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RISK FACTORS ASSOCIATED WITH DIARRHEA DISEASE IN CHILDREN: A LITERATURE REVIEW

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Abstract: Goal: To analyze the socio-environmental factors related to the occurrence of acute diarrhea in children from 2009 to 2018. **Methodology:** An integrative literature review study, carried out from 2009 to 2018, in the SCOPUS, Web of Science, Pubmed databases, using the descriptors "diarrhea, infantile", diarrhea, sanitation, "socioeconomic factors", using English, Portuguese and Spanish. **Results:** A total of 32 articles were selected, in English and Portuguese, developed in countries in South America, Africa and Asia. The determinants related to diarrhea are: biological (age and sex); socioeconomic (family income, schooling, type of housing), environmental (vectors, seasonality, environmental contamination) and behavioral (personal hygiene, food hygiene, breastfeeding). **Final considerations:** The authors highlight the importance of implementing actions that address environmental health, mainly focused on priority regions.

Keywords: Socioeconomic Factors, Childhood Diarrhea, Sanitation.

INTRODUCTION

One of the biggest challenges of today's society are urban environmental problems. There are countless diseases resulting from land use and occupation, lack of basic sanitation and unsanitary living conditions in many cities (AYACH et al., 2012).

Therefore, socio-environmental determinants influence the health-disease process, directly interfering with well-being. Thus, populations with greater lack of resources, without access to water, sanitation facilities and with a lower level of education are more vulnerable to illness from diarrhea (BUSS & PELEGRINI FILHO, 2007).

Diarrhea remains one of the leading causes of child morbidity and mortality, in 2016 it accounted for about 8% of deaths in children under five years of age in the world, which is equivalent to about 480,000 children. Despite effective measures to prevent and treat the disease and the downward trend in the number of deaths worldwide, in recent years the disease persists as a major public health problem in developing countries (UNICEF, 2018).

It is undeniable that environmental changes have a significant impact on health, especially for the most vulnerable populations. However, the interference of these impacts on health has not yet been fully clarified, as health is influenced by environmental, social, economic and cultural factors, which interact with each other influencing the health-disease process (MYERS et al., 2013).

Thus, understanding how social, economic and environmental determinants interfere in the health-disease process of the most vulnerable populations is today an essential goal for strengthening environmental health policies. Therefore, this study aims to analyze the socio-environmental factors related to the occurrence of acute diarrhea in children, from 2009 to 2018.

METHODOLOGY

The integrative literature review is a method that aims to synthesize results obtained in research on a topic or issue, in a systematic, orderly and comprehensive manner. It is characterized by providing broader information about a subject/problem, thus constituting a body of knowledge.

From this perspective, the present work is an integrative literature review, having as a guiding research question: what are the socio-environmental factors related to the occurrence of acute diarrhea in children from 2009 to 2018?

The elaboration of the review went through the following steps: delimitation of the theme, identification of the guiding question and

study objective, determination of inclusion and exclusion criteria, selection of studies, analysis, discussion and presentation of the evidence found.

The bibliographic survey was carried out between January and March 2019, developed together with the electronic databases: SCOPUS, WEB OF SCIENCE, PUBMED, and by the indexed databases of the Virtual Health Library (VHL) Latin American and Caribbean Literature in Health Sciences (LILACS) and Medical Literature Analysis and Retrieval System Online (MEDLINE).

To search for articles, selected descriptors were used by consulting the Health Sciences Descriptors (DeCS) with the combination of the Boolean operators AND and OR, having as a search strategy the descriptors: "diarrhea, infantile" OR diarrhea AND sanitation AND " socioeconomic factors" and respective in Portuguese and Spanish. The languages English, Portuguese and Spanish were used, with a temporal cut of the last decade, from 2009 to 2018. The following exclusion criteria were used: articles that did not contextualize with the object proposed by the work, literature review article, meta-analysis, dissertation, theses, letter to the reader, and duplication of articles in the databases.

From the combination of descriptors, 425 publications were located, (202) SCOPUS, (151) VHL, (41) PUBMED and (31) WEB OF SCIENCE. After defining the period, 343 titles were eliminated, remaining after analysis a total of 82 articles (41) SCOPUS, (28) VHL, (10) WEB OF SCIENCE and (3) PUBMED. 22

Then, a reading of the titles and summaries of the 82 articles found was started, in order to present their distribution after inclusion and exclusion criteria. Of these, 32 articles were excluded. Then, the 50 articles were read in full, the thematic content analysis technique was used by reading and rereading the results of the studies, 18 articles were excluded for not meeting the selection criteria. After a further meticulous reading, the sample consisted of 32 articles. We sought to identify relevant aspects that suited the research question initially established.

RESULTS

The final sample consisted of 32 articles, of which 84.4% were in English and 15.6% in Portuguese and no Spanish article. Most of the studies, 25%, were carried out in 2017, followed by 18.8% in 2018 and 2014 each year and the year 2009 had the lowest number of studies with only 3.1%. In the years 2010 and 2011 there was no publication.

As for the origin of studies by continent, Africa had the highest concentration of studies 43.8%, followed by Asia 28% and the Americas 18.8%. No studies have been reported in Europe and Oceania.

Regarding the distribution between countries, graph 3, Ethiopia concentrated 21.9%, followed by Brazil with 18.8%, India, Nigeria and Tanzania with 6.3% each, the other countries with 3.1%. Among the sample, 9.4% were multicenter studies carried out in several countries.

Among the determinants of diarrhea studied in this review, three groups of risk factors for diarrhea illness were grouped: Environmental factors; cultural and behavioral factors; and socioeconomic and demographic factors.

Environmental factors have a greater relationship with the risk of illness, among these factors, the absence of sanitary facilities, which include a water supply system, garbage collection and the presence of latrines was reported by 71.9% of the studies, followed by the presence of flies and insects at home with 12.5%. Regarding cultural and behavioral factors, poor hygiene habits were reported by 34.4% of the studies, followed by inadequate disposal of domestic solid waste and irregular

handling, storage and consumption of water and food with 18.8% each. And finally, the socioeconomic and demographic factors with higher risk 31.3% were associated with families with lower income and 28.1% with lower parental education.

DISCUSSION

In the analyzed studies, a high incidence of diarrhea was observed in all the countries studied, with incidence values ranging from 6.1% in the district of Mkuranga in Tanzania to 35.4% in the city of Jordão in the Amazon region of Brazil (MASHOTO et al. al., 2014; IMADA et al., 2016). A large survey conducted in 29 countries in Sub-Saharan Africa and South Asia, with a population of 269,014 children, confirms the high incidence of diarrhea among the countries studied, with a 15% rate of diarrhea episodes in the two weeks prior to the survey. (JUNG; LOU; CHENG, 2017).

In all studies, acute diarrhea was defined as the condition characterized by two or more episodes of liquid and semi-liquid stools in a period of up to 14 days. In the study carried out by Al-Ghamdi; Bentham; Hunter, (2009) the authors reported that of the children who had diarrhea, 76% had abdominal pain, 43% had nausea and vomiting, 34% had hyperthermia and more than 1% had dysentery, presence of blood in the stool.

As for the transmission of gastrointestinal diseases, contamination via the fecal-oral route has the greatest potential for transmitting diarrhea. In two studies, one in Kenya and the other in South Africa, fecal coliforms, human-associated bacteroides HF 183 and Escherichia coli were reported as the main contaminants in drinking water, food and soil (BAUZA et al., 2017; KAPWATA et al., 2018).

Children under five years of age are the most susceptible individuals to illness from diarrhea, due to lower immunity, malnutrition, among other factors. The risk becomes increased from six months to the second year of life. In this age group, children are in the weaning process, start introducing food, start taking objects to their mouths and increase their mobility as they begin to crawl and walk, exploring more spaces and increasing the risk of contact with food and contaminated environments (THIEM, 2012; GODANA; MENGISTIE, 2013; MASHOTO et al., 2014; MIHRETE; ALEMIE; TEFERRA, 2014; THIAM et al., 2017; ASFAHA et al. 2018; VASCONCELOS et al., 2018).

The average duration of episodes varies from 1 to 3 days, and they tend to decrease with increasing age (AL-GHAMDI; BENTHAM; HUNTER, 2009; SANTOS et al., 2012; MASHOTO et al., 2014). High rates are associated with repeated infections, the same child usually has more than one diarrheal episode per year. In the study by Thiam et al., (2017), the incidence of children who had more than one episode in a year was 30%. In the findings of Santos et al., (2012) the proportion was 3 to 13 episodes of diarrhea per child each year.

For Thiam et al., (2017), underprivileged populations are more susceptible to illness from poverty-related diseases, as they have a set of socio-environmental conditions that are unfavorable to human health.

Corroborating this thesis, the study carried out by Bühler et al., (2014) in all regions of Brazil, pointed out that diarrhea morbidity and mortality is directly related to demographic and socio-economic issues in each region. The highest probability of morbidity and mortality from diarrhea historically remains in the North and Northeast regions of Brazil.

It is a consensus in the literature that there are several factors responsible for diarrhea in children. These factors can be biological, social, demographic, economic,

environmental, cultural, behavioral and related to the coverage and effectiveness of health services (SIMA; NG; ELIMELECH, 2013; GODANA; MENGISTIE, 2013; MIHRETE; ALEMIE; TEFERRA, 2014; PFADENHAUER; REHFUESS, 2015; ASFAHA et al., 2018).

ENVIRONMENTAL FACTORS ASSOCIATED WITH DIARRHEA

The seasonality pattern of diarrhea varies depending on the geographic region. For Herrera et al., (2017), in a study carried out in 35 countries in America, Africa and Asia, higher temperatures are associated with a higher probability of diarrhea, while higher rainfall is associated with a lower probability of diarrhea. Unlike this finding, a study carried out in Senegal found a higher prevalence in the cold season period (THIAM et al., 2017). However, in the surveys carried out in Lebanon, Jordan and Vietnam, there was no seasonal pattern, only minimal variations throughout the year (El-Fadel et al., 2014; THIEM, 2012).

In Brazil, when evaluating children over five years of age, no seasonality pattern is identified, however, younger children, especially in non-Ecuadorian states (Central-West, Southeast and South) there was a shift in the seasonal peaks of diarrhea after the policy of vaccination against rotavirus, in 2006. In the years 2000 to 2005, the highest occurrence occurred between the months of June and October, which corresponds to winter and early spring. When analyzing the years 2007 to 2014, the post-vaccine period, a shift from the peak to summer and early autumn can be seen (BAKER; ALONSO, 2018).

Thus, it is observed that, depending on the geographic region, diarrhea may present a seasonal pattern, this variation may most likely be linked to the etiological agent, since viruses have greater circulation in winter and bacteria in the warmer seasons.

Evidence suggests that the most important transmission is from human to human. However, animals are an important source of pathogens and may be involved in zoonotic transmission even if not observed in the study (THIEM, 2012).

For Bruyn et al., (2018) in rural areas, raising chickens by families is not associated with the occurrence of diarrhea. Regarding the creation of large animals, there was also no association with the occurrence of diarrhea, but when associated with the consumption of milk on the previous day.

The presence of flies and insects in the home is associated with the chain of transmission of diarrhea. These vectors in the presence of uncollected garbage, latrines with the presence of feces or without protection increase the risk of disease transmission (OLORUNTOBA; FOLARIN; AYEDE, 2014; THIAM et al., 2017; CHA et al., 2017). For Adane et al., (2017) the risk of diarrhea increases 2.5 times in the presence of flies in the home and 3.2 times greater in the presence of uncollected garbage.

Herrera et al., 2017, when studying land cover and the relationship with the occurrence of diarrhea, showed that in rural households with unimproved water, upstream tree cover reduces the likelihood of diarrhea. The effect of a 30% increase in tree cover upstream reduces the likelihood of developing diarrhea by 4%, a value similar to the effect of improved sanitation which reduces by 4%. Thus, the author suggests that the benefit of tree cover in rural households with untreated water can be as significant for reducing diarrhea as water supply in cities.

Environmental factors have an important relationship with the occurrence of diarrhea. Low sanitation coverage stands out in relation to the other determinants, as they induce

high environmental contamination and, consequently, a greater risk of illness. Thus, actions aimed at covering basic sanitation become a priority (BÜHLER et al., 2014; EL-FADEL et al., 2014; PFADENHAUER; REHFUESS, 2015; JUNG; LOU; CHENG, 2017; ADANE et al., 2017; BITEW; WOLDU; GIZAW, 2017; CHA et al., 2017; KAPWATA et al., 2018; ASFAHA et al., 2018).

Sanitation is a protective factor against diarrhea for both urban and rural areas. The improved sanitation ratio shows a marked protective tendency for the occurrence of diarrhea for sanitation coverage above 60%. Lower sanitation coverage does not have such significant impacts on the reduction of cases of water transmission due to the prevalence of high environmental contamination (JUNG; LOU; CHENG, 2017).

The study carried out in the state of Bahia, by Rasella, (2013), which evaluated the coverage of the Água para Todos Program (PAT), demonstrated a strong impact on reducing mortality and a slight reduction in morbidity from diarrhea in municipalities with the highest rates of diarrhea. program coverage. However, municipalities with lower PAT coverage also showed a reduction in morbidity and mortality. The authors infer that sanitation, even when it has low coverage, brings benefits, especially when directed to areas of greater environmental vulnerability. Diarrhea is identified as one of the main water diseases, and has a cycle of fecal-oral infection (ASFAHA et al., 2018).

In a study carried out in Ethiopia, the likelihood of developing diarrhea was 2.5 times greater when water was collected from unprotected sources and 4.5 times greater when the source was shared with other animals, such as cattle. (BITEW; WOLDU; GIZAW, 2017). In Brazil, it was also observed that the risk of diarrhea was 1.6 times higher in children who used well water when compared to those who used public water (IMADA et al., 2016).

For Kapwata et al., (2018) four risks are related to water and rural areas, they are: poor quality of water acquired at the source of supply, contamination of water in handling and storage, association with the diameter of containers with large openings that allow contamination by hands, or by insects and, finally, the irregularity in the supply of water that leads to the need for storage.

The presence of sanitary facilities and the proper disposal of household waste associated with hygiene habits are protective factors for diarrhea as they reduce the contamination of the peridomiciliary environment, and reduce the presence of vectors that can contaminate water and food (GEBRU; TAHA; KASSAHUN, 2014; OLORUNTOBA; FOLARIN; AYEDE, 2014; PFADENHAUER; REHFUESS, 2015; CHA et al., 2017; ASFAHA et al., 2018, NILIMA et al., 2018).

In the study carried out by Adane et al., (2017) in Ethiopia, it was observed that the household occupancy rate is directly related to a higher occurrence of diarrhea. Children under five years of age are 4.7 times more likely to develop diarrhea when facilities are shared by six or more households, 6.6 times for toilet facilities within a distance of 15 meters from home, 3.9 times when there is a presence of faeces in the house or near the latrines; 2.5 times higher in the presence of flies in the household and 3.2 times higher in the presence of uncollected garbage.

CULTURAL AND BEHAVIORAL FACTORS ASSOCIATED WITH DIARRHEA

Studies indicate that both environmental and behavioral factors interfere with risk factors for diarrheal diseases. The consumption of contaminated water and food, hygiene habits and the practice of

breastfeeding are important modules related to gastrointestinal diseases.

For Kapwata et al., (2018), risk factors for diarrhea are linked to the use and storage of water and food. Drinking tap water and storing cooked foods in unrefrigerated containers are major risk factors for diarrhea. Improper practice of handling and storing water for cooking and drinking are important ways of contaminating water, increasing the risk of infections.

A study carried out in Kibera, Kenya found that soil ingestion by children is an important source of diarrhea transmission in large urban slums. The chance of developing diarrhea is nine times greater in children who ingested soil when compared to those who did not. Escherichia coli was detected in 100% of the samples, and the fecal marker bacteroides, associated with humans HF 183, in 93% of the soil samples collected (BAUZA et al., 2017).

Household hygiene practices such as hand hygiene after using the toilet, care with food preparation and proper disposal of domestic solid waste are protective factors against diarrhea (SIMA; NG; ELIMELECH, 2013; MASHOTO et al., 2014; BITEW; WOLDU; GIZAW, 2017; THIAM et al., 2017). Gebru; Taha; Kassahun (2014) adds that children whose mothers did not wash their hands were 2.21 times more likely to get sick than mothers who practiced hand washing. Children whose mothers did not use soap to wash their hands were 7.4 times more likely to have diarrhea when compared to mothers who use soap.

Breastfeeding is considered a protective practice against diarrhea, because in addition to offering maternal antibodies, it reduces contact with unhygienic situations, such as when preparing food and others. Children who were not exclusively breastfed are five times more likely to get sick compared to those who were exclusively breastfed (ASFAHA et al., 2018). Children who received cow's milk in the first month after delivery were twice as likely to develop diarrhea when compared to children who never consumed cow's milk and 1.76 times greater when they received cow's milk after 30 days (IMADA et al, 2016).

Health education becomes a great ally in health promotion and disease prevention, as raising awareness of daily hygiene habits, taking care of drinking water, preparing food and vaccinating children is essential for healthy child development. Thus, the articulation of educational health actions that involve children and especially families is important.

SOCIOECONOMIC AND DEMOGRAPHIC FACTORS ASSOCIATED WITH DIARRHEA

Socioeconomic and demographic factors have a strong relationship with the risk of developing diarrhea. Parents' level of education, family income, household structure, family size is reported as an important variable in the modulation of illness (SANTOS et al., 2012; GODANA; MENGISTIE, 2013; MIHRETE; ALEMIE; TEFERRA, 2014; ; WOLDU; BITEW; GIZAW, 2016; IMADA et al., 2016; DESMENNU et al., 2017; BITEW; WOLDU; GIZAW, 2017; HERRERA et al., 2017; THIAM et al. 2017; ADANE et al., 2017 ; ASFAHA et al., 2018, NILIMA et al., 2018; VASCONCELOS et al., 2018).

For Asfaha et al., (2018) the educational level of mothers has a strong relationship with children's diarrhea. Children of mothers with low education are three times more likely to get sick than mothers with higher educational status. The educational level influences hygiene practices, food care, and practices of prevention and control of communicable diseases, since these families have more access to information.

The level of training of mothers is an important protective factor against diarrhea, such as infant feeding, hygiene practices, breastfeeding and vaccination (MIHRETE; ALEMIE; TEFERRA, 2014). Corroborating this Bitew finding; woldu; Gizaw, (2017) points out that the prevalence of diarrhea in children of mothers without formal education is 15.5%, while children whose mothers have a university degree is 6.4%. To Mihrete; Alemie; Teferra, (2014), paternal schooling is also significantly associated with diarrheal disease.

The role of education as an agent of transformation of safe practices for health is evident. The formal education of both family members and children interfere with hygiene practices and health protective practices. Likewise, environmental education can be a great ally in the process of raising awareness among parents and children for health promotion and disease prevention.

Another important determinant is the number of children under five years old at home influences the occurrence of diarrhea. In households with more than three children, the risk of diarrhea increases fourfold. The agglomeration of people favors the precariousness of hygiene conditions and contamination of water and food, in addition to the fact that the care provided by the caregiver or guardian of the child becomes limited for a greater number of children in the household (VASCONCELOS et al., 2018).

In addition to the agglomeration of people at home, the structure of the home also interferes with illness, the number of rooms was associated with the risk of illness. Children who lived in houses with only one bedroom were 5.8 times more likely to develop diarrhea compared to those who lived in houses with more than one bedroom (BITEW; WOLDU; GIZAW, 2017).

A study carried out in the Amazon region, in the city of Jordão, one of the most isolated and poorest in Brazil, the substantial increase in the population benefiting from an income transfer program, which positively impacts family status, as well as the provision of access to services and implementation of health promotion actions. The prevalence of diarrhea in children under five years old had a significant reduction, from 45.1% in 2005 to 35.4% in 2012 (IMADA et al. 2016).

FINAL CONSIDERATIONS

This study, carried out by gathering evidence from previous studies, identified several determinants associated with the disease. Among the determinants are: environmental (environmental contamination, sanitary facilities, vectors, seasonality, deforestation); behavioral (hygiene habits, waste disposal, water and food contamination and weaning), socioeconomic and demographic (family income, schooling, density of people, type of housing) and biological (age). These determinants interact with each other creating conditions of vulnerability.

It is understood that measures to reduce the risk of diarrhea are effective and involve actions aimed at improving the supply of water, installing a sanitary structure, collecting solid waste, controlling vectors, encouraging breastfeeding, vaccinating children and implementation of health education programs. These actions have a great impact on environmental conditions to the point that, by reducing environmental contamination, they interrupt the transmission cycle of waterborne diseases.

This study points to the need to fill the gap on how the determinants interact with each other and the individual correlation of these factors in the global burden of disease. Thus, it is necessary to develop studies that use new approaches in order to point out vulnerabilities for illness from diarrhea and point out priority actions for health promotion and prevention.

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