Review Paper

Role of the World Health Organization in Management of Gastrointestinal Diseases Caused by Contaminated Water in Children in the Middle East: A Review Paper

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Citation Alijanzadeh Maliji B, Babayeemehr A, Rohani K, Mehrabani S, Aghajanpour F. Role of the World Health Organization in Management of Gastrointestinal Diseases Caused by Contaminated Water in Children in the Middle East: A Review Paper. Journal of Pediatrics Review. 2023; 11(1):59-66. http://dx.doi.org/10.32598/jpr.11.1.285.2

http://dx.doi.org/10.32598/jpr.11.1.285.2

Article info:
Received: 07 Nov 2022
First Revision: 25 Dec 2022
Accepted: 29 Dec 2022
Published: 01 Jan 2023

Key Words:
Contaminated water, Pediatric gastrointestinal diseases, World Health Organization

ABSTRACT

Background: The World Health Organization (WHO), as the international authority on public health and water quality, directs and monitors global efforts to prevent the transmission of waterborne diseases and advises governments on the development of health-based goals and regulations.

Objectives: This review study aims to investigate the management methods, including control, prevention, and treatment of gastrointestinal (GI) diseases in children in the Middle East caused by contaminated water through WHO.

Methods: For this purpose, Scopus, Google scholar, PubMed, SID, Irandoc, and up-to-date databases were searched without time limitation. Keywords included contaminated water, pediatric, GI diseases, and WHO. In this study, the full text of various articles in Persian and English was used. After removing duplicate articles and articles that did not fit the topic of the study, 54 articles were finally selected.

Results: Based on the findings, the World Health Organization has reported that diarrhea, polio, hepatitis A, and cholera are the most common GI infectious diseases caused by contaminated water in children in the Middle East. The present reports of waterborne disease represent only a small proportion of the total number of cases of this disease in the population. In some areas, it has been shown that investments in water and wastewater supply by responsible institutions can provide a net economic gain by reducing negative health impacts and healthcare costs.

Results The results of this study indicate that most of the diseases caused by contaminated water affect children, due to low ability to observe personal hygiene and the state of the child's immune system, which often leads to the death of children.

Conclusions: The lack of diagnosis and insufficient prevalence of these diseases in some Middle Eastern countries, followed by the lack of attention to the prevention and control of waterborne diseases, threatens the health policies of these countries. International organizations, especially the World Health Organization and the united nations children's fund, play a vital role in addressing and controlling this problem.

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Introduction

Availability and access to clean water are essential for public health, whether for drinking, domestic use, food production, or recreational purposes. In 2010, the united nations general assembly explicitly recognized the human right to water and wastewater. Contaminated water exposes people to preventable health risks. Contaminated and unsanitary water is the main cause of many infectious diseases, such as cholera, diarrhea, dysentery, Hepatitis A, typhoid fever, and polio [1]. It was estimated that 829,000 people die each year due to diarrhea caused by unclean drinking water. However, diarrhea is largely preventable, and if these risk factors are considered, 297,000 children under 5 years of age can be saved from death each year [2].

Diarrhea is the most common disease associated with contaminated food and water, but other factors cause diarrhea. In 2020, more than 250 million people needed preventive treatment for schistosomiasis (an acute and chronic disease caused by parasitic worms that result from contact with contaminated water). By 2025, half of the world's population will live in water-scarce areas, and most children will be at risk of water-related diseases. As the international authority on public health and water quality, World Health Organization (WHO) leads global efforts to prevent the transmission of waterborne diseases and advises governments on developing health-related goals and regulations. Poor sanitation also contributes to polio transmission because contaminated feces can be spread through water [3].

It took 14 years from the detection of polio to its control and containment. Subsequently, with the security changes in the region and the reduction of the water standard level, its outbreak was reported again in 2013 in Syria, after which the disease also spread to Iraq.

Excessive abstraction of deep groundwater has led to skeletal fluorosis, which can cause permanent disabilities in children if water with high fluoride concentrations is consumed. Water with high fluoride content is found throughout the Middle East and North Africa, including rural areas in Iran [4] and Yemen [5]. High concentrations of arsenic [6], nitrates [7], and radioactive elements, such as radium, and salinity [8] are also present in deep groundwater and can adversely affect children's health. In Jordan, natural carcinogenic radium isotopes have been detected in a deep fossil aquifer at concentrations 2000% above international drinking water standards. Radium in drinking water can have serious health consequences as it accumulates in bones and tissues and increases the risk of cancer over a lifetime. Children have a lower body mass than adults, therefore chemicals and toxins in water can be dangerous to children in concentrations that are relatively harmless to adults [9]. Waterborne pathogens that cause disease include some living organisms (usually from animal waste), various types of viruses, bacteria, fungi, and intestinal worms [10].

The present study was conducted to manage, including control, prevention, and treatment of the diseases related to contaminated water, and to take a step forward by presenting the measures and possibilities of the WHO and international determination.

Methods

For this review, Scopus, Google Scholar, PubMed, SID, Irandoc, and up-to-date databases were searched without time limitation. Keywords included "contaminated water", "pediatric gastrointestinal (GI) diseases", and "WHO". The full text of various articles in Persian and English was used for this study. After removing duplicate articles and articles that did not fit the topic of the study, 54 articles were finally selected.

Results

Diarrhea

Diarrhea is a contagious and very common disease in which the stool becomes loose and watery so that it comes out completely smooth. Diarrhea may last for several days and results in loss of water and electrolytes. In the past, severe dehydration and fluid loss were the main causes of death from diarrhea. Currently, other causes, such as septic bacterial infections account for an increasing proportion of all diarrhea-related deaths. Malnourished or immunocompromised children and people with HIV are at increased risk for life-threatening diarrhea that can lead to death [11]. In medicine, diarrhea is when one has three or more loose or liquid stools per day. Frequent stools that are not loose or liquid [12], as well as loose and mushy stools in breastfed infants, obviously cannot be called diarrhea [13, 14]. Diarrhea is usually a symptom of GI infection, which can be caused by a variety of bacterial, viral, and parasitic organisms. The infection spreads through contaminated food or drinking water or from person to person as a result of a lack of hygiene [13].

Diarrhea is the second leading cause of death in children under five, a disease that is both preventable and treatable. Each year, approximately 525,000 children under the age of five die from diarrhea [15]. Most cases of diarrhea can be prevented through clean drinking water and proper hygiene. Worldwide, there are nearly 1.7 billion cases of childhood diarrhea each year. Diarrhea is a leading cause of illness, malnutrition, and mortality in children under 5 years of age [16]. The brunt of this disease falls on children growing up in the world's poorest countries and is largely linked to inadequate drinking water and sanitation [17]. Against this background, improving access to safe drinking water and sanitation is one of the most important aspects of the millennium development goals (MDGs). Although recent statements by the United Nations and the WHO suggest that the MDGs for access to water have already been met [18], there are compelling arguments that these claims are exaggerated. However, even if the MDGs are fully achieved, 100 million people will still lack access to sustainable clean water sources [19].

Cholera

Cholera is a diarrheal disease caused by the bacterium Vibrio cholerae. Approximately 20% of people infected with V. cholerae develop acute, watery diarrhea, and 10%–20% of infected individuals develop severe diarrhea and vomiting [20, 21]. The incubation period of cholera is short (a few hours to 5 days) [22]. Cholera can spread rapidly in places with poor water and sanitation [23]. Disease outbreaks are usually caused by the consumption of contaminated water or food. Because cholera has a relatively high infectious dose, the organism [24] often relies on heavy contamination of drinking water or multiplication of the pathogen in contaminated food to cause outbreaks. Since the 19th century, the world has experienced 7 cholera epidemics that have killed millions of people. The current seventh pandemic began in South Asia in 1961 and spread to all regions under the supervision of the WHO. In 2016 alone, more than 132,000 cholera cases with 2,420 deaths were reported in 38 countries worldwide, representing a mortality rate of 1.8% [25].

Of all continents, Africa is the most affected by the current pandemic. In 2016, 17 African countries accounted for 54% of all global cases. Moreover, the mortality rate in Africa (2.5%) was higher than that of global levels (1.8%). Of the 2,420 deaths reported globally in 2016, 1,762 (73%) occurred in Africa. Inadequate water and sanitation are considered a driving force behind cholera epidemics in Africa [26].

Hepatitis A

Hepatitis A is an inflammation of the liver parenchymal tissue caused by the Hepatitis A virus (HAV) via the direct or indirect fecal-oral route. The virus is transmitted primarily when an uninfected person eats food or water contaminated with the feces of an infected person. Hepatitis A is closely associated with unhealthy food or water, inadequate hygiene, improper personal hygiene, and oral-anal sex. Unlike Hepatitis B and C, Hepatitis A does not cause chronic liver disease, but it can cause debilitating symptoms and, in rare cases, fulminant Hepatitis (acute liver failure), which is often fatal. According to estimates from WHO, 7,134 people worldwide died from Hepatitis A in 2016 (representing 0.5% of deaths from viral hepatitis). Hepatitis A occurs sporadically and epidemically worldwide and tends to recur at regular intervals. Epidemics associated with contaminated food or water can erupt explosively, as in Shanghai in 1988, where an estimated 300,000 people were affected [27].

In addition, the course of Hepatitis A can last for months and affect the population through person-to-person transmission. HAVs persist in the environment and can resist food manufacturing processes routinely used to inactivate or control bacterial pathogens [28]. Geographic areas of distribution can be designated as areas of high, moderate, or low levels of HAV infection. However, the infection does not always equate to disease, as young infected children do not show recognizable symptoms. Infection is common in low- and middle-income countries with inadequate sanitation and hygiene practices, and most children (90%) are infected with HAV before the age of 10, often without symptoms [27]. HAV is transmitted mainly by the fecal-oral route. This occurs when an uninfected person eats food or water contaminated with the feces of an infected person. In families, when an infected person prepares food for family members, this can happen with contaminated hands. Waterborne outbreaks, although rare, are usually associated with sewage-contaminated water or inadequate water treatment.

Typhoid fever

Typhoid fever remains a leading cause of death in low- and middle-income countries, with an estimated 10-20 million typhoid cases and about 200,000 deaths per year [29-31]. In South and Southeast Asia, *Salmonella typhi* was identified as the most common bacterial pathogen associated with bloodstream infection (BSI) in hospitalized patients between 1990 and 2010 [32]. In contrast, *S. typhi* was not considered a major cause of BSI in southern and

eastern African countries during the same period, even in centers with long-term bacteremia surveillance [33]. Instead, non-typhoidal *Salmonella serovars* were much more critical causes of BSI. Since 2012, the trend has changed dramatically, and several reports have described the occurrence of typhoid fever as a major cause of BSI in southern and eastern Africa [34-37].

Although the triggers of this recent occurrence are unclear, water, especially river water is still one of the factors in the spread of this disease. Typhoid fever is now recognized as a major public health problem in Africa and Asia [38, 39].

Polio

Poliovirus (PV) is a non-enveloped, positive-sense, single-stranded RNA virus belonging to the Enterovirus genus of the *Picornaviridae* family [40, 41]. PV has a relatively small (≈30 nm) icosahedral particle structure composed of four distinct capsid proteins, including viral protein (VP)1, where most antigenic epitopes are located [42, 43]. Similar to other non-polio enteroviruses (NPEV), PV is transmitted via the fecal-oral route and replicates efficiently in the intestinal tract. During PV infection, the virus is shed from the human intestine into feces for approximately 2 months [44-46]. The disease is transmitted to humans mainly through contaminated water and food. Although most PV infections are asymptomatic, in some cases patients may develop poliomyelitis after viremia, resulting in "residual paralysis" [47].

The role of the WHO

WHO, as the international authority on public health and water quality, directs and monitors global efforts to prevent the transmission of waterborne diseases and advises governments on the development of health-based goals and regulations [48]. WHO provides a set of water quality guidelines, including those for drinking water, safe use of wastewater, and clean recreational waters. The WHO's water quality guidelines are based on preventive measures and this issue was conducted seriously since 2004. This guideline, with health-related goals, includes the development and implementation of water safety plans by utilities to efficiently identify and manage from the watershed to the consumer, and independent monitoring to ensure the effectiveness of water safety plans, with the aim that the WHO is subject to global health standards from the source of the water until it reaches the consumer's hand [49].

WHO also assists countries in implementing drinking water quality guidelines by updating these guidelines and providing direct assistance to countries. This assistance includes developing local drinking water quality regulations consistent with the principles of the guidelines and developing, implementing, and prioritizing water safety programs [50]. Since 2014, WHO has been analyzing household water treatment technologies based on health-related performance criteria as part of the international scheme to evaluate household water treatment technologies. The purpose of this Scheme is to ensure the performance of technologies delivered to users, to protect against pathogens that cause diarrheal diseases, and to strengthen policy and regulatory mechanisms at the national level to support appropriate targeting and consistent and correct use of such products [51].

The WHO works closely with united nations international children's emergency fund (UNICEF) on water and health issues. In 2015, the two agencies jointly developed the water and sanitation for health facility improvement tool (WASH FIT) approach to improve water and sanitation quality. The water and sanitation for health facility improvement tool (WASH FIT) aim to guide small and primary health facilities in low- and middle-income countries through a continuous cycle of assessments, priority setting, and specific and targeted interventions. The 2019 report described practical steps that countries can take to improve water, joint actions, and targets [52].

The WHO collaborates with member states and other relevant agencies in the following areas

1. Supporting national policies and investments in the treatment of diarrheal diseases and their complications

2. Supporting the improvement of access to safe drinking water and sanitation in developing countries

3. Conducting extensive research on the prevention and control of diarrheal diseases in collaboration with the World Bank

4. Creating extensive capacity to implement preventive measures, including sanitation, water resource improvement, household water treatment, and clean water storage

5. Creating new health initiatives, such as rotavirus vaccination and support for health worker training, es-

pecially in low-income communities, such as the Middle East [53].

Practical actions by WHO

In May 2016, the World Health Assembly approved the first global health sector strategy on viral hepatitis, 2016-2021. The strategy emphasizes the crucial role of universal health coverage, and the strategy's goals are aligned with sustainable development goals. This strategy has the vision to eliminate viral hepatitis as a public health problem.

This global project aims to reduce the number of new viral hepatitis infections by 90% and the number of deaths caused by viral hepatitis by 65% by 2030. The actions that countries and the WHO Secretariat must take to achieve these goals are set out in the strategy. The WHO works in the following areas to help countries achieve the global hepatitis targets under the 2030 agenda for sustainable development, raising awareness, promoting participation, and mobilizing resources, developing strategies and evidence-based data for action, improving health equity in response to hepatitis, preventing transmission; and scaling up screening, care, and treatment services.

The WHO published a progress report on HIV, viral hepatitis, and sexually transmitted infections in 2021, highlighting successful work to eliminate them. This report included global statistics on viral Hepatitis B and C, rates of new infections, the prevalence of chronic infections, and mortality rates from these 2 viruses, as well as key interventions.

Since 2011, the WHO has partnered with national governments, civil society, and member states to plan annual world hepatitis day campaigns (as one of its nine annual health campaigns) to raise awareness and understanding of viral hepatitis [54].

Limitations of the study

In this study, an initial survey was conducted to collect information from various sources and assess the status of waterborne disease surveillance at the regional level in the Middle East and North Africa. This study revealed the complexity of this issue and the lack of systematic information on the status and surveillance of waterborne diseases in the Middle East and North Africa region.

Surveillance of waterborne diseases can be compromised due to poor performance in the early stages and a lack of timely diagnosis and treatment. Limitations include, inadequate laboratory capacity in terms of human resources and funding, lack of meaningful epidemiological data, lack of a uniform reporting method, and lack of priority areas to improve waterborne disease surveillance, including strengthening capacity for epidemiological investigations to identify pathogens and their transmission routes.

Further suggestions

Based on the conducted study, the following suggestions are made:

1- Improving the identification of cases related to recreational waters, aquatic foods, and aquatic products;

2- Strengthening capacity to identify cases originating from small water systems in rural areas;

3- Increasing WHO activity in the Middle East region, particularly in war-torn countries, such as Afghanistan, Iraq, Syria, and Yemen; and using the capacity of trustee agencies, such as the World Bank.

Conclusion

The main findings of the current study show that diarrhea, polio, Hepatitis A, and cholera are the most common waterborne GI infectious diseases in the Middle East and North Africa region from the perspective of the WHO. The present reports of waterborne diseases represent only a small fraction of the total number of cases of these diseases studied in the population.

To justify this claim, it can be said that the weak diagnosis of cases and prevalence of these diseases in countries such as the Middle East and the lack of pathogen attribution and especially the sources of transmission of emerging diseases (including cryptosporidiosis, giardiasis, legionellosis) cannot be accurately identified in health systems compared to other diseases, which threatens the health policies of countries if serious attention is not paid to the prevention and control of waterborne diseases. Access to safe drinking water for health is one of the vital and fundamental human rights. The importance of healthy and clean water in ensuring human health has been recognized by international organizations, particularly the WHO, as a set of accepted outcomes. Clean drinking water is considered an important health issue that can be developed at the regional, national, and local levels. In some areas, it has been shown that investments in water and wastewa-

ter supply by responsible institutions can provide net economic benefits by reducing negative health impacts and healthcare costs. Diseases caused by contaminated water are often caused by pathogenic microbes that spread and multiply through contaminated water. Transmission of these diseases occurs through the use of contaminated water instead of drinking water, food preparation, and washing of clothes. Many developing countries do not have water treatment plants. In some deprived areas of the world, the availability of fresh water is so rare that people in these areas do not have enough time or money to cover the cost of providing clean drinking water. This problem is not unique to developing countries.

According to a report published in the global network of infectious diseases and epidemiology online, about 18% of disease outbreaks investigated by the WHO in developed European regions are related to contaminated water. Most waterborne disease outbreaks are due to contaminated public drinking water and then recreational facilities (lakes, swimming pools, water parks). Diseases caused by contaminated water mainly affect children, due to the lack of personal hygiene and the state of the child's immune system, which often leads to the death of children. Knowledge about the types of diseases caused by polluted water has increased the attention of experts and professionals in this field in recent decades compared to the past. International organizations, especially the WHO and the United Nations Children's Fund play a vital role in addressing and controlling this problem; in particular, the WHO, since this issue falls within the scope of the objectives and powers of that organization.

Ethical Considerations

Compliance with ethical guidelines

No ethical considerations are considered in this research.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors contributions

All authors equally contributed to preparing this article.

Conflicts of interest

The authors declared no conflict of interest.

Acknowledgements

We are grateful to the Clinical Research Development Committee of Amirkola Children's Hospital and Non-communicable Pediatric Diseases Research Center, Health Research Institute of Babol University of Medical Sciences.

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