Comparative study of the prevalence and risk factors associated with diarrhoea among the people of rural areas and urban slums in Chittagong, Bangladesh

Sadia Farhana[1], Asif Raihan[2]

[1]*Doctoral Research Assistant, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia*
[2]*Institute of Climate Change, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

ABSTRACT

Diarrhoea is widely recognized as a major cause of morbidity and mortality. It is a serious public health problem in Bangladesh and can occur throughout the year which could lead to an immunological distress and a nationwide financial burden. Therefore, this study aims to determine the prevalence and association of different sociodemographic and behavioural factors of diarrhoea in Chittagong with a comparison of diarrhoea prevalence between urban slums and rural areas. To ascertain the prevalence and associated factors of diarrhoeal infection among 774 people selected from urban slums and rural areas in Bangladesh, a cross-sectional study was conducted using a structured questionnaire from April 2018 to March 2019. Collected data from the total observation of 18,576 times were analyzed using Chi-square (χ2) test. The overall prevalence of diarrhoea was found at 19.37% (3600/18576 cases) and 36.18% (280/774 individuals). The maximum prevalence was 41.58% (111/190 individuals) which was found in urban slums in contrast with rural areas 34.42% (383/584 individuals). A higher prevalence (16.78%) was found in the summer season (June). The empirical data revealed a higher prevalence of diarrhea in urban slums than in rural areas where sociodemographic factors e.g., gender, education, presence of other diseases except diarrhoea, and behavioral factors e.g., handwashing practice before eating, sharing toilets, income, handwashing practice after defecation were significantly associated with diarrhoea. From the observation of different age groups and comparative analysis, this study recommend community health education to be implemented in slum areas where the significant risk factors could be intensified.

Keywords: *Diarrhoea, Prevalence, Risk factor, Infection, Community health, Bangladesh*

1. INTRODUCTION

Diarrhoea is the passage of three or more loose or liquid stools or more than 200gm of stool per day, or more frequently than normal for the individual. It is caused by a virus, bacteria, parasites, medication (e.g., antibiotics), lactose intolerance, fructose, artificial sweeteners, surgery, and other digestive disorders (e.g., Crohn's disease, ulcerative colitis, celiac disease, microscopic colitis, etc) which cause disturbance of the gastrointestinal tract consisting of changes in the intestinal motility, absorption, stomach pain, abdominal cramps, bloating, thirst, weight loss, fever, blood or pus in the stools, persistent vomiting, dehydration and governs to an increase in the number of stools and changes in their consistency [1, 2]. Moreover, diarrhoea is a global problem causing a major threat to human health. Almost everyone has become affected by diarrhoea at some point in their lives [3]. Generally, a poor health condition is connected with a high incidence of diarrhoea in low- and middle-income countries (especially in tropical and subtropical) like South Africa, West Africa, Central America, South America, India, Pakistan, Ghana, Mexica, and pericentral and urban central zones in Senegal [4,5]. A youngster under the age of five has diarrhoea three times a year on average in underdeveloped countries. Nearly 1.5 million deaths occurred globally from

diarrhoea every year and the rate of a child dying of this disease is around 525000 where half of all diarrhoea deaths in children occurred in the five countries of India, Nigeria, Congo, Pakistan, and China in 2008 (4.249 million) [6].

Although Bangladesh has the highest life expectancy and the lowest infant mortality rates in the South Asian region, the incidence of childhood morbidity for diarrhoea is still alarming [7] and it is one of the major causes of death in Bangladesh [8]. The number of diarrhoea patients has been increasing at least every five minutes and the disease was 7th in ranking among the top 20 diseases and its prevalence was 6.6 per 1000 individuals in Bangladesh [9]. In terms of the divisions (larger administrative unit of Bangladesh), a higher prevalence (7.10%) was reported in Barisal followed by the Dhaka division (6.98%) and Chittagong division (6.68%) [10]. Defecation in the open air is common all over the country and is closely associated with the occurrence of diarrhoea [2].

Approximately 5.7 million people of Bangladesh live in urban slums which are unsuitable for proper housing and sanitation [11]. On the other hand, over 80% of the population of this country live in the villages, which lack good sanitation, and clean drinking water and have numerous other problems such as poor communication, lack of electricity, and inadequate health services [12]. For these reasons, rural areas and urban slums are at risk of diarrhoeal morbidity. For most people in developing countries like Bangladesh, the major source of food is cereals which are referred to as the origin of diarrhoea. It was seen worldwide that there was a marked negative relationship between diarrhoea and physical growth, reduction in appetite, altered feeding practices, decreased growth, fitness, and absorption of nutrients. The goal of this study is to compare the prevalence of diarrhoea in Chittagong's urban slums and rural areas, as well as the relationship between key sociodemographic and behavioral risk factors in the most prevalent area between the two. As a result, the study will identify the factors where interventions are needed to avoid diarrhea-related losses in persons of all ages.

Epidemiological survey of childhood diarrhoea has been greatly performed in rural and slum areas of developing countries where the determinant factors, e.g., mother's educational status, mother's employment, and family income [13] the age of child, religion, wealth index, number of children under five years of age, source of drinking water, toilet facility and disposal of youngest child's stools were come out [14]. In India, the prevalence of childhood diarrhoea has risen from 9% to 9.2% between 2016 and 2020 [15]. The prevalence rate was different from country to country, e.g., 22.7% in urban slums of Bangladesh [16], 50.7% in Nepal [17], 80.3% in Pakistan [18], 25% in India [19], 36.3% in Senegal [5], 24.80% in Burundi, 13.1% in Rwanda and 13.91% in Tanzania [20], 18.8% in Nigeria [21], 22.1% in rural areas of Ethiopia [22], 10.9% in remote coastal area of Bangladesh [23].

Though the communities are smaller in size and sparsely populated in rural areas, improper refuse disposal practices, lack of handwashing facilities, the presence of two or more siblings in a household, and the age of the child were the major risk factors for diarrhoea in India [24], in Rwanda [25]. On the other hand, urbanization is gradually exemplified by social disparity, poverty, and the spread of slums [26] where the slum environment has close proximity of sanitation facilities to homes, education, sharing, and poor hygiene of sanitation facilities and housing compounds all of which have negative health consequences including the high prevalence of diarrhoea [27, 28, 16].

From the available literature, it has been seen that many works are done in different parts of the world including Bangladesh, and focus only on the status of childhood diarrhoea among under five years but there is a little rese¬arch on the prevalence of diarrhoeal diseases in Chittagong and no specific study on Shitakunda, Mirsharai, and slums of Chittagong city among the people of all ages. Thus, this study intends to observe the significant factors related to the higher prevalence between the urban slums and rural areas of Chittagong.

2. METHODOLOGY

2.1. Search strategy

A cross-sectional study was conducted using a structured questionnaire to determine the prevalence and associated factors of diarrhoeal illness in urban slums and rural areas of Chittagong, Bangladesh. Chi-square ($\chi 2$) test was utilized to analyze the data. Generally, the cross-sectional design is used for population-based surveys and to assess the prevalence of diseases [29]. To better represent total diarrhoeal prevalence coverage in Bangladesh's Chittagong district, we selected Sitakunda and Mirsharai upazilas (rural areas) and slums of Chittagong city as study sites are

located in the northeast Chittagong region of Chittagong. A total of 10 villages from Sitakunda, 10 villages from Mirsharai, and 10 slums from Chittagong city were randomly selected. From each village and slum, 6 regular households were selected according to some inclusion criteria, e.g., all permanent family members from each household, willing to participate, all ages, and gender. From each place, 60 families and a total of 180 families from three different places were surveyed by the author. Finally, the total number of people from 180 families was 774 (303 from Sitakunda, 281 from Mirsharai, and 190 from slums of Chittagong city). Each people were observed twice per month. A total of 774 people from three different places were observed 18,576 times (7272 for Sitakunda, 6744 for Mirsharai, and 4560 for slums of Chittagong city) all over the year. In all cases, face-to-face interviews were done. During the interviews, the researcher used a well-structured questionnaire that contained questions on sociodemographic and behavioral characteristics and took notes as discreetly as possible and reviewed them immediately after the interview to ensure that all information was captured.

2.2. Research variables

The study used the independent variables (the risk factors i.e., gender, age, presence of other diseases, education, income, occupation, the habit of food consumption, sharing toilet, washing of toilet, hygiene practices (handwashing practice after defecation and before eating) and the dependent variable (occurrence of diarrhoea) to measure the diarrhoeal prevalence and association of sociodemographic and behavioral factors related to diarrhoea in Sitakunda Upazila, Mirsharai Upazila and slums of Chittagong city. Based on previous studies, the most correlated factors were selected as the variables.

2.3. Data analysis

Chi-square test was used to test the association between sociodemographic and behavioral factors and the prevalence of diarrhoea at 5% or 0.05 and 1% or 0.01 levels of significance. The hypothesis testing by the Chi-square test is done to test the hypothesis of no association between two or more groups, populations, or criteria (i.e., to check independence between two variables). In this study, each dependent variable was tested to see its association with the dependent variable. The prevalence was calculated using the following formula:

$$\text{Prevalence} = \frac{\text{Number of infected hosts}}{\text{Total observed host}} \times 100$$

3. RESULTS

3.1. Study characteristics

A total of 303 (133 male and 170 female) people from Sitakunda, 281 (135 male and 146 female) people from Mirsharai, and 190 (84 male and 106 female) people from slums were observed during the study period. Figure 1 is incorporated to show the overall diarrhoeal prevalence in Chittagong, a comparison of the prevalence in two rural areas and in-between urban slums and rural areas.

3.2. Diarrhoeal infection in Chittagong

After collecting data from the three different regions of Chittagong, a total of 280 (36.18%, out of 774 studied) people were found to be infected 3600 times (19.38%, out of 18576 observations), during the whole study period. In Sitakunda and Mirsharai the prevalence was 34.98% and 33.81% as a total infection of 106 people and 95 people were noticed. Among a total of 190, 79 (41.58%) people were suffered in urban slums during the present study.

3.3. Monthly fluctuation of diarrhoea prevalence

During the present study, the higher prevalence was found in June'18 (12.02%) followed by April'18 (10.08%), July'18 (9.95%), March'19 (9.56%), August'18 (8.53%), February'19 (8.27%), January'19 and September'18 (6.46%), November'18 (6.33%), December'18 (6.20%) and October'18 (4.91%). Figure 2 shows the diarrhoeal prevalence rate in each month of the total study period from three selected areas. The highest prevalence was recorded in June'18 (16.8%), March'19 (12.21%), and August'18 (12.2%) from Sitakunda, Mirsharai, and urban

slums respectively.

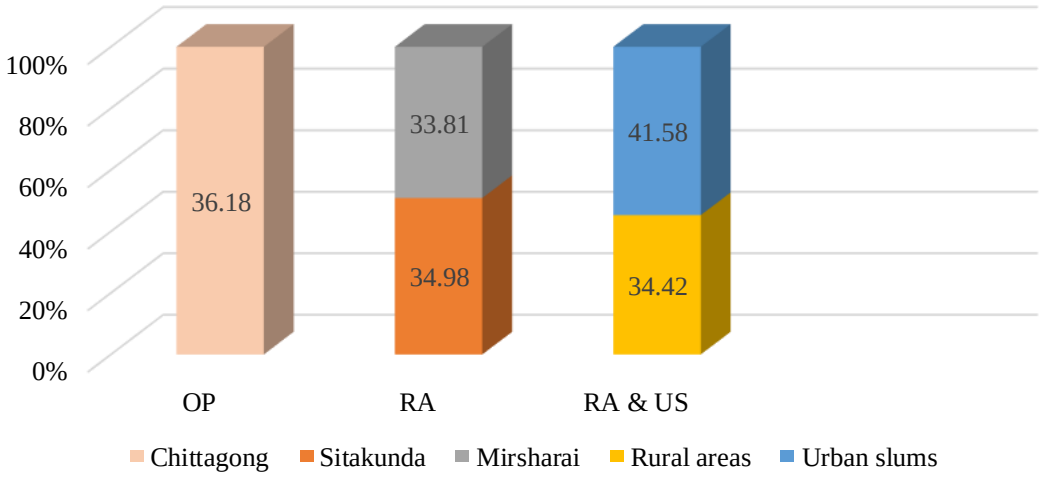

Fig. 1: Percentage of hosts who suffered from diarrhoea in Sitakunda, Mirsharai, and slums of Chittagong city. OP: overall prevalence, RA: comparative prevalence in rural areas (Sitakunda & Mirsharai), and RA & US: comparative prevalence in rural areas and urban slums.

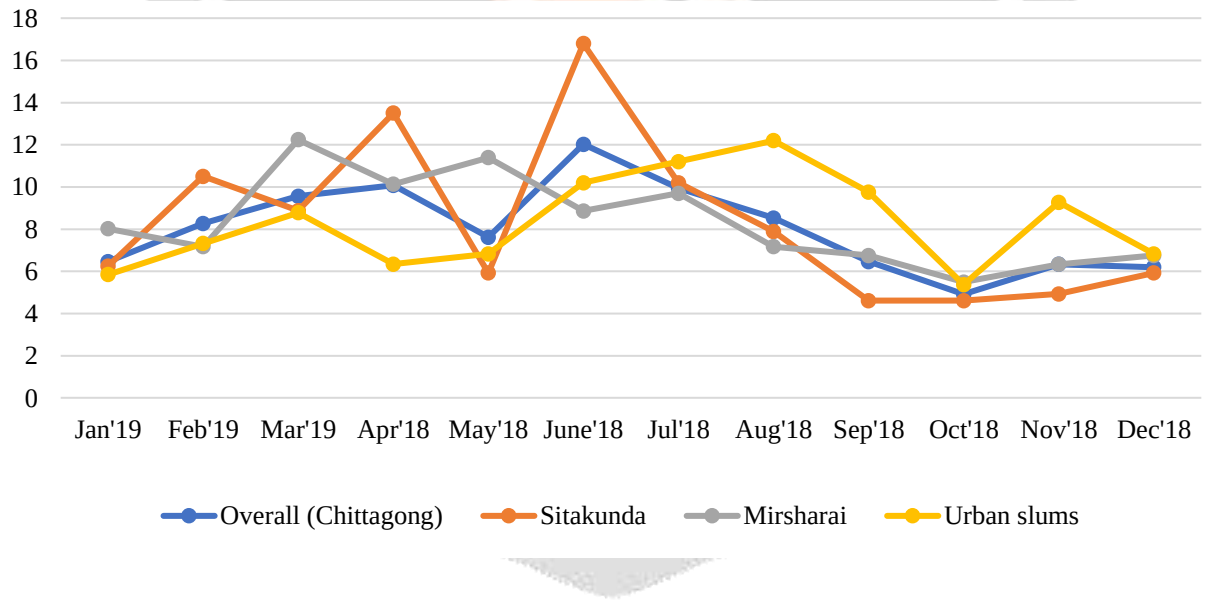

Fig. 2: Percentage of diarrhoea prevalence in Sitakunda, Mirsharai, urban slums, and the overall prevalence of Chittagong from the data of these three regions for one year (from December 2018 to January 2019).

3.4. Diarrhea prevalence and sociodemographic and behavioural factors

Table 1 shows the association of diarrhea prevalence with sociodemographic factors. In the rural areas, out of the 201 respondents, 103 (32.59%) were females while 98 (36.58%) were males but in the urban slums, there were more males (58.33%). This variable was not statistically significant (p=0.31) in rural areas while the reverse result was seen for urban slums. In the rural areas, the commonest age group was the child under 5 years (77.78%), but in the urban slums, the age group of 5-18 years (52.5%) was the commonest. Age was statistically significant in rural areas while diarrhoea in urban slums was not significantly associated with age. In the urban slums and rural areas, the most infected rate (54.65% and 42.55% respectively) was found among the people who were suffered from other

diseases except diarrhoea which was statistically significant in both regions. The commonest respondents were illiterate in rural areas (52.78%) and urban slums (52.38%) but the education level was not statistically significant in urban slums (p= 0.03). Statistical significance of income was seen in both regions. The highest rate (58.62% in rural areas and 60.87% in urban slums) of infection was recorded in the same group (5000< BDT) from two regions.

Table 1: Percentage of people who suffered from diarrhoea and its association with their sociodemographic characteristics.

Variables	Diarrhea hosts									
	Rural areas (n =201)				p- value	Urban slum (n=79)				p- value
	Positive		Negative			Positive		Negative		
	n	%	n	%		n	%	n	%	
Gender										
Female	103	32.59	213	67.41	0.31	30	28.3	76	71.7	0
Male	98	36.58	170	63.43		49	58.33	35	41.67	
Age (years)										
<5	35	77.78	10	22.22	0	9	45	11	55	0.4
5-18	46	23	154	77		21	52.5	19	47.5	
19–40	29	14.15	176	85.85		29	37.18	49	62.82	
40>	91	67.91	43	32.09		20	38.46	32	61.54	
Presence of other diseases except for diarrhoea										
Yes	120	42.55	162	57.45	0	47	54.65	39	45.35	0
No	81	26.82	221	73.18		32	30.77	72	69.23	
Education (except age 5<)										
Illiterate	76	52.78	68	47.22	0	22	52.38	20	47.62	0.03
Primary	43	26.54	119	73.46		28	46.67	32	53.33	
Above primary	47	20.17	186	79.83		20	29.41	48	70.59	
Income (BDT)										
5000<	105	58.62	72	41.38	0	56	60.87	36	39.13	0
5000-20000	51	26.29	143	73.71		23	23.47	75	76.53	
20,000>	48	22.22	168	77.78						
Occupation (except age 5<)										
Unemployed	96	35.16	177	64.84	0.026	29	36.25	51	63.75	0.218
Employed	70	26.32	196	73.68		41	45.56	49	54.44	

The occupation was not statistically significant in both regions (p=0.026 in rural areas and p=0.218 in urban slums) but unemployed persons had a high rate of incidence in rural areas (35.16%) and urban slums (36.25%). Behavioral factors are represented in Table 2. The respondents of rural areas (39.62%) and urban slums (43.36%) had the practice to take food outside. This habit was not statistically significant with the occurrence of diarrhoea (p=0.545). The commonest respondents did not practice handwashing with soap after defecation in rural areas (43.15%) and urban slums (55.7%) but this variable was statistically significant in both regions. The rate of respondents who did not practice handwashing before eating was higher in rural areas (51.56%) and urban slums (52.78%). There was a statistical significance between this variable and diarrhoeal prevalence in both regions. In rural areas, the commonest respondents (69.14%) washed the toilet once a year, and the commonest respondents in slums (51.06%) washed the toilet once in a month but there was no statistical significance in this variable in slums (p=0.08), while in rural areas it was statistically significant. Conversely, the practice of using the shared toilet was statistically significant in rural areas but not in urban slums (p=0.03) but most of the respondents shared toiled in rural areas (46.3%) and urban slums (48.98%).

Table 2: Percentage of people who suffered from diarrhoea and its association with their behavioral characteristics.

Variables	Diarrhea hosts									
	Rural areas (n = 201)				p- value	Urban slum (n = 79)				p- value
	Positive		Negative			Positive		Negative		
	n	%	n	%		n	%	n	%	
The habit of food consumption										
Only home	98	30.25	226	69.75	0.018	30	38.96	47	61.04	0.545
Home and outside	103	39.62	157	60.38		49	43.36	64	56.64	
Handwashing practice after defecation										
With soap	75	25.68	217	74.32	0	35	31.53	76	68.47	0
Without soap	126	43.15	166	43.34		44	55.7	35	44.3	
Handwashing practice before eating										
Yes	50	15.92	264	84.08	0	32	32.65	66	67.35	0
No	116	51.56	109	48.44		38	52.78	34	47.22	
Washing of toilet										
Daily	28	14.14	170	85.86	0	11	47.83	12	52.17	0.08
Weekly	60	33.71	118	66.29		14	26.92	38	73.08	
Monthly	57	44.88	70	55.12		24	51.06	23	48.94	
Yearly	56	69.14	25	30.86		30	44.12	38	55.88	
Sharing toilet										
Yes	119	46.3	138	53.7	0	48	48.98	50	51.02	0.03
No	82	25.08	245	74.92		31	33.33	62	66.67	

4. DISCUSSION

On the basis of the infection rate, the overall prevalence of diarrhoea was recorded at 36.18%. Similar findings were found in Senegal (36.3%), Ethiopia (37.5% and 35.6%), Vietnam (33.33%), Rwanda (34.9%), India (35%), Iran (34%) and Nairobi (36%). Comparatively a higher rate was recorded from Bangladesh (66%, [30]), in India (93%, [31]) and in Nepal (50.7%, [29]). On the contrary, a lower rate was also found in Bangladesh (6.68%, [21]), Australia 6.5%, Canada 7.9%, and Ethiopia [32]. Due to the environmental pattern of different geographical regions, the prevalence rate might be different. During this study, the peak prevalence was found in the month of June'18 (12.02%). This finding is in line with other studies that reported a high prevalence of diarrhoea in this season [22]. The study showed that the occurrence of diarrhoea was higher (41.58%) in urban slums (slums of Chittagong city) compared to a 34.42% prevalence rate in rural areas (villages of Sitakunda and Mirsharai). Similarly, some works had the same scenario in Bangladesh [33], India [22], and Ethiopia [34].

Though gender, was not statistically significant only in rural areas, the prevalence of diarrhoea was higher in males (36.58% in rural areas and 58.33% in urban slums) than females (32.59% in rural areas and 28.30% in urban slums) in both regions. Most of the studies showed that the percentage of diarrhoea in males was higher than in females [12, 14, 35]. On the contrary, some authors also recorded the highest prevalence among females [5,24]. In rural areas the scenario of diarrhoeal prevalence among the different age groups was as follows: 77.78% (5 <) > 67.91% (40 >) > 23% (5-18) > 14.15% (19-40) which was statistically significant. On the other hand, in urban slums this rate was: 52.5% (5-18) > 45% (5 <) > 38.46% (40 >) > 37.18% (19-40) but it was not statistically significant. In different countries including Bangladesh, many studies have shown that children are most vulnerable to diarrhoea and the high-risk group was also found in age 5 < years [7, 5, 21, 24, 29, 32] and age above twenty years [21]. On the other hand, some found the lowest rate of diarrhoea in adults (≥ 65) years of age [8].

People suffering from other diseases (42.55%, 120 infected out of 282 observed in rural areas and 54.65%, 47/86 in urban slums) were more at risk of diarrhoeal occurrence than people without having other diseases (26.82% in rural areas and 30.77% in urban slums). This variable was statistically significant in both regions. Many authors reported an influence of the presence of other diseases on diarrhoeal occurrence all over the world [36, 30]. In terms of education, the scenario was 52.78% ((illiterate) > 26.54% (primary) > 20.17% (above primary) in rural areas and in

urban slums, this scenario was 52.38% ((illiterate) > 46.67% (primary) > 29.41% (above primary). Educational status was statistically significant in both regions. Similar findings were found in Bangladesh [37, 16], Somalia [38], India [31], Nepal [29], Vietnam [39], Tanzania [40], Nigeria [4], Kenya [19], Africa [41], Cambodia [42], Ethiopia [32].

In rural areas, the status of diarrhoeal prevalence and income was 58.62% (5000 < BDT) > 26.29% (5000-20,000 BDT) > 22.22% (20,000 BDT>) and it had a highly statistical significance in rural areas and urban slums with a scenario of 60.87% (5000 < BDT) > 23.47% (5000-20,000 BDT) in slums. Similar results were found in Bangladesh [37, 16], Vietnam [39], Nigeria [4], Thailand [43], Nepal [29], and Rwanda [25] where the incidence of diarrhoea was reported to be higher among those who belonged to the family with a lower monthly income. Unemployed people (35.16%) were more vulnerable than employed people (26.32%) in rural areas and it had a statistical significance. Whereas, in urban slums, the occurrence of diarrhoea was higher among employed people (45.56%) than unemployed people (36.25%) and there was no statistical significance. In many countries like Bangladesh [37, 21], Vietnam [39], Nepal [29], and Cambodia [44] an influence of occupation on diarrhoeal occurrence were reported.

The occurrence of diarrhoea was higher among the people taking food from home and outside (39.62% in rural areas and 43.36% in urban slums) than people taking food from home (30.25% in rural areas and 38.96% in urban slums). The nature of food consumption was statistically significant only in rural areas. There was no available information about the influence of feeding habits on diarrhoeal occurrence. People washing hands without soap after defecation (43.15% in rural areas and 55.70% in slums) were found to be suffered more from diarrhoea than the people washing hands with soap (25.68% in rural areas and 31.53% in slums) in both regions of study and this practice was statistically significant in rural and urban areas. Similar findings were found in Bangladesh [30], Nigeria [14], Kenya [45], and Nepal [29] which recorded a strong influence of handwashing practice after defecation on the occurrence of diarrhoea.

The prevalence of diarrhoea among the people who did not wash their hands before eating (51.56% in rural areas and 52.78% in urban slums) was comparatively higher than those who washed hands before eating (15.92% in rural areas and 32.65% in urban slums). Similar findings were found in Bangladesh [16], Kenya [45], Tanzania [40], Vietnam [39], India [29]. The scenario of diarrhoeal prevalence at different level of washing of toilet was as follows: 69.14% (yearly) > 44.88% (monthly) > 33.71% (weekly) > 14.14% (daily) in rural areas and the scenario for urban slums was: 51.06% (monthly) > 47.83% (daily) > 44.12% (yearly) > 26.92% (weekly). There was no available information about the influence of washing toilets on diarrhoeal occurrence. The prevalence rate of diarrhoea was higher among the people using the shared toilet (46.30% in rural areas and 48.98% in urban slums) than the people who did not use the shared toilet (25.08% in rural areas and 33.33% in urban slums). Similar findings were found in Rwanda [25] and Sudan [46].

5. CONCLUSIONS

In a nutshell, diarrhoea is a common disease. From this study, it was clear that inhabitants of slums were more at risk of diarrhoeal occurrence. A variety of sociodemographic and behavioral factors (i.e., gender, age, presence of other diseases, education, income, occupation, the habit of food consumption, handwashing practice after defecation, handwashing practice before eating, washing of toilet, and sharing toilet) were behind this scenario. Among these factors, education, and use of a shared toilet, gender, presence of other diseases (except diarrhoea), income, handwashing practice before eating and after defecation had a profound influence on diarrhoeal occurrence. Enhanced education, improved economic status, and good hygiene practice are protective in this population and based on findings from the current study it is recommended that the public health programmes must target to slums of Chittagong districts where the higher prevalence of diarrhoea is persisting, and needful preventive measures should be taken to combat the incident and intensity of diarrhoea.

6. REFERENCES

[1] Wald, A. (2019). Factitious diarrhea: clinical manifestations, diagnosis, and management.
[2] WHO. (2013). Reproductive and women's health. The World Health Organization. Retrieved from

www.afrowho.int.
[3] Global Burden of Disease Study. (2016). Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet, 388(10053), 1545-1602.
[4] Odo, C., Onalu, C., Nwatu, U., Nwafor, N., Ebimgbo, S. (2021). Factors associated with the prevalence of diarrhoea among children in rural areas of Enugu State, Nigeria: Practice considerations for social workers. Sage Journals. https://doi.org/10.1177/00208728211034229
[5] Thiam, S., Diène, A. N., Fuhrimann, S., Winkler, M. S., Sy, I., Ndione, J. A., Cissé, G. (2017). Prevalence of diarrhoea and risk factors among children under five years old in Mbour, Senegal: a cross-sectional study. Infectious diseases of poverty, 6(04), 43-54.
[6] WHO. (2017). Diarrhoeal disease. The World Health Organization. Retrieved from: https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease.
[7] IHME. (2014). Institute for Health Metrics and Evaluation. Global burden of disease compare, estimates of under-five deaths. Retrieved from http://vizhub. healthdata.org/gbd-compare.
[8] Chowdhury, F., Khan, I. A., Patel, S., Siddiq, A. U., Saha, N. C., Khan, A. I., Ali, M. (2015). Diarrheal illness and healthcare seeking behavior among a population at high risk for diarrhea in Dhaka, Bangladesh. PLoS One, 10(6), e0130105.
[9] ICDDR. (2019). International Centre for Diarrhoeal Disease Research. Cholera and other diarrhoeal diseases. Retrieved from https://www.icddrb.org/
[10] Sarker, A. R., Sultana, M., Mahumud, R. A., Sheikh, N., Van Der Meer, R., Morton, A. (2016). Prevalence and health care–seeking behavior for childhood diarrheal disease in Bangladesh. Global pediatric health, 3, 2333794X16680901.
[11] Farthing, M., Salam, M. A., Lindberg, G., Dite, P., Khalif, I., Salazar-Lindo, E., LeMair, A. (2013). Acute diarrhea in adults and children: a global perspective. Journal of clinical gastroenterology, 47(1), 12-20.
[12] Farthing, M., Salam, M. A., Lindberg, G., Dite, P., Khalif, I., Salazar-Lindo, E., LeMair, A. (2013). Acute diarrhea in adults and children: a global perspective. Journal of clinical gastroenterology, 47(1), 12-20.
[13] Ugboko, H. U., Nwinyi, O. C., Oranusi, S. U., Fagbeminiyi, F. F. (2021). Risk Factors of Diarrhoea among Children Under Five Years in Southwest Nigeria. International Journal of Microbiology https://doi.org/10.1155/2021/8868543
[14] Nasser, S. (2014). Socio-demographic, socio-economic and household environmental characteristics associated with diarrheal disease among children under five years of age in Ethiopia. Stockholm University.
[15] Ghosh, K., Chakraborty, A. S., Mog, M. (2021). Prevalence of diarrhoea among under five children in India and its contextual determinants: A geo-spatial analysis. Clinical Epidemiology and Global Health, 12, 100813.
[16] Khan, W. A., Griffiths, J. K., Bennish, M. L. (2013). Gastrointestinal and extra-intestinal manifestations of childhood shigellosis in a region where all four species of Shigella are endemic. PloS one, 8(5), e64097.
[17] Sedhain, P. (2014). Water, sanitation, socioeconomic status and prevalence of waterborne diseases: A cross-sectional study at Makwanpur District, Nepal (Master's thesis, UiT Norges arktiske universitet).
[18] Habib, M. I., Kazi, S. G., Khan, K. M. A., Zia, N. (2014). Rota virus diarrhea in hospitalized children. Journal of the college of physicians and surgeons Pakistan, 24(2), 114.
[19] Jyothi, P., Prasanthi, K., Kamala, P. (2016). Prevalence of Rotavirus Diarrhoea in Children below 5 Years, a Pilot Study. International Journal of Current Microbiology and Applied Sciences, 5, 71-74.
[20] OConnell, B. J., Quinn, M. A., Scheuerman, P. (2017). Risk factors of diarrheal disease among children in the East African countries of Burundi, Rwanda and Tanzania. Global J Med Public Health, 6(1), 8.
[21] Peter, A. K., Umar, U. (2018). Combating diarrhoea in Nigeria: the way forward. J Microbiol Exp, 6(4), 191-197.
[22] Ganguly, E., Sharma, P. K., Bunker, C. H. (2015). Prevalence and risk factors of diarrhea morbidity among under-five children in India: A systematic review and meta-analysis. Indian journal of child health, 2(4), 152.
[23] Khan, M. S. I., Al Banna, M. H., Akter, S., Chakma, M., Begum, M. R., Hassan, M. N. (2018). Diarrheal prevalence and risk factors among under five years children in remote coastal area of Bangladesh. Asian-Australasian Journal of Food Safety and Security, 2(2), 93-99.
[24] McPike, J., Luke, N. (2012). Rethinking the urban advantage: differences in child diarrhea across rural, urban nonslum and urban slum locations in India. In Population Association of America 2012 Annual Meeting.
[25] Sinharoy, S. S., Schmidt, W. P., Cox, K., Clemence, Z., Mfura, L., Wendt, R., Clasen, T. (2016). Child diarrhoea and nutritional status in rural Rwanda: a cross-sectional study to explore contributing environmental and demographic factors. Tropical medicine & international health, 21(8), 956-964.

[26] Manna, B., Nasrin, D., Kanungo, S., Roy, S., Ramamurthy, T., Kotloff, K. L., Sur, D. (2013). Determinants of health care seeking for diarrheal illness in young children in urban slums of Kolkata, India. The American journal of tropical medicine and hygiene, 89, 56.
[27] Adane, M., Mengistie, B., Kloos, H., Medhin, G., Mulat, W. (2017). Sanitation facilities, hygienic conditions, and prevalence of acute diarrhea among under-five children in slums of Addis Ababa, Ethiopia: Baseline survey of a longitudinal study. PloS one, 12(8), e0182783.
[28] Basa, S. (2015). Prevalence of Diarrhoea among Under-Five children and Health Seeking Behavior of their Mothers in an Urban Slum of Delhi. Asian Journal of Biomedical and Pharmaceutical Sciences, 5(45), 08.
[29] Setia, M. S., & Panda, S. (2017). Summary and synthesis: How to present a research proposal. Indian Journal of Dermatology, 62(5), 443.
[30] Halim, F. B., Haider, M. Z. (2017). Prevalence and economic costs of diarrheal illness among adult slum dwellers in Khulna City, Bangladesh. J. Health Social Sci., 2(1), 83-98.
[31] Mashoto, K. O., Malebo, H. M., Msisiri, E., Peter, E. (2014). Prevalence, one week incidence and knowledge on causes of diarrhea: household survey of under-fives and adults in Mkuranga district, Tanzania. BMC public health, 14(1), 1-8.
[32] Kakulu, R. K. (2012). Diarrhoea among under-five children and household water treatment and safe storage factors in Mkuranga district, Tanzania (Doctoral dissertation, Muhimbili University of Health and Allied Sciences).
[33] Kasye, D. G., Garoma, N. H., Kassa, M. A. (2018). Assessment of the prevalence of diarrheal disease under-five children Serbo Town, Jimma Zone South West Ethiopia. Clin Mother Child Health, 15(281), 2.
[34] Getachew, A., Guadu, T., Tadie, A., Gizaw, Z., Gebrehiwot, M., Cherkos, D. H., Gebrecherkos, T. (2018). Diarrhea prevalence and sociodemographic factors among under-five children in rural areas of North Gondar Zone, Northwest Ethiopia. International journal of pediatrics, 2018. https://doi.org/10.1155/2018/6031594
[35] Budhathoki, S. S., Bhattachan, M., Yadav, A. K., Upadhyaya, P., Pokharel, P. K. (2016). Eco-social and behavioural determinants of diarrhoea in under-five children of Nepal: a framework analysis of the existing literature. Tropical medicine and health, 44(1), 1-7.
[36] Bossi, P., Antonuzzo, A., Cherny, N., Rosengarten, O., Pernot, S., Trippa, F., Schuler, U., Snegovoy, A., Jordan, K., Ripamonti, C. (2018). Diarrhoea in adult cancer patients: esmo clinical practice guidelines. Annals of Oncology, 29(4), 1260142.
[37] Colombara, D. V., Cowgill, K. D., Faruque, A. S. (2013). Risk factors for severe cholera among children under five in rural and urban Bangladesh, 2000–2008: a hospital-based surveillance study. PLoS One, 8(1), e54395.
[38] Upadhyay, R. P., Chinnakali, P., Bhilwar, M., Krishnan, B., Kulkarni, V., Gupta, A., Rizwan, S. A. (2015). Prevalence of malnutrition, acute respiratory infections and diarrhoea in children aged 1-5 years in urban slums of Puducherry, South India. Int J Contemp Pediatr, 2(1), 37-41.
[39] Hilson, H. (2018). Diarrhoea and diabetes. Practical Diabetes, 35(6), 195-196.
[40] Mannan, S. R., Rahman, M. A. (2010). Exploring the link between food-hygiene practices and diarrhoea among the children of garments worker mothers in dhaka. Anwer Khan Modern Medical College Journal, 1(2), 4-11.
[41] Arvelo, W., Kim, A., Creek, T., Legwaila, K., Puhr, N., Johnston, S., Bowen, A. (2010). Case–control study to determine risk factors for diarrhea among children during a large outbreak in a country with a high prevalence of HIV infection. International Journal of Infectious Diseases, 14(11), e1002-e1007.
[42] Meles, K., Bekele, D. (2017). A Ten Years Retrospective and Cross Sectional Study of Entamoeba histolytica in Atsbi Wonberta Woreda at Mulu Assefa Hospital, Eastern Tigray Ethiopia. Pelagia Research Library, 8(4), 30-39.
[43] Chompook, P., Todd, J., Wheeler, J. G., von Seidlein, L., Clemens, J., Chaicumpa, W. (2006). Risk factors for shigellosis in Thailand. International Journal of Infectious Diseases, 10(6), 425-433.
[44] Merali, H. S., Morgan, M. S., Boonshuyar, C. (2018). Diarrheal knowledge and preventative behaviors among the caregivers of children under 5 years of age on the Tonle Sap Lake, Cambodia. Research and reports in tropical medicine, 9, 35.
[45] Kavili, D. M. (2014). Prevalence of Entamoeba histolytica Infections among the Children Attending Primary Schools in Kyuso Zone, Kyuso District, Kitui County, Kenya (Doctoral dissertation, Kenyatta University).
[46] Karambu, S., Matiru, V., Kiptoo, M., Oundo, J. (2014). Characterization and factors associated with diarrhoeal diseases caused by enteric bacterial pathogens among children aged five years and below attending Igembe District Hospital, Kenya. Pan African Medical Journal, 16(1).

BIOGRAPHY

	Sadia Farhana is currently working as a Doctoral Research Assistant at the School of Medical Sciences, Universiti Sains Malaysia. She completed her B.Sc. and M.Sc. in Zoology (Parasitology) from the Department of Zoology, University of Chittagong, Bangladesh. She worked as a Lecturer at the Department of Biology in Feni Girls' Cadet College, Bangladesh.
	Asif Raihan is currently working as a Post-Doctoral Researcher at the Institute of Climate Change, Universiti Kebangsaan Malaysia. He completed his Ph.D. in "Forests and Climate Change" from the Institute of Climate Change, Universiti Kebangsaan Malaysia.