin (Roddick *et al.*, 2004). This speaks of their vulnerability to this disorder and predisposition to the attendant death.

Dehydration: Water crisis is responsible for dehydration in children, which leads to a reduction in both mental and physical performance. Children are at much greater risk of dehydration because the process can begin much more rapidly in them. Since they are still growing, there is all the more need to keep their bodies hydrated for proper functioning. A loss of 2% of body fluids causes 20% reduction in performance in both physical and mental activities in children. Dehydration in excess of 3% may lead to heat stroke, a condition to which children are much more prone than adults are (Water\Health information, 2009a).

Dehydration causes contraction and false labour in pregnancy, as well as health risks for the newborn baby (Water\Health information, 2009b).

High Infant Mortality Rates (IMRs): Table 2 shows 16 African countries with Infant Mortality Rates (IMRs) above 100 per 1,000 in 2006. In the same year, nine other countries in the continent

Table 2: Sixteen African countries with IMR above 100 per 1,000

African country	Infant mortality rate per 1,000	African country	Infant mortality rate per 1,000
Burundi	100.3	Cote d'Ivoire	114.7
Tanzania	104.1	Somalia	115.7
Malawi	104.2	Burkina Faso	116.8
Nigeria	109.3	Mali	127.4
Tchad	112.4	Angola	131.8
Guinea Bissau	112.7	Liberia	134.0
Rwanda	113.0	Niger	146.8
Cong (DRC)	113.7	Sierra Leone	160.8

Source: ADB (2007b)

Table 3: Group range of Under-five Mortality Rates for African countries (2006)

No. of African countries	Range of under-five mortality rate per 1000
2	> 250
4	200-249
17	150-199
14	100-149
14	< 100

Source: ADB (2007a)

recorded IMR between 77.5 and 92.6 per 1000, ten others recorded between 57 and 72.7 per 1000, eight others recorded between 31.4 and 52.4 per 1000 and only four others recorded between 14 and 25.6 per 1,000. The average IMR was 83 per 1000 (ADB, 2007a).

Water is a major nutrient for children. Good sanitation practices, which require good water supply, are preventive measures for diarrhoeal diseases. Therefore, these high figures are directly related to water and sanitation crisis.

According a study conducted in Nigeria, which constitutes one-fifth of Africa's population, diarrhoeal diseases are second to malaria as the main cause of infant mortality and morbidity (NAFDAC, 2001).

High under-five mortality rates: The average under-five mortality rate (U-5MR) for African countries in 2006 was 138 per 1,000 (ADB, 2007a). Two countries recorded 250 and above per 1000, four countries recorded between 200 and 249 per 1000, seventeen countries had between 150 and 199 per 1000, fourteen countries had between 100 and 149 per 1000 and another fourteen countries had 100 and below per 1000 (Table 3).

As was observed for Nigeria, diarrhoeal diseases, which are direct consequences of water and sanitation crisis, are third (to malaria and vaccine preventable disease, VPD) as the main cause of under-five mortality and morbidity (NNAFDAC, 2001).

Malnutrition: Malnutrition is responsible for high rate of stunting (33.5%), underweight (30.7%) and wasting (15.6%) among under-five children (Eneh, 2005). Since, water is one of the most important nutrients for children, keeping them healthy and also helping them perform better (Water\Health information-drinking water and children-babies.htm), water crisis is chief factor of malnutrition in children.

Table 4: Group range of life expectancy at birth for African countries

No. of African countries	Life expectancy at birth (years)
7	70-74
1	64
14	50-57
21	40-49
5	31-39
None	0-30

Source: ADB (2007a)

Table 5: Group range of MMR for African countries in 2006

No. of African countries	Range of MMR per 1000
17	>100
35	11-99
None	≤9

Source: ADB (2007a)

Dull skin: Since regular tap water contains bacteria and minerals which can clog skin pores (Water\Health information-Water and beautiful skin.htm), children face the danger of having dull skin in water crisis. Heavy water causes irritation and discolouration of the skin of children. It is also responsible for poor water penetration and hydration of the skin, which leads to poor skin glow, radiance and complexion beauty.

Low life expectancy and loss of parents: Senior African citizens face higher risk of dehydration because of diminished kidney function (Water\Health information - importance of water to the elderly senior citizens.htm), especially in the water crisis situation, thereby, worsening the low life expectancy related problems in African continent, where low life expectancy accounts for early death of parents. From Table 4, only 7 African countries recorded 70-74 years for life expectancy at birth in 2006, one country recorded 64 years, 14 countries recorded 50-57 years, 21 countries recorded 40-49 years and as high as 5 countries recorded 31-39 years (ADB, 2007b).

The average figure was an appalling and miserable 51 years. It means that Africans above 51 years of age are living on injury time. Worse still, many African men marry between 35 and 45 years of age and have very young and tender families at the average life expectancy age.

Exacerbating the low life expectancy situation is high Maternal Mortality Rate (MMR). Table 5 shows that seventeen countries recorded 3-digit figures, 35 recorded 2-digit figures and none recorded a single-digit figure of MMR in Africa (ADB, 2007a). Average MMR was 84 per 1000 for African countries in 2006.

Therefore, high MMR and low life expectancy related to water and sanitation crisis affect infants and children in the following ways (Eneh, 2009a, b):

- Increase in the population of orphans and vulnerable children
- Increase in the number of homes headed by children
- The attendant perpetuation of the circle of poverty
- Inability of children to develop to their full potential due to premature death of selves or parents

- Inability of undeveloped children to harness the country's resources for national development
- Poverty-induced child labour and trafficking
- Increase in stress-induced social conflicts and reprisals and
- The attendant death tolls

CONCLUSION AND RECOMMENDATIONS

The dictum, which says that Water takes the path of least resistance and flows downwards, is fast being disproved. Due to poor water governance, the path of water is now a bloody hard road. This most crucial substance to survival now flows upwards to the rich in the society. Worldwide, one billion people do not have any water within a 15 min walking distance from their homes.

Preventive healthcare must be emphasized, as against curative care. Pro-poor health policies and increased health budgets are imperative. Sustained access to safe water and adequate sanitation will help decongest 50% of hospital beds in sub-Saharan Africa, save 12% of the health budget and regain 3-5% losses in Gross Domestic Product, GDP, due to work and school days lost to water-related illnesses.

Since, water is this important for the well being of infants and under-five children in Africa, the quality and availability of safe water must be assured. Emphasis should be on preventive healthcare and pro-poor health policies to ensure the quality and availability of safe water. To this end, individual, family, corporate and governmental efforts must be stepped up in urgently addressing water crisis. To do this, they must be first sensitized and enlightened, especially in Africa.

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