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Risk factors associated with acute diarrhea in children treated at Lodana Health Center in Ecuador

Christian Vinces[1*], Tanya Brigitte[2], Doménica Violeta García Delgado[3], Milena Alcívar Palma[4], María Vera García[5], Fernanda Irene Gómez García[6]
Universidad Particular San Gregorio de Portoviejo
Corresponding Author: Christian Vinces covvjunior@hotmail.com

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A B S T R A C T

Acute diarrheal diseases (ADDs) are among the leading causes of childhood morbidity and mortality worldwide. This study, conducted at the Lodana Health Center in Ecuador in 2024, analyzed risk factors associated with ADDs in children aged 0 to 9 years. Surveys were administered to 84 parents or guardians, revealing that although 81% were aware of the disease, only 61% identified preventive measures. Nearly half of the children experienced at least one diarrheal episode in the past six months, and 90% received medical care. Despite 100% being vaccinated against rotavirus and 99% of caregivers reporting handwashing before preparing food, risk conditions persisted: 41% consumed bottled water without additional treatment and nearly half of households lacked sewage procedures. The study concludes that ADDs are closely linked to deficiencies in sanitation and access to safe water

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INTRODUCTION

Acute diarrheal diseases (ADDs) Diarrheal diseases are one of the most common causes of morbidity and mortality worldwide, and children are the most vulnerable population; every year there are 1.7 billion cases of childhood diarrheal diseases worldwide, causing the death of 443,832 children under 5 years of age and another 50,851 children aged 5 to 9 (World Health Organization (2024)) . In turn, diarrheal diseases in children are influenced by factors mainly related to poor hygiene conditions in a population or community, a globally established problem; worldwide, more than 2.5 billion people lack access to basic sanitation (Camacho, 2020) .

In developing countries, socioeconomic factors exacerbate acute diarrheal diseases (ADDs), triggering such episodes up to three times a year, resulting in the deprivation of nutrients necessary for child development throughout the illness (Yard Foster et al., 2021) . According to Alpaugh et al. (2024) , in Latin America, 12.2% of households with children frequently experience ADDs, a figure that varies depending on factors such as household water and sanitation infrastructure, overcrowding, flooring and wall materials, and security of tenure . In Ecuador, acute diarrhea is a public health problem. According to Lalangui et al. (2024) , 209,668 cases of these diseases were recorded in Ecuador between 2014 and 2019, representing a 9.2% increase in the latter year compared to previous years. In that study, the most impacted group was children under 5 years old, and the highest rates were concentrated in the southern and southwestern regions of the country.

In rural areas of Ecuador, such as the community of Lodana , the consumption of contaminated water and food is considered the main factor associated with the occurrence of the causative agents of acute diarrheal diseases in children. Ecuadorian families living in these types of communities often consume water from wells, springs, streams, and rivers, which in most cases have poor sanitation. This situation is exacerbated by the poverty in which many households in Lodana live , which limits access to both basic infrastructure and health services, including vaccination, creating a more favorable environment for the presence of acute diarrhea in this canton. (Astudillo et al., 2024; Macias et al., 2025) .

Some studies have indicated that factors contribute to a higher incidence of acute diarrheal diseases (ADDs) in rural communities, such as unstable sanitation conditions (Bhavnani et al., 2014) , inefficient hygiene practices (Sosa et al., 2022) , lack of potable water (Chakraborty et al., 2024) , limited health infrastructure (Chavez et al., 2022) , and childhood malnutrition (Garzon, 2024) , which create an ideal environment for the development of acute diarrhea in children. However, the lack of information on risk factors for acute diarrhea in children in Lodana highlights the need to generate data to understand this problem in the local child population. Therefore, the objective of this research was to analyze the main risk factors for acute diarrheal diseases in children aged 0 to 9 years treated at the Lodana Health Center .

LITERATURE REVIEW

Diarrhea is defined as the passage of loose or liquid stools three or more times a day (or more frequently than normal for the individual). Frequent passage of formed (solid) stools is not diarrhea, nor is the passage of loose, pasty stools by breastfed infants (Povea & Hevia, 2019). Diarrhea is usually a symptom of an infection in the digestive system. The main cause of acute diarrhea in children is viral, although bacterial agents may be predominant in warmer months and in older children, and viruses in colder months (Guzmán Vera, 2016).

Types of diarrheal diseases and their main clinical manifestations Based on duration and clinical characteristics, diarrheal diseases are classified into three types:

Acute diarrhea: It lasts for several hours, extending from 7 to 14 days, and is the most frequent type of diarrhea in children. It is usually infectious, caused by viruses, and less frequently by bacteria and parasites. Most cases are self-limiting or involve functional gastrointestinal disorders. Patients present with nausea, vomiting, watery and bulky stools, and abdominal cramps (WHO, 2024; Sokic -Milutinovic et al., 2021).

Persistent diarrhea: This occurs when it lasts for more than 14 days. The most common causes are laxative abuse, chronic alcohol abuse, previous bowel surgery, bowel disease or fistula, diabetic enteropathy, Addison's disease, and hormone-producing tumors such as villous adenoma of the colon, medullary thyroid cancer, or neuroendocrine tumors. Symptoms may include loose or watery stools, urgency to defecate, fecal incontinence, abdominal pain, and malabsorption symptoms such as weight loss, bloating, and greasy, foul-smelling stools. Dehydration and malnutrition are significant risks in prolonged cases (WHO, 2024; Sokic -Milutinovic et al., 2021).

Dysentery: Characterized by being an acute diarrhea with the particularity of presenting blood and mucus in the stools (WHO, 2024).

Risk Factors Associated With Acute Diarrheal Diseases

Risk is the probability of suffering harm, illness, or death in the presence of certain circumstances that affect a person, group of people, community, or environment; it expresses the proximity of harm or whether it may or may not occur. (Toledo Curbelo, 2004).

Risk Factor

A risk factor is defined as any attribute, characteristic, or condition that confers upon an individual a varying degree of susceptibility to developing a disease or health condition. According to Peñaherrera (2023), risk factors related to diarrheal diseases fall into three groups: behavioral factors, host factors, and factors related to the environment or climatic variations. Behavioral factors refer to the storage of food at room temperature for extended periods before consumption, which predisposes to the proliferation of microorganisms, thus contaminating the food. Host factors include malnutrition and immunosuppression, which increase the risk of developing life-threatening diarrhea. Similarly, climatic variations influence the prevalence of diarrhea, with viral diarrhea occurring more frequently during the winter months, while bacterial diarrhea increases during the summer. Finally, having a low

socioeconomic level, especially in people living in rural areas without a sewage system, is a predisposing factor for individuals to ingest contaminated food and water, resulting in an increased incidence of acute diarrheal diseases.

Complications of Acute Diarrhea in Children

The most common complication is dehydration, which can be related to electrolyte imbalance and metabolic acidosis. According to the WHO (2024), the degrees of dehydration can be divided into: Severe dehydration, presenting with manifestations such as lethargy or loss of consciousness, sunken eyes, inability or near inability to drink, and slow return (2 seconds or more) to normal after pinching the skin; it is considered severe if at least two of these signs are present. Moderate dehydration, presenting with irritability, sunken eyes, and thirst. Other complications of acute diarrheal diseases in children are those resulting from the spread of the causative agents to other organs, leading to processes such as intestinal perforation, peritonitis, pyelonephritis, bronchopneumonia, and meningoencephalitis, among others, which can result in septic shock (Gonzáles et al., 2020).

Prevention of Acute Diarrheal Diseases

To effectively prevent acute diarrheal diseases, a comprehensive approach encompassing various measures is essential. These include access to safe drinking water for consumption and hygiene, the use of improved sanitation facilities for proper excreta disposal, and frequent handwashing with soap, especially before eating and after using the toilet. Exclusive breastfeeding is recommended for infants during the first six months of life, as it provides essential nutrients and antibodies. Maintaining proper personal and food hygiene, such as proper cooking and handling of food, is also crucial. Furthermore, health education that informs about the modes of transmission of infections and vaccination against rotavirus, a leading cause of childhood diarrhea, complement these preventive actions, contributing to a significant reduction in the incidence of these diseases (Reyes-Gómez et al., 2018).

Another method that has proven effective is vaccination against rotavirus, one of the most common causative agents of acute diarrheal diseases (ADD). Among the best-known vaccines are Rotarix and RotaTeq , both administered orally by placing drops in the child's mouth. They have shown 90% effectiveness in preventing infections caused by this virus. Infants should receive two or three doses depending on the vaccine. Rotarix is administered at six weeks of age and the second dose at ten weeks of age, while RotaTeq should be administered between six and twelve weeks of age, with the second dose four to ten weeks after the first, and the third dose completed before 32 weeks of age (US Department of Health and Human Services & Centers for Disease Control and Prevention). Disease Control and Prevention , 2021; Velasquez-Portocarrero et al., 2022).

METHODOLOGY

An observational, descriptive, quantitative, cross-sectional study was conducted in the community of Lodana , Ecuador, during the second half of 2024. The study population consisted of the parents or legal guardians of children aged 0 to 9 years who attended the Lodana Health Center during the data collection period. A non-probability convenience sampling method was used, resulting in a total of 84 parents or guardians to be surveyed.

The study included parents or legal guardians residing in the parish of Lodana who voluntarily agreed to participate and fully completed the questionnaire. Those excluded were individuals who did not provide informed consent, submitted incomplete or inconsistent questionnaires, or did not reside in the parish of Lodana at the time of the survey.

For data collection, a structured survey of 10 closed-ended questions was used, developed based on previous references related to determinants of child health and diarrheal diseases. The instrument assessed aspects such as housing conditions, hygiene practices, access to drinking water, excreta disposal, and history of episodes of acute diarrheal diseases in children.

Descriptive statistics (frequency and percentage) were used to summarize the characteristics of the surveyed population and the factors associated with the presence of acute diarrheal diseases in children. To further the analysis, a comprehensive cause-and-effect analysis approach was applied using the Ishikawa diagram, identifying the main causes of children developing acute diarrheal diseases. A strategic analysis of the situation was also conducted using SWOT and CAME tools, which allowed for the identification of strengths, opportunities, weaknesses, and threats, and the development of corrective strategies.

The study was conducted in accordance with the Declaration of Helsinki, ensuring the autonomy, confidentiality, and well-being of the participants. Informed consent was obtained, and the data were anonymized and protected with access limited to the research team.

RESULTS

Regarding knowledge, Table 1 shows that while 81% of caregivers reported knowing what acute diarrheal disease is, only 61% reported knowing preventive measures, highlighting a gap between disease recognition and the adoption of effective preventive behaviors. This pattern has been reported in rural communities in Bolivia, where, although most of the sample of family members of children under five years of age have an idea about the concept of diarrhea, 51% are unaware of preventive measures for it, emphasizing that general knowledge does not necessarily translate into protective practices (Condori, 2023) .

Table 1. Parents' Knowledge About Acute Diarrhea and Preventive Measures

Variable	Frequency absolute	Percentage
Knowledge about the concept of acute diarrheal disease		
- Yeah	68	81
- No	16	19
Knowledge about preventing diarrhea episodes in children		
- Yeah	51	61
- No	33	39

On the other hand, it was found that almost half of the children had at least one diarrheal episode in the last six months (49%) and that, of those episodes, the vast majority (90%) received medical attention, as shown in Figure 1.

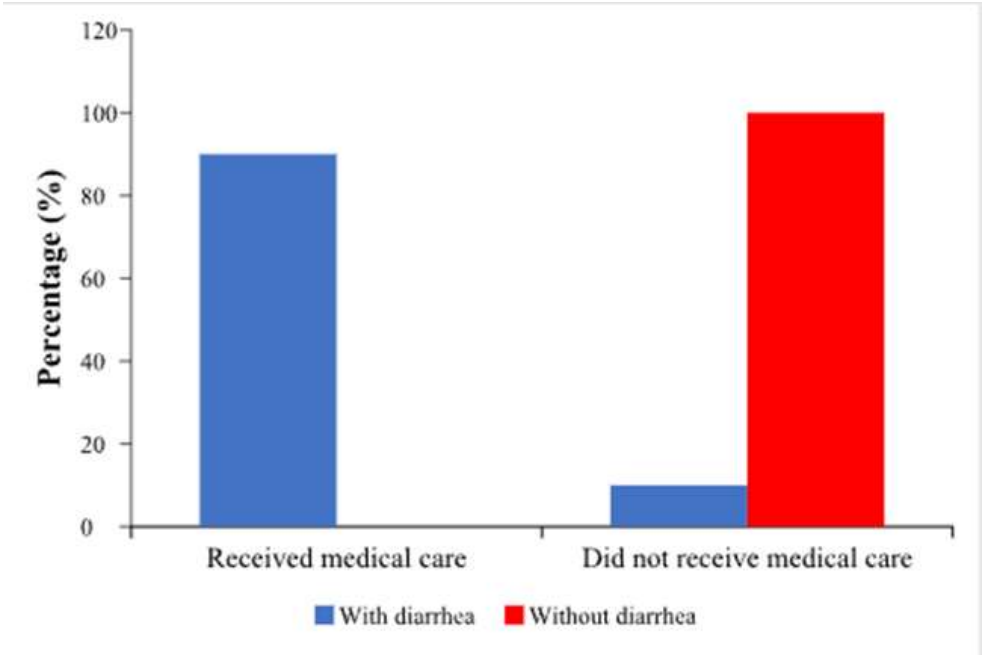

Figure 1. Relationship Between Episodes of Diarrhea and Medical Care Received in Children Aged 0 to 9 Years Treated at the Lodana Health Centre in the Last 6 Months

Although this prevalence may seem high, it should be considered that the recall period used (6 months) is longer than the usual period in national surveys, which is typically 14 days, thus increasing the reported figures (Vargas et al., 2025) . However, the finding coincides with the persistent burden of diarrheal disease in rural Andean communities and contrasts with the response of caregivers when seeking care, where more than 90% of episodes were treated in health services (Vargas et al., 2025) .

Regarding the frequency of disinfection of utensils and baby bottles at home, the majority of caregivers (87%) reported disinfecting utensils and bottles daily, while 13% do so less frequently or not at all. This suggests a good level of

practice, but a susceptible subgroup that could favor fecal-oral transmission. However, frequency alone is not enough: studies in rural Peruvian communities show that the quality of water used for washing and domestic handling/storage strongly influence the presence of pathogens in the home and infant colonization by enteropathogens (Loyola et al., 2020) , and local analyses indicate that factors such as the type of container, the presence of animals in the kitchen, and waste management increase water contamination at the point of use (Larson et al., 2023).

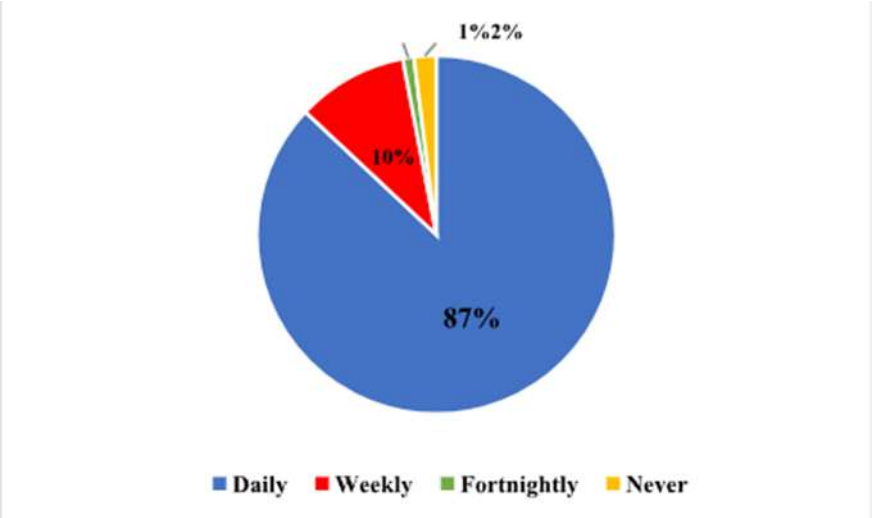

Figure 2. Frequency of Disinfection of Utensils and Baby Bottles at Home

Other research shows that isolated household interventions have limited effects on diarrheal morbidity; therefore, effective programs combine: (a) ensuring safe water for washing, (b) promoting correct cleaning/disinfection techniques (washing with detergent + boiling or validated disinfection) and (c) demonstration education with practical follow-up (Nuño et al., 2022; Ogutu et al., 2022) .

Regarding water and sanitation conditions, although 58% of households reported boiling their water, 41% consume it from containers without additional treatment, and almost half lack a sewer connection, using septic tanks or latrines, as shown in Table 2. This situation reflects the characteristic profile of rural South American communities, where the absence of basic infrastructure increases the risk of environmental fecal contamination. In rural districts of the Colombian Caribbean, studies showed that drinking water was classified as having a high microbiological risk, which was directly associated with the high prevalence of diarrhea in children (Galezzo et al., 2020)

Table 2. Results on Sanitary Conditions, Vaccination and Preventive Habits in Children of Lodana

Variable	Frequency absolute	Percentage
Rotavirus vaccination		
- Yeah	84	100
- No	0	0
Zinc or vitamin A supplementation		
- Yeah	63	75
- No	21	25
Water treatment before consumption		
- Boil the water	49	58
- Use untreated drums	34	41
- Filter the water	1	1
Frequency of hand washing before preparing food		
- Always	83	99
- Occasionally	1	1
Home sewer system		
- Yeah It has a sewer system.	43	51
- It does not have a sewage system (they use septic tanks or latrines)	41	49

One positive factor in these results is that there is 100% rotavirus vaccination coverage, which represents a strength. health Locally , although general vaccination does not eliminate uncovered enteropathogens, it does reduce severe forms of rotavirus infection, and together with actions to improve access to water, sanitation, and hygiene, it contributes to decreasing childhood diarrheal mortality, as has occurred in Peru (Huicho et al., 2019) . Similarly, 75% of parents mention supplementing their children with zinc or vitamin A. Scientific evidence confirms that therapeutic supplementation with these micronutrients reduces the duration and likelihood of persistent diarrhea in children and is a cost-effective intervention for managing acute episodes; therefore, improving coverage and the correct use of zinc in community care represents an opportunity (Ali et al., 2024) . Regarding the frequency of handwashing before preparing food, 99 % of parents or caregivers report always washing their hands before preparing food, which is beneficial for reducing the risk of infants suffering from diarrheal diseases, and is reflected in research in similar contexts. In rural schools in Colombia , interventions to improve access to water, sanitation, and hygiene reduced child absenteeism due to diarrhea, indicating that actual habits could be improved (Overgaard et al., 2016) . However, although 99% reported washing their hands before preparing food, social desirability bias is highly likely . An intervention study in rural schools and communities has shown that self-reports tend to overestimate actual practices and that verification through observational indicators (presence of

soap/water, practical demonstration) is key for a valid assessment of hygiene habits (Sarmiento et al., 2022) , suggesting that the evaluation of hygiene practices should be complemented by observational indicators and not just surveys.

Figure 3 shows an Ishikawa diagram, which shows that diarrheal diseases in children aged 0 to 9 years treated at the Lodana Health Center are due to a multifactorial network where deficiencies in water and sanitation converge, such as untreated consumption, unsafe storage and lack of sewage, with inconsistent domestic hygiene practices that favor fecal-oral transmission

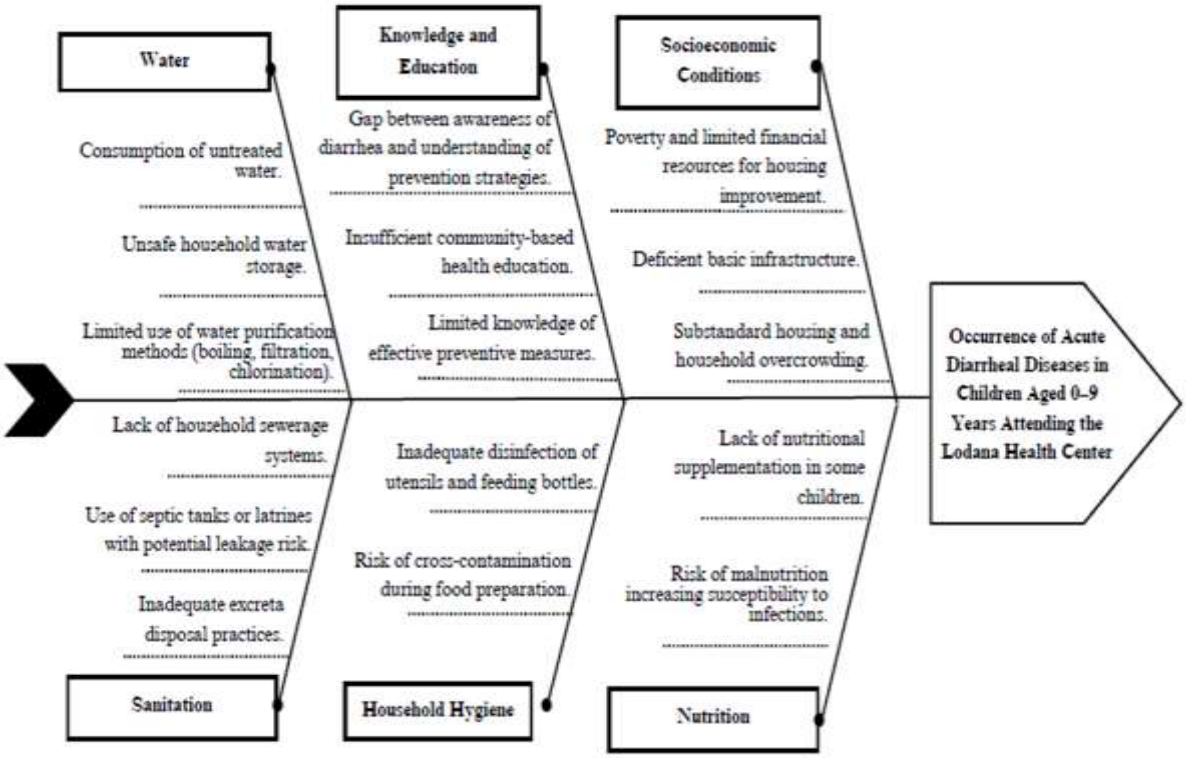

Figure 3. Ishikawa Diagram of Risk Factors Associated With Acute Diarrheal Diseases in Children From Lodana

This is compounded by limitations in caregivers' preventative knowledge; they recognize the disease but do not always implement effective protective measures, in addition to adverse socioeconomic conditions that perpetuate precarious housing and basic infrastructure. While there are strengths such as universal rotavirus vaccination coverage and micronutrient supplementation, these interventions may prove insufficient given the constant exposure to enteropathogens and the vulnerability associated with childhood malnutrition.

Table 3 presents a SWOT analysis, highlighting the total coverage of rotavirus vaccination and the high rate of self-reported hygiene practices as strengths . Opportunities include expanding zinc and vitamin A supplementation, supported as a cost-effective intervention (Ali et al., 2024) , and strengthening community education through participatory methodologies (Nuño et al., 2022) .

DISCUSSION

This part allows you to elaborate on your results findings academically. You must not put numbers related to your statistical tests here; instead, you have to explain that numbers here. You have to compile your discussion with academic supports to your study and a good explanation according to the specific area you are investigating.

Table 3. SWOT Analysis of Risk Factors for Acute Diarrheal Diseases in Children from Lodana , Ecuador

SWOT	**Aspects**
Strengths	• 100% coverage in rotavirus vaccination. • 99% of caregivers report washing their hands before preparing food. • 87% disinfect utensils and baby bottles daily. • 90% of diarrhea episodes received medical attention.
Opportunities	• Implement safe water and basic sanitation programs with local support. • Increase supplementation with zinc and vitamin A to strengthen immunity. • Develop health education campaigns using participatory methodologies. • Strengthen community surveillance and health promoters in prevention.
Weaknesses	• Only 61% of caregivers know about preventative measures, reflecting a health education gap. • High consumption of bottled water without additional treatment (41%), which increases the risk of contamination. • Social desirability bias in hygiene habit reports, which reduces the validity of the results. • Methodological design with non-probability sampling (84 participants), which limits the generalizability of the findings
Threats	• 49% of households do not have sewage systems, using septic tanks or latrines. • Persistence of socioeconomic conditions of poverty that limit access to sanitation and basic services. • Permanent risk of exposure to enteropathogens in rural environments with structural deficiencies. • Climate change and rainfall variability that increase vulnerability to water pollution (Bhavnani et al., 2014).

The main weaknesses are the low proportion of caregivers who know about preventive measures and the consumption of untreated water, factors already identified in studies from Ecuador and Peru as key determinants of childhood diarrhea (Larson et al., 2023; Loyola et al., 2020) . Regarding threats , structural poverty and the lack of sanitation coincide with what has been described in Latin American research as central conditions for the persistence of diarrheal diseases, in addition to the growing risk of climate change on water quality (Bhavnani et al., 2014) .

Continuing the SWOT analysis, Table 4 shows a CAME analysis, which is a tool that allows the diagnostic observations to be transformed into concrete and sustainable lines of action for the Lodana community .

Table 4. CAME Analysis of Risk Factors For Acute Diarrheal Diseases in Children From Lodana , Ecuador

CAME	**Proposed actions**
Correct (Weaknesses)	• Design community training programs to improve caregivers' preventive knowledge. • Implement mandatory chlorination or boiling systems in homes that consume untreated water. • Supplement surveys with practical observations to reduce bias in hygiene reports. • Promote studies with larger samples and probabilistic sampling.
Face (Threats)	• Manage intersectoral projects to expand sewerage and basic sanitation coverage. • Develop social support programs that reduce economic barriers to access to safe water. • Strengthen community resilience to climate change through water management plans. • Promote partnerships with municipalities to improve infrastructure in rural communities.
Keep (Strengths)	• Consolidate 100% coverage of rotavirus vaccination. • Maintain campaigns promoting hand washing and disinfection of utensils. • Strengthen the response capacity of the Health Center in providing timely care for diarrheal episodes. • Continue food supplementation programs for school children and preschoolers.
Blow (Opportunities)	• Scale up zinc and vitamin A supplementation towards full coverage. • Incorporate participatory methodologies in health education (demonstration workshops, follow-up in homes). • Implement community surveillance of diarrheal diseases with the participation of health promoters.

CAME	Proposed actions
	• Leverage local networks and international cooperation for financing safe water projects.

This analysis shows that in Lodana , it is necessary to address educational weaknesses and lack of access to safe water through caregiver training programs and household water disinfection. Simultaneously, the lack of sanitation and poverty must be tackled with intersectoral projects that strengthen basic sanitation and resilience to climate change. Furthermore, it is recommended to maintain the progress achieved, such as the universal coverage of rotavirus vaccination, which has been shown to reduce hospitalizations and infant mortality from diarrhea in Latin America (Burnett et al., 2016).

Similarly, it is important to exploit opportunities by expanding zinc and vitamin A supplementation, which is effective in shortening the duration and severity of diarrhea, and consolidating participatory education and community surveillance strategies that have proven effective in rural contexts (Nuño et al., 2022; Overgaard et al., 2016) .

CONCLUSIONS AND RECOMMENDATIONS

Acute diarrheal diseases in Lodana are less a response to isolated failures of the health system and more a response to structural and programmatic determinants, such as deficits in water quality, sanitation and domestic practices, which requires integrated interventions; therefore, it is a priority to implement sustainable solutions focused on ensuring safe water at the point of consumption, strengthening sanitation, ensuring access to and correct use of treatments and complementing education with demonstration activities and practical verification, coordinated with local services and monitored to ensure impact and sustainability.

FURTHER STUDY

This study still has limitations, so further research on the topic of risk factors associated with acute diarrhea in children treated at Lodana Health Center is needed to improve this study and add insight for the writer and readers.

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