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THE CORRELATION BETWEEN MATERNAL AWARENESS, HYGIENE PRACTICES, AND THE INCIDENCE OF DIARRHOEAL CASES: A CROSS-SECTIONAL STUDY IN LAHORE

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ABSTRACT

Diarrhea is the second leading cause of death among children under five years of age and causes 53,000 child deaths in Pakistan annually. Lahore, being densely populated, is the most affected area compared to the other cities of Punjab. This cross-sectional survey was conducted in the urban areas of Lahore, in the surroundings of the Punjab University. A questionnaire was filled out by 100 participant mothers whose child was affected at least once. Several variables were evaluated, and significance was checked using Chi-square. Of the total of the participants, 85% of the mothers were aware and mainly educated. About two-thirds (63%) of children were vaccinated for Rotavirus. Hand washing habits and safe drinking were significantly reducing the incidence. Spreading more awareness through media, stopping the unnecessary use of medications, promoting hand washing practice and increasing awareness about the Rotavirus vaccine will help reduce the incidence and prevalence of diarrhea.

Keywords Childhood Diarrhea; Hygiene Practices; Hygiene Practices of Mothers at Home; Rotavirus Immunization; Knowledge; Behavior

INTRODUCTION

Diarrhea causes 2195 deaths worldwide every day, which is one out of nine deaths in children. This occurs primarily due to dehydration and can be treated by giving ORS (oral rehydration salts) to children (CDC, 2015). The causes of almost 88% of deaths are inadequate hygiene and unsafe drinking water (UNICEF, 2006) and 40% of all hospitalizations are due to Rotavirus (Robert E Black *et al.*, 2013; WHO, 2008). Rotavirus and *E. coli* are the causes of maximum events, in less developed areas: with poor hygiene and sanitation (UNICEF, 2016). A survey showed that around 58% of deaths are caused by poor sanitation and unsafe water, by analyzing data from 145 countries (Annette, 2013).

A survey conducted in Peshawar shows that children given filtered water are more prone to diarrhea. Similarly, the number of cases was higher, when mothers did not prefer hygiene practices (Ayesha, 2019). Due to unhygienic food, almost 40% of children had diarrhea (Rajat *et al.*, 2020). Lifesaving preventive measures include vaccination against rotavirus, mother education, clean drinking water, improved hygiene, a habit of washing hands with soap and exclusive breastfeeding (Soboksa *et al.*, 2020).

In Pakistan, diarrhea-related diseases resulted in 53,000 child deaths annually (The News, 2017). These affect almost 60-75 million people and 60 % of deaths under five years of age are due to poor hygiene, polluted water, and sanitation-related illnesses. In

Pakistan, there are 5-6 episodes among children of age 0-5 annually. In Punjab, the reported prevalence was 7.8% (Ferozsons Labs, 2017). According to *The Express Tribune*, the number of patients with diarrhea admitted to Lahore (74,337) was greater than in other Punjab cities such as Multan (7,294), Bahawalpur (6,859), Faisalabad (6,113), Sheikhpura (8,306) and Rawalpindi (12,236) (The Express Tribune, 2017). In Lahore, an awareness seminar was conducted entitled 'Plan International Pakistan in collaboration with HUD (United States Department of Housing and Urban Development) and Punjab organized Global Hand Washing Day'. It had a nice theme, "Our Hands, Our Future". This was to motivate people to improve their hand washing habits. Improvement in domestic hygiene conditions can also reduce the burden of childhood diarrhea (The News, 2017). Unfortunately, the rotavirus vaccine was not included in the routine childhood immunization schedule before 2017 and its price is also high in Pakistan. CDC (Centers for Disease Control and Prevention) stated that Rotarix® (RV1) administered at 2 and 4 months (2 doses), is very effective in preventing rotavirus-associated diarrhea (CDC, 2018). Our study was conducted in 2018-2019, so most of the children were not vaccinated for Rotavirus.

Antibiotics are used for the treatment of bacterial diarrhea. However, inappropriate use of antibiotics and anti-diarrheal agents is common, which leads to harmful side effects (Summit Medical Group, 2014).

According to the FDA (U.S. Food and Drug Administration), lactase and gluten intolerance can lead to diarrhea in children that are lactase deficient or unable to tolerate gluten. Lactose is present in milk and gluten in wheat and grains. Eggs are also one of the common foods implicated in diarrhea (FDA Consumer Updates, 2009).

We aimed to fill some of the scientific gaps by creating better knowledge and practice by doing this study on the control of diarrhea among children aged 0-9 years, in Lahore. The effects of mother's hygiene, rotavirus immunization, medications, and food allergies on the occurrence of diarrhea were the main focus of the study.

OBJECTIVES

1. To identify the mother awareness from the targeted population of Lahore.
2. To go through the management practices, when not managed well leads to increase incidences.
3. To spread more awareness and persuading them to follow hygiene practices by demonstrating their impact.

MATERIALS AND METHODS

Study area and time period: The study was carried out from 25 November 2018 to 10 January 2019 in the University of the Punjab, Lahore. A questionnaire was designed to be filled in by mothers. The targeted areas included: Jinnah Hospital, Allama Iqbal Medical College, Sheikh Zayed Hospital, Punjab University Girls Hostel, Model Town, Johar Town, Faisal Town and Allama Iqbal Town. Some questionnaires were filled out by mothers themselves, while others were filled by conducting face-to-face interviews.

Population and study design: The survey used a cross-sectional study design and the targeted population was mothers from the premises of Punjab University Lahore, whose children (out-patients) had diarrhea at least once. We went to mothers in public places and asked them to participate in the study. There were 50 questions in the questionnaire. The eligibility criteria for the population were, (1) being a mother of at least one child who has suffered from diarrhea in the past three months, (2) providing written consent for participation in this study, and (3) the age of one child must be from 0 to 9 years.

Sample Size Determination and Sampling Technique: The sample size (n) for the cross-sectional study was calculated using the formula $n = (Z\alpha/2)^2 p(1-p)/d^2$; where n is the required sample size, $Z = 1.96$ for a confidence level (α) of 95%, P is the proportion of prevalence of diarrhea in the premises of Punjab university which was 7% and d is the margin of error (5%). The required sample was calculated to be 100.

Non-probability convenience sampling technique was used to collect data from the premises of Punjab University, Lahore. The sample was collected proportionally from the targeted towns and hospitals close to the university.

Study Variables: The outcome variable was the prevalence of diarrhea related to the hygiene practices of mothers. Questions were asked from mothers related to knowledge about diarrhea; how many times the child has been affected by diarrhea, hand washing, and feeding practices of mothers and what treatment options they opted for their children. Three sets of options were given to answer the questions such as 'Yes' and 'No'. Relevance of the following variables was checked with the outcome variable: Sociodemographic characteristics of mothers and children, Mother's awareness of symptoms, precautionary measures, method of water purification and treatment options, food allergies and status of rotavirus immunization.

Ethical Considerations: The University of the Punjab, Lahore, had approved the study. Participation in the filling of the questionnaire was voluntary. All the collected information was handled confidentially. No biological samples were collected.

Statistical analysis: The data collected was organized using descriptive and inferential statistics. Before analyzing the data, missing values were checked. The information gathered was compressed by engaging measurements of recurrence, rates and tables for categorical variables. The relationship of each variable with diarrhea was tested using a chi-square test. The significance level for all statistical analyzes was set at < 0.05 .

RESULTS

Sociodemographic characteristics: Children 0-9 years of age were part of the study. All the participant mothers were Pakistani and between 28-40 years of age. From the total participants, 1) 17 were uneducated, 87 had higher or secondary education, 38 were employed; 2) 62 were housewives, and 3) 89 were married, 2 were widowed, 4 were separated and 5 were single mothers. The average monthly income of the participants was Rs.50, 000. It was found that sex of the child had no significant association with diarrhea but age of the child and age of the mother showed significant correlation with diarrhea. Moreover, household size showed a significant association with diarrhea. Our study indicated that diarrheal incidence increases with increasing number of children at home (Table 1)

Table 1 Association of sociodemographic characteristics and the appearance of diarrhea among children in the past 3 months

Variables	Category	Frequency	Diarrhea in the last 3 months		P-value
			Present (%)	Absent (%)	
Sex of the child	Male	48	29	19	0.60719
	Female	52	34	18	
Age of the child	0-3 Y	40	31	09	0.00315*
	3-6 Y	37	24	13	
	6-9 Y	23	08	15	
Age of the mother	≤30	33	21	12	0.01301*
	≥30	67	25	42	
Marital status of the mother	Single	05	03	02	0.75329
	Married	89	37	52	
	Widowed/divorced	02	01	01	
	Separated	04	01	03	
Mother's education	Primary	06	04	02	0.00488*
	Secondary	40	17	23	
	Higher	37	10	27	
	uneducated	17	13	04	
Mother's occupation	Employed	38	21	17	0.50436
	Housewives	62	30	32	
Household Size	≥7	53	42	11	0.00035*
	<7	47	21	26	
Monthly family income	<10,000	7	6	1	0.03366*
	10,000-30,000	22	8	14	
	30,000-50,000	53	20	33	
	>50,000	18	4	14	

* Correlation is significant at $p < 0.05$

Mother's Awareness: Around 80% of the mothers knew correct definition of diarrhea, its symptoms and precautions. Respondent mothers had least knowledge about the causes of diarrhea and the foods that stimulate the incidence of diarrhea. More than half of mothers knew that intestinal illnesses and the side effects of medical treatments promote diarrhea. Almost half of the mothers agreed that symptoms appear after 12 hours of meal intake. 70% of the children lost weight during the last episode of diarrhea. Most mothers knew the correct preparation of ORS and preferred to give ORS as an initial treatment to their children. Only 42% of the respondents were fully aware of the danger signs associated with diarrhea (Table 3).

Mother's Literacy Rate: The education level of the mother has a direct relationship with the child's health. Two third of the mothers were having a higher level of education. A few of them got their primary education while 17/100 were uneducated (Table 1).

Association of Age with Diarrhea: We found that 85% of diarrheal episodes occurred in children under the age of 6 years. The percentage prevalence was 40%, 37% and 23% in the age group 0-3, 3-6, and 6-9 years, respectively.

Status of Rotavirus Vaccination: There exists a strong association between status of immunization and incidence of diarrhea. About two-thirds (63%) of women have vaccinated their children. Out of these, 18% got diarrhea while 45% remained unaffected. 37% mothers did not go for vaccinating their children. Of these, 30% got diarrhea, while 7% remained unaffected (Table 2).

Exclusive breastfeeding: Almost 77% of the mothers mentioned that their child was exclusively breastfed. Of these, 24% had diarrhea, while 53% remained unaffected. The rest of the women mentioned that their child was not exclusively breastfed. Of these 10% have diarrhea while 13% remain unaffected (Table 2)

Table 1. Correlation analyses between Breastfeeding practice, food allergy, rotavirus vaccination, precautionary measures, treatment and incidence of diarrhea among children during the past 3 months

Variables	Category	Frequency	Diarrhea in the last 3 months		P-value
			Present (%)	Absent (%)	
Exclusive breastfeeding	Breastfed	77	24	53	0.27415
	Not Breastfed	23	10	13	
Food Allergy	Allergic	35	12	23	0.06157
	Not Allergic	65	35	30	
Food Allergy items	Milk	07	05	02	0.07667
	Egg	05	01	04	
	Peanuts	09	02	07	
	Wheat/Cerelac	10	07	03	
	Junk food	04	03	01	

Diarrheal Treatment	Given	89	23	46	0.0023*
	Not given	11	09	02	
Diarrheal Treatment Options	ORS	70	08	62	<0.0001*
	Medications	09	07	02	
	Herbal Medicine	10	07	03	
Rotavirus vaccination	Vaccinated	63	18	45	<0.00001*
	Not vaccinated	37	30	07	
Drinking water treatment	Treated	52	11	41	0.00008*
	Not treated	48	39	09	
Drinking water treatment options	Boiling	10	01	09	0.71
	Filtration	35	11	24	
	Chlorination	07	01	06	
Precautionary measures before exposure	Taken	67	21	46	0.01180*
	Not taken	33	19	14	
Precautionary measures before exposure	Hand sanitization	16	07	09	0.04444*
	Use of filtered water	30	11	19	
	Provision of clean food	21	15	06	
Precautionary measures after exposure	Taken	78	27	51	0.03849*
	Not taken	22	13	09	
Precautionary measures after exposure	Offer more water	59	12	47	0.0074*
	Increased fluid intake	10	06	04	
	Limited caffeinated products consumption	09	05	04	

* Correlation is significant at $p < 0.05$

Food allergies: In our analysis, 35% of mothers responded that their child had a food allergy. Of these, 12% had diarrhea, while 23% did not show symptoms. Of the non-allergic children (65%), 35% had diarrhea while 30% remained healthy. Milk, egg, peanuts, wheat and junk food were listed as food allergic items by mothers. Table 2 indicates a higher rate of milk, wheat, and peanut allergies.

Medications/Treatment Options: Diarrheal treatment was given to most of the children, that is, 89%. ORS was administered as an initial treatment and was the most common practice among mothers (70%). Some mothers were giving medications after consultation with the doctor. The majority of mothers preferred imodium and metronidazole (Flagyl). Some nonprescription medicines used included Imodium, bismuth subsalicylate, Lomotil, and Pedialyte. All of these help the body to absorb fluid more easily. In addition to ORS and medications, some mothers (9%)

practiced home remedies, including herbal medicines, to prevent diarrhea (Table 2).

Preventions and Precautions: Preventive measures varied according to the exposure to diarrhea. It was found out that most of the mothers were taking precautions after their child exposure to diarrhea. We found that most of the mothers used filtered water, 16% agreed that they sanitized their hands, while 21% said that they provided clean food as a precautionary measure. About 59% of mothers offered more drinking water after first exposure, while few had limited the consumption of caffeinated products (Table 2).

Hands Washing Habit of Mothers: Hand washing practices reduce diarrheal incidence by one-third. Many mothers do not wash their hands before preparing food and feeding their children. Washing hands only with water is the common practice among mothers. Our study showed that the hygiene practices of mothers had a strong correlation with the incidence of diarrhea (Table 3).

Table 3: Awareness of mothers and their hygiene practices in association with diarrhea among children in the past 3 months

Variables	Category	Frequency	Diarrhea in the last 3 months		P-value
			Present (%)	Absent (%)	
Awareness of Mothers					
Definition of Diarrhea	Know	81	53	28	0.85162
	Don't Know	19	12	7	
Symptoms of diarrhea	Know	78	37	41	0.035803*
	Don't Know	22	16	06	

Causes of diarrhea	Know	56	25	31	0.009847*
	Don't know	44	31	13	
Precautions to Reduce Diarrhea	Know	79	34	45	0.00692*
	Don't know	21	16	05	
Correct preparation of ORS	Know	82	32	50	0.086535
	Don't know	18	11	07	
Danger signs	Know	42	19	23	0.010334*
	Don't know	58	41	17	
Hygienic Practices of Mothers					
Hand washing before food preparation	Always	35	11	24	0.0001*
	Occasionally	65	46	19	
Hand washing practice before food preparation	only water	73	23	50	0.8619
	soap and water	27	9	18	
Hand washing before feeding	Always	40	14	26	0.0089*
	Occasionally	60	37	23	
Hand washing practice before feeding	only water	78	51	27	0.0384*
	soap and water	22	09	13	
Hand washing after defecation of a child	Always	81	21	60	0.0071*
	Occasionally	19	11	8	
Hand washing practice after defecation of a child	water only	73	42	31	0.0005*
	soap and water	27	05	22	

* Correlation is significant at $p < 0.05$

DISCUSSION

The findings of our study showed that the food hygiene practices of mothers have a strong impact on the prevalence of diarrhea among children. We analyzed that most of the affected children were under the age of 6 years. It is a persistent problem for children of this age, since 1.87 million children dying of diarrhea worldwide are under the age of 5 years (Cynthia *et al.*, 2008). According to the World Health Organization, 'estimates of mortality from diarrheal diseases among children in developing countries turned out to be 1.6 million deaths per year' (M. Farthing *et al.*, 2008). In South Asia and Africa, approximately 82% of deaths in children under five years of age are caused by diarrheal diseases (Gupta, 2012). It is because of less established acquired immunity and a decrease in maternally acquired immunity over time. A similar study reported that 84.5% of households had children suffering from diarrhea in the last 3 months (Zahid *et al.*, 2014).

Our study showed that the prevalence of diarrhea was higher in children aged 1 to 3 years. Compared with other areas of Pakistan, the prevalence of diarrhea was found to be higher in rural areas compared to urban areas (Mengistie *et al.*, 2013). The prevalence of diarrhea in urban areas of Sindh and Balochistan is higher than in rural areas (Ali *et al.*, 2021). Furthermore, a study showed that the prevalence of diarrhea is particularly high in Punjab (20.6%) and Khyber Pakhtunkhwa (21.4%), respectively. Infant contact with fecal contamination during crawling (in children under 1 year of age) can also lead to a high incidence. Moreover, Children's cognitive development can be severely affected due to diarrhea (Bowen *et al.*, 2012).

Sociodemographic characteristics like age and educational status of the mother did not show any significant association. Only the size of the household shows a significant association with diarrhea. One of the studies reported the likelihood of childhood diarrhea was higher in households that have one child. Having more than one child reduces the risk of diarrhea, as the influence of mothers also reduces (Soboksa *et al.*, 2020). It was found that the sex of the child has no significant association with diarrhea which is similar to the findings of Ali *et al.*, who also did not find a significant correlation between the two variables (Ali *et al.*, 2021). A study conducted in Bangladesh also suggested that the prevalence of diarrhea was higher in male than female children (Sarker *et al.*, 2016).

Mother's awareness is the predominant factor that can bring a positive change in the community towards dealing with diarrheal incidence. More than 20% of our survey was about the awareness of mothers. It was observed that 80% of the mothers were aware of diarrhea and precautionary measures. In our study, the mothers identified poor hygiene practices, contaminated food and water as the major causes of diarrhea. A study conducted in Punjab identified similar causes of diarrhea. They stated that excessive food consumption was the leading cause of diarrhea. Moreover, they believed soil eating to be the cause of worm infections resulting in diarrhea (Nielsen *et al.*, 2003).

Similar cases were also reported in Iran and Nigeria. It was found that 67% of mothers knew about ORS and its method of preparation. While a study in Karachi, Pakistan reported 89.9% of mothers knew about ORS and 74.5% knew its correct preparation (Zahid *et al.*, 2014). Similarly, Halvorson reported that

sixty-two (95%) of the respondents said ORS is an effective treatment (Halvorson, 2004).

Two-thirds of the mothers were aware of the foods that stimulated the incidence of diarrhea. It was found that allergic food items had no significant association with diarrhea. Around 35% of allergic children were affected, which is a higher number as compared to non-allergic children. Most of our participants were educated and followed hygiene practices. The findings of one study demonstrated that most mothers (92%) defined diarrhea correctly which is higher than other studies done in Leukoma, Ethiopia (65.4%) and Karachi, Pakistan (52.5%) (Workie *et al.*, 2016). Another study from Karachi states that mothers' knowledge about the control of diarrhea is significantly low in low socioeconomic groups (Sana *et al.*, 2017). Mothers need to be more aware of diarrhea, its incidence, causes, and remedies, as unhygienic practices, poverty, and illiteracy increase the burden of the disease.

A very important finding of our study is that there is a significant difference between mothers' knowledge and their management practice. Although a large proportion of mothers were aware of the disease, that is, 80%, but their practice on the management of diarrhea was poor, that is, 40%. Similar results were obtained from the study in Ethiopia i.e., 42% (Workie *et al.*, 2016). While a study conducted in Senegal reported that 23.2% had good practice in the management of diarrhea (S. Thiam *et al.*, 2019). Most of the mothers used ORS together with imodium and metronidazole as a treatment option. A large proportion of mothers used oral rehydration solution as the initial treatment for diarrhea. Most of them obtained information on the preparation of ORS and medications from the hospital. Antibiotics and magnesium-containing laxatives are commonly used (Seth, 2012). We analyzed that 21% of the cases were due to antibiotics.

We found that two-thirds of mothers used filtered/boiled drinking water for their children. It was the quality of the water that had a significant association with diarrhea. In a study in Lahore, more than 50% of the water samples were found to be contaminated, contributing 40% to overall deaths and 30% to the incidence of the disease. And, as a consequence, diarrhea was the main killer of infants (Hayder *et al.*, 2016). In our survey, most mothers treated the water by boiling or filtration, while a small proportion, that is, 7% preferred chlorination. Excessive use of chlorine can lead to water contamination. Similarly, if the filters remain unchanged after a specific time, impurities clog in the filter, making water impure. The use of contaminated water or the improper treatment of water can be one of the factors leading to the prevalence of diarrhea. Almost 70% of the cases were attributed to contaminated water (Troegar *et al.*, 2017) Similarly studies from Ethiopia and Burundi show that the water source is an important factor for childhood diarrhea.

It was noted that changing the water source from unimproved to clean water was found to reduce the risk of disease by 23% (Soboksa *et al.*, 2020). This study also identified that there was a significant association between handwashing practice and diarrhea which is contrary to the findings of Ali *et al.*, who did not find any significant correlation between the two variables. Their findings also highlighted the similar results that joint access to water, sanitation and hygiene can reduce the incidence of diarrhea (Ali *et al.*, 2021). Similar findings state that children of these mothers are at higher risk, who prepare their food on the ground, under unhygienic conditions (Chakravarty *et al.*, 2017; Kumiko *et al.*, 2009). A meta-analysis of 39 studies showed that hygiene and water quality with some other interventions, such as improved sanitation facilities and proper excretory disposal, can significantly reduce the level of diarrheal episodes (Fewtrell and Colford, 2005).

Rotavirus is the leading cause of childhood diarrhea, causing 500,000 deaths annually (Rubeena *et al.*, 2017). Rotavirus is a cause of nosocomial diarrhea in children (Khoshdel *et al.*, 2014) and leads mainly to high morbidity and mortality (Giri *et al.*, 2019). In our analysis, almost two-thirds of the children were vaccinated and diarrhea incidence was more in unvaccinated children. This is a higher number, but our affected population was not poor. In rural areas, the number is reversed. Acute diarrhea was found to be present in more than half of the children. The samples were collected from 64 villages of Sindh, Pakistan (Shah *et al.*, 2003).

Similarly, a study in Beijing reported that rotavirus accounts for more than one fifth of childhood diarrhea. These reports reflect that rotavirus vaccines should be administered to reduce the disease. The WHO recommended in 2009 that all countries promote the rotavirus vaccine (Tian *et al.*, 2018). A study reported a prevalence of rotavirus of 63.8% in children under five years of age (Thiam *et al.*, 2017). Although hygiene practice is good for controlling the prevalence of diarrhea, rotavirus vaccination is the ultimate protective measure.

'Prevention is better than cure', the measures taken to stop something from happening are very important. Hand washing and safe drinking water have greatly reduced the cases in our study. Precautionary measures of offering more water and reduction in caffeinated products' consumption have reduced the incidence by 66%. In short, provision of sanitation facilities, implementing hygienic practices and improving water quality and excretory disposal can reduce one-quarter of the diarrheal episodes. Campaigns should be launched to make people aware of diarrheal severity, soap handwashing practices and the possible treatment options.

Our study has some limitations. First, the severity of the disease and the relationship of diarrhea with food storage conditions and waste disposal were not accessed. Second, household characteristics were not

defined completely. Lastly, boiling water was not clearly defined in terms of time and temperature.

CONCLUSION

Diarrhea is more prevalent among children of age under 6 years. The lack of access to clean drinking water and the unhygienic practices of mothers are the main factors leading to diarrhea among children. The incidence of diarrhea can be reduced with better understanding, improved water purification techniques, good mother's hygiene, and immunization against rotavirus. Further studies and assessment are needed to observe behavior patterns of mothers and find other means of improving hygiene to protect children from diarrhea. Moreover, enhanced awareness can lead to better management of diarrhea at home.

CONFLICTS OF INTERESTS

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CONTRIBUTION STATEMENT

As a corresponding author I state that all authors contributed equally in research and writing of this paper. Ayesha Sadiqa and Bisma Shahzadi worked on introduction and methodology respectively. Rafia Mazhar contributed to the statistics applied. Muhammad Haseeb Arif and Muhammad Hassan Saeed finalized the draft and did the editing part.

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