Original Article

Factors associated with diarrhea in children under 12 years of age referred to Ostad Motahari hospital of Jahrom in 2020

Vahid Mogharab[1], Shabnam Rajput[2]

[1]Department of Pediatrics, Jahrom University of Medical Sciences, [2]Department of Pediatrics, School of Medicine, Jahrom University of Medical Sciences, Jahrom, Iran

Abstract

Background and Objective: Despite the relatively high prevalence of diarrhea among children, clinical features and factors associated with the incidence of diarrhea in children have not been yet studied in Jahrom. Therefore, this study aimed to determine the factors associated with diarrhea in children under 12 years of age referred to Ostad Motahari Hospital of Jahrom, Iran, in 2020. **Materials and Methods:** The present study was a descriptive cross-sectional study, in which 385 children under 12 years of age with diarrhea complaints were selected using the census sampling method. The checklist used to collect data included patient-related factors, maternal factors, family factors, type of diarrhea, and stool test. **Results:** There was a significant relationship between the availability of proper hand-washing facilities, the use of water purifier, a history of antibiotic use, and the incidence season with a possible factor of diarrhea, type of diarrhea, the frequency of diarrhea per day, and pus cell outcome ($P < 0.0001$). However, no statistically significant relationship was observed between the availability of safe drinking water, travel history of patients, and consumption of raw or undercooked foods with a possible factor of diarrhea and OB/OP results ($P < 0.05$). **Conclusion:** Recognizing environmental risk factors to inform parents about preventing diarrhea in children can be an effective strategy to avoid imposing a heavy financial burden on the health system.

Keywords: Children, diarrhea, stool test, (Stool OP/OB)

Introduction

Diarrhea is currently a major public health problem and one of the most important causes of morbidity and mortality among children in developing countries.[1,2] It is estimated that each year about 1 billion cases of diarrhea and 2.5 million deaths from this disease occur among children under 5. About 80% of deaths from diarrhea occur in the first two years of life. Diarrhea is often associated with long-term side effects such as malnutrition, stunted growth, and defects in the immune system. In general, children experience an average of two to three episodes of diarrhea per year. Although most cases of diarrhea in children are not severe and may require no special intervention, some cases are potentially fatal.[3] Diarrhea is the leading public health problem that is related to the quality of the water and sanitation system.[4] The main factors in preventing diarrhea are public health, personal hygiene, and the availability of safe drinking water.[5] Unfortunately, diarrhea is one of the most common problems among Iranian children, especially in deprived areas and in children with malnutrition. Due to the interactions between diarrhea and malnutrition and the role of malnutrition in developmental disorders in children, improving programs to treat diarrhea has an important role in children's health.[6]

Address for correspondence: Dr. Shabnam Rajput, Department of Pediatrics, School of Medicine, Jahrom University of Medical Sciences, Jahrom, Iran.
E-mail: rajputshabnam.ped@gmail.com

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The use of oral rehydration salt (ORS) is very effective in reducing morbidity and mortality from diarrhea, but it does not reduce the duration or severity of diarrhea. The duration of diarrhea depends on several factors, including low weight-for-age, reduced cellular immunity, zinc deficiency, etc., The high prevalence of diarrheal diseases and their impact on infant morbidity and mortality in developing countries has led to more than 1 billion new cases of the disease and approximately 3.3 million child deaths each year.[7]

The incidence of diarrhea is more common in infants between 6 and 11 months of age when complementary foods are introduced into their diet. This condition is a reflection of collaborative effects of reduced antibodies from the mother's body, lack of active immunity in infants, eating contaminated foods, starting walking on all fours, and direct contact with human or animal feces.[8] Malnutrition is recognized as a major cause of death in children. On the other hand, children with malnutrition are more prone to diarrhea because malnutrition causes infection and the infection causes diarrhea in a repeated vicious cycle.[9] Given the negative effects of diarrhea on the child's development and nutrition, on one hand, and the relationship of malnutrition with more severe diarrhea in children and increased risk of death from infectious diseases, including diarrhea, on the other hand, it was decided to conduct a detailed study to identify the factors associated with the occurrence of diarrhea, because introducing these factors and planning to educate them to families could prevent long-term diarrhea attacks and, thus, save the lives of thousands of children at risk and prevent stunted growth in them.

The main purpose of this study was to investigate the factors associated with diarrhea in children under 12 years of age to identify its intensifying risk factors and provide solutions to eliminate or minimize them.

Materials and Methods

Study design

The present study was a descriptive cross-sectional study conducted on 385 children under 12 years of age with diarrhea who were referred to Ostad Motahari hospital in Jahrom. This study was conducted after receiving the code of ethics IR.JUMS.REC.1400.012 from the Vice Chancellor for Research of University of Medical Sciences, Jahrom, Iran. All children under 12 years of age with diarrhea who had been referred to Ostad Motahari hospital from November 1, 2016 were examined until the required number of samples were collected.

Inclusion criteria were children under 12 years of age, hospitalization with diarrhea, and the absence of other medical problems. Exclusion criteria included parents' unwillingness to participate in the study, failure to fill out the checklists, unavailability of patient information, and transfer of patients to other wards. Data were collected using a questionnaire. The questionnaires were completed by the researcher and with the help of pretrained health workers during face-to-face meetings.

Maternal factors in the questionnaire included age and type of delivery, presence of underlying disease (diabetes, hypertension, immunodeficiency diseases), education level, and employment status. Factors related to the family included income level, the presence of suitable hand-washing utilities at home, the quality of drinking water at home and living place, and the use of water purifiers at home.

Factors related to the patient included age, gender, time of weaning, travel during the last week (especially to rural areas and farms), duration of diarrhea (≥2 days, 3–5 days, and 5 ≥ days), the season of referral to the doctor, information about the number of diarrhea per day (≥2 times, 3–5 times, 5 ≥ times), taking antibiotics within 15 days before referring to the hospital, eating foods such as undercooked meat, fast food, various processed foods, and breast milk or formula.

Factors related to disease also included the type of diarrhea (osmotic or secretory), which was determined based on the mother's statements on the increased number of stools or decreased consistency compared with the previous defecation. Because the stool osmolality is equal to the plasma osmolality and is about 290, the following formula was used to obtain the osmotic gap to distinguish these two types of diarrhea.

$$\text{Stool osmotic GAP} = 290 - [2 \times (\text{stool Na} + \text{stool K})]$$

After completing the questionnaires, the collected data was analyzed using Statistical Package for Social Sciences (SPSS) software version 22. The results were reported as frequency (percentage) and median (mid-quarter range). Kolmogorov–Smirnov test was used to test the normality of data distribution. Inferential statistical methods, including the Chi-square test and, if necessary, Fisher's exact test, were used to analyze the data. $P < 0.05$ was considered statistically significant.

Results

Of 385 children in our study, 186 were girls and 199 were boys. Age group of 1–2 years had the highest number of children with diarrhea (65.19%) followed by the age group of 3–6 years (30.80%). The mean age of mothers was 23 years and the majority of them were illiterate (61%) and housewives (83%). Underlying disease was observed in only 21 parents. Cesarean section was the most preferred method of childbirth among the mothers (63%). The majority of families reported moderate levels of well-being and income. In 33.86% of children under 2 years of age, the nutrition was limited to breastfeeding, whereas the other types of complementary feeding were also used in addition to breast milk. A summary of the demographic status of the children studied and their parents are presented in Table 1.

Regarding the frequency of diarrhea type, 77.9% had secretory diarrhea and 22.1% had osmotic diarrhea. The pathogenicity was viral in 61.8%, bacterial in 36.6%, and miscellaneous in other cases (nonbacterial and nonviral). In terms of the number of

diarrhea per day, 77.9% experienced diarrhea between two and five times a day, 18.7% twice or less a day, and 3.4% five times or more a day.

Examining the health status of children with diarrhea showed that 287 (74.5%) children had access to appropriate hand-washing facilities at home and 303 (78.7%) to adequate free drinking water. Moreover, only 20 people (5.2%) used water purifiers, 12 patients (3.1%) had a history of travel in recent days, and 89 patients (32.1%) had a history of antibiotic use within 15 days before hospitalization. Consumption of undercooked and processed foods was reported in a large number of children with diarrhea (about 90%). Most of the visits to the doctor were done in summer (63.9%) followed by spring (22.1%).

According to OB/OP results, 214 (55.6%) children showed OB-negative, 63 (16.4%) showed OB-trace, and 10.9%, 10.1% and 7% children showed OB+, OB++ and OB+++, respectively. According to the RBC results, 269 (69.9%) children were with negative RBC, 61 (15.8%) with RBC 1–3, 18 (4.7%) with RBC 4–6, 16 (4.2%) with RBC 7–12, and nine (2.3%) with RBC 13–22. Also in 12 (3.1%) cases, the amount of RBC was reported as many. The results of the pus cell test were negative in 257 (66.8%) patients. In 45 patients (11.7%), pus cell was 1–5, in 18 patients (4.7%) between 5 and 12, in five patients (1.3%) between 13 and 23, and in 60 patients (15–15%) this value was reported as many.

Table 1: Summary of demographic status of children with diarrhea and their parents

Variable	No.	%
Gender		
Girl	186	48.3
Boy	199	51.7
Child age (years)		
1-2	251	65.19
3-6	118	30.80
7-9	10	2.91
10-12	6	1.1
Mother's age	23 (19-25)*	
Parents' level of education		
Illiterate	58	15.1
Diploma or below	235	61
Higher than diploma	92	23.9
Underlying disease in parents		
Yes	22	5.7
No	363	94.3
Maternity type		
Normal	144	37.4
Cesarean section	241	62.6
Employment status of the mother		
Homemaker	320	83.1
Employed	65	16.9
Income level of family		
Earnings less than expenses	108	28.1
Income equals expenditure	258	67
Earnings more than expenses	19	4.9

*Median (mid-quarter range)

According to fat droplet results, 271 cases (70.4%) had negative fat droplets, and 10 (2.6%), 19 (4.9%), and 85 (22.1%) cases had low-, medium-, and high-fat droplets, respectively.

There was a statistically significant relationship between the availability of suitable hand-washing utilities at home and the possible factor of diarrhea as well as the OB/OP result ($P < 0.0001$) [Tables 2 and 3]. Bacterial diarrhea was reported in 83.7% of patients with no access to suitable hand-washing utilities, whereas this type of diarrhea was reported in 20.6% of patients who had access to appropriate hand-washing utilities at home [Table 2].

In patients who had access to adequate safe drinking water, diarrhea was viral in 67.7% and bacterial in 34%. There was no statistically significant relationship between access to adequate safe drinking water and the possible factor of diarrhea ($P = 0.058$). [Table 2].

Bacterial diarrhea was observed in 38.6% of patients who did not use the water purifier. There was a statistically significant relationship between the use of water purifiers and the possible factor of diarrhea ($P < 0.0001$). Viral diarrhea was reported in 12

Table 2: Relationship between health status and referral season with the possible factor of diarrhea

Variable	Possible factor of diarrhea			*P*
	Viral	Bacterial	Others	
Suitable hand-washing utilities at home				
Yes	224 (78)	59 (20.6)	4 (1.4)	<0.0001
No	14 (14.3)	82 (83.7)	2 (2)	
Safe drinking water				
Yes	196 (64.7)	103 (34)	4 (1.3)	0.058
No	42 (51.2)	38 (46.3)	2 (2.4)	
The use of water purifier				
Yes	20 (100)	0 (0)	0 (0)	<0.0001
No	218 (59.7)	141 (38.6)	6 (1.6)	
Patient travel history (especially to rural areas				
Yes	12 (100)	0 (0)	0 (0)	0.014
No	226 (60)	141 (37.8)	6 (1.6)	
A history of antibiotics use within 15 days before referring to the hospital,				
Yes	89 (100)	0 (0)	0 (0)	<0.0001
No	149 (50.3)	141 (47.6)	6 (2)	
Time or season of referral to the doctor				
Fall	54 (100)	0 (0)	0 (0)	<0.0001
Spring	85 (100)	0 (0)	0 (0)	
Summer	99 (40.2)	141 (57.3)	6 (2.4)	
Consumption various undercooked and processed foods				
Yes	219 (62.9)	124 (35.6)	5 (1.4)	0.236
No	19 (51.4)	17 (45.9)	1 (2.7)	

children with a history of travel, and bacterial diarrhea in 37.8% of children without a history of travel. However, no significant relationship was observed between the patient's travel history and the possible factor of diarrhea ($P = 0.014$). [Table 2].

There was no statistically significant relationship between the variables of safe drinking water, patient's travel history, and consumption of undercooked and processed foods with the OB/OP results ($P < 0.05$) [Table 3]. However, the history of antibiotic use within 15 days before hospitalization had a significant relationship with the possible factor of diarrhea and OB/OP result ($P < 0.0001$ and $P = 0.002$, respectively), so none of the children with a history of antibiotic use had bacterial diarrhea, and OB/OP-positive cases were lower in patients with a history of antibiotics than in nonusers [Tables 2 and 3].

The results also showed a statistically significant relationship between the season of occurrence and the possible factor of diarrhea and OB/OP result ($P < 0.0001$). Bacterial diarrhea was reported in 57.3% of the patients who were referred in the summer, whereas most of the patients referred in the spring and autumn were reported with viral diarrhea. Moreover, the cases with positive OB/OP were higher in patients who were referred in summer than in those who were referred in other seasons. Finally, no statistically significant relationship was found between the consumption of undercooked and processed foods and the possible factor of diarrhea ($P = 0.236$) [Tables 2 and 3].

The results showed that there was a statistically significant relationship between the type of diarrhea (secretory or osmotic) and the probable factor of diarrhea (viral or bacterial) with the frequency of diarrhea per day ($P < 0.0001$) [Table 4]. There was also a statistically significant relationship between the possible factor of diarrhea and OP/OB results with pus cell outcome ($P < 0.0001$) [Table 5].

Table 3: Relationship between health status of children with diarrhea and the season of occurrence with OB/OP result

Variable	OB/OP result		*P*
	Negative	Positive	
Suitable hand-washing utilities at home			
Yes	174 (60.6)	113 (39.4)	0.001
No	40 (40.8)	58 (59.2)	
Safe drinking water			
Yes	168 (55.4)	135 (44.6)	0.916
No	46 (56.1)	36 (43.9)	
The use of water purifier			
Yes	200 (54.8)	165 (45.2)	0.001
No	14 (70)	6 (30)	
Patient travel history (especially to rural areas			
Yes	8 (66.7)	4 (33.3)	0.432
No	206 (55.2)	167 (44.8)	
A history of antibiotics use within 15 days before referring to the hospital,			
Yes	62 (69.7)	27 (30.3)	0.002
No	152 (51.4)	144 (48.6)	
Time or season of referral to the doctor			
Fall	38 (70.4)	16 (29.6)	<0.0001
Spring	59 (69.4)	26 (30.6)	
Summer	117 (47.6)	129 (52.4)	
Consumption various undercooked and processed foods			
Yes	194 (55.7)	154 (44.3)	0.844
No	20 (54.1)	17 (45.9)	

Table 4: Relationship between the frequency of diarrhea with the type of diarrhea (secretory and osmotic) and the probable factor of diarrhea

Variable	Possible factor of diarrhea			*P*
	≤2 times per day	2–5 times per day	≥5 times per day	
Type of diarrhea				
Secretory	72 (24)	219 (73)	9 (3)	<0.0001
Osmotic	0 (0)	81 (95.3)	4 (4.7)	
Time or season of referral to the doctor				
Viral	72 (30.3)	166 (69.7)	0 (0)	<0.0001
Bacterial	0 (0)	134 (95)	7 (5)	
Others	0 (0)	0 (0)	6 (100)	

Discussion

In the present study, most of the participants were in the age group of 1 to 2 years. According to the results of the Abbasi study, with the increasing age of the child, the incidence of diarrhea decreased, which confirms the results of the present study. Because at this age children walk on all fours and their hands constantly touch the ground, touching the mouth, as a habit of children at this age, can be an important factor in causing diarrhea. In addition, children at this age have a weak immune system and are more prone to the disease.[10,11]

The economic status of families can be an effective factor in childhood diarrhea. Although the economic status was not directly evaluated in this study, given that most mothers were homemakers and the majority of families had a moderate income, it was clear that economically poor families were at higher risk. It should be noted that the evaluation of economic status as an independent factor requires more detailed and extensive studies.[12,13]

According to a study by Sahiledengle *et al*.[14] children whose mothers were homemakers were at a lower risk of diarrhea than children whose mothers were employed. These results contradict the findings of the present study. The findings of both studies seem acceptable from different perspectives. On one hand, it can be argued that homemaker mothers spend more time caring for their children in various aspects including health, nutrition, and so on.

According to Mosley and Chen, family income and wealth, parental education, and access to health services determine the

Table 5: Relationship of possible factors of diarrhea and OP/OB result with pus cell outcome

Variable	Pus cell result		*P*
	Negative	Positive	
Suitable hand-washing utilities at home			
Viral	182 (76.5)	56 (23.5)	<0.0001
Bacterial	74 (52.5)	67 (47.5)	
Others	1 (16.7)	5 (83.3)	
Safe drinking water			
Negative	194 (90.7)	20 (9.3)	<0.0001
Trace	29 (46)	34 (54)	
+	14 (33.3)	28 (67.7)	
++	5 (12.8)	34 (87.2)	
+++	1 (3.7)	26 (96.3)	

health and survival of children.[15] Another study concluded that education was a more important predictor of the onset of a health problem compared with income while income was more strongly associated with the progression of health problems.[16] The chances of a child's survival are closely tied with the mother's education. In all countries, the worst survival rate is reported in children born to illiterate mothers, and improving the educational status of patients has played an important role in children's survival over the past decade.[17] Maternal education is related to the child's health in several ways, including higher family income, participation in decision-making, better use of available services, and better childcare.[18]

Studies on the relationship between family income and education and child health have yielded different results. According to Nahum, the family income had a significant relationship with the child's health, and this relationship increased with child age. They concluded that parental education did not affect child health.[19] The results of a study by Fine and Fordtran.[20] showed that there was a significant relationship between maternal education and the incidence of diarrhea in children, which is consistent with the results of the present study.

In the present study, there were 251 children under 2 years of age, of which 85 children were exclusively breastfed. Since most children under 2 years of age with diarrhea in this study consumed infant formula, it can be clearly stated that breastfeeding up to 6 months of age is a protective factor against diarrhea. This finding could be evidence of the presence of immunoglobulins and antibodies in breast milk that can passively protect the baby against diarrhea.[20,21]

In terms of duration, only 9.6% of children had diarrhea for more than 14 days. This finding was in line with Abbasi's study reported that in 78 (11%) out of 708 children, diarrhea lasted more than 14 days.[22]

According to the results of the present study, there was a significant relationship between the availability of appropriate hand-washing facilities at home and the possible factor of diarrhea. This finding is consistent with the results of the Gedamu study, which found that children who used public toilets and whose mothers used only water to wash their hands were more prone to diarrhea.[23]

In the present study, 83.7% of individuals with poor health conditions had bacterial diarrhea. There was no significant relationship between safe drinking water and the possible factor of diarrhea, but in people with inadequate access to safe drinking water, the potential for viral infection was higher than the potential for bacterial infection.

There was also a significant relationship between the use of water purifiers and the possible factor of diarrhea so that children with diarrhea who also used a water purifier had a possible viral pathogen.

Khabaz *et al.*[24] conducted a study to examine the factors affecting acute diarrhea in children and found no significant relationship between the type of water consumed and diarrhea, which contradicts the results of the present study. Numerous studies have been conducted in this field and the majority have emphasized that unsafe water is associated with diarrhea, and the use of safe bottled water can prevent the occurrence of this disease.[25-27]

In the present study, a small number of people, i.e., only 3% had a history of travel, and no statistically significant relationship was found between the patient's travel history and the possible factor of diarrhea. Travel can cause diarrhea because of some factors such as dietary changes and travel stress. However, infectious agents such as various bacteria, viruses, and parasites can enter the gastrointestinal tract and cause the signs and symptoms of diarrhea during travel. According to the results of the present study, the probable factor of diarrhea in children with a history of travel was viral type. Since *Escherichia coli* is one of the most common causes of diarrhea during travel, it was expected that the possible factor should be bacterial, but the results showed the opposite. However, the travel season can play a key role in the probable factor of diarrhea. Viral diarrhea is one of the causes of travel diarrhea that is more prevalent in summer. Since the exact time and season of travel were not included among the studied variables, it is not possible to certainly discuss the results of this part of the study.

In regards to the use of antibiotics, 23% of people had taken antibiotics before referring to the hospital. The human gut contains beneficial microorganisms (bacteria) that help the gut in proper functioning and absorbing nutrients. In the cases where these bacteria are killed or their amount is less than normal for any reason, harmful bacteria replace them and cause diarrhea.

Regarding the consumption of undercooked and processed food, no statistically significant relationship was observed between the possible factor and the consumption of undercooked and processed food. However, the viral pathogens in these people

were more prevalent than the bacterial. Although infectious disease specialists believe that the consumption of contaminated foods is the most common cause of bacterial diarrhea, the results of the present study showed that undercooked and processed foods could lead to both viral and bacterial diarrhea with approximately equal proportions. However, this cannot be asserted with certainty, because not all processed and undercooked foods can be definitively pathogenic.

According to the results, a statistically significant relationship was observed between the season of incidence and hospitalization and the possible factor of diarrhea. Bacterial pathogens were the most probable cause of diarrhea in patients who were referred in summer while in patients who were referred in spring and autumn, the most probable cause was viral pathogens. The result is acceptable because it can be argued that in summer, foods are more prone to spoilage due to higher temperatures, and bacteria in hot and cold foods cause spoilage or diarrhea and vomiting in consumers.

Moreover, the consumption of higher volumes of water in the summer can increase the incidence of bacterial diarrhea considering the possibility of water contamination. Laboratory results for fecal analysis showed that the results were negative in most of the cases. According to OB results, 55.6% of children were found with OB negative, 69.9% with RBC negative, 66.8% with pus cell negative, and finally, 70.4% with fat droplet negative.

In peroxidase-based tests for OB, a daily blood loss of about 2–5 mL in the intestines is normal. Excessive bleeding can be detected on an OB test.[28] In addition, the daily excretion of fat in the stool is less than 6 g, and this amount remains constant even if the daily consumption of fat is 100–125 g. Fat excretion in the stool may be moderately increased in the case of fat malabsorption in patients with diarrhea. Thus, a moderate increase in fecal fat excretion in a patient with diarrhea does not indicate that malabsorption is the primary cause and further investigations should be performed to determine the cause of diarrhea.[29,30]

Various tests may be used to diagnose fat malabsorption (steatorrhea). The gold standard in the diagnosis of steatorrhea is the quantitative calculation of stool fat.[20]

According to the statistical results of the present study, there was a statistically significant relationship between the possible factor of diarrhea (viral or bacterial pathogens) and pus cell result, in a way that patients with bacterial diarrhea had higher rates of pus cell positive than patients with viral diarrhea. A statistically significant relationship was also observed between the OP/OB and the pus cell results.

Conclusion

Based on the findings of this study, it is suggested to investigate and determine the role of dietary and health habits in the occurrence of diarrhea in children, and develop and implement educational programs on diarrhea, including preparing free booklets to enhance parental awareness about diarrhea and how to prevent it. Schools can also play an important role in raising the awareness of parents and even children. Encouraging and educating children to eat healthy foods and observe personal hygiene can be very helpful in preventing diarrhea.

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Conflicts of interest

There are no conflicts of interest.

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