

Risk factors of diarrhea in children under 5 years in Al-Mukalla, Yemen

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ABSTRACT

الأهداف: تحديد العوامل المساعدة للإصابة بالإسهال في الأطفال الذين تقل أعمارهم عن 5 سنوات في المكلا، اليمن ومقارنة ذلك بدراسات مماثلة.

الطريقة: دراسة مقارنة للحالات المصابة بالإسهال وأخرى غير مصابة (100 حالة مصابة بالإسهال و 100 حالة مصابة بمرض آخر غير الإسهال) للأطفال الذين يحضرون مستشفى الولادة والأطفال والعيادات الخارجية، فضلاً عن مراكز الرعاية الصحية الأولية في مدينة المكلا، حضرموت، اليمن خلال شهر فبراير و إبريل 2013 م.

النتائج: وجدنا من بين العوامل التي قمنا بدراستها ثلاثة عوامل مهمة مصاحبة للإصابة بالإسهال وهي ازدحام المنزل $p=0.02$ وتطعيم الطفل حسب عمره $p=0.027$ وتكرار الإصابة بالإسهال في الثلاثة الأشهر الماضية $p=0.001$.

الخلاصة: الإسهالات مصاحبة بشكل ملحوظ مع التطعيم غير التام وتكرار الإصابة بالإسهال وازدحام المنزل.

Objectives: To assess the risk factors associated with diarrhea among children below 5-years-old in Mukalla, Yemen, and compare with other studies.

Methods: We conducted a case-control study on 200 children (100 cases and 100 controls) who attended the Maternity and Child Hospital, outpatient-clinics, and the Primary Health Care Centers in Al-Mukalla, Hadhramout, Yemen between February and April 2013.

Results: We found that the significant risk factors associated with diarrhea were crowded housing (odds ratio [OR] 2.02; $p=0.02$; confidence interval [CI] 1.03-4.01), incomplete vaccination of the child (OR=2.02; $p=0.027$; CI: 1.08-3.8), and recurrent diarrheal illness during the last 3 months (OR=6.61; $p=0.001$; CI: 3.41-12.90).

Conclusion: Diarrheal diseases are strongly associated with incomplete vaccination, recurrent diarrheal disease, and crowded housing.

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Globally, more than 10 million children die each year, of which approximately 1.5 million die from diarrhea.¹⁻³ In 2003, 390,520 cases of diarrhea were reported to the Central Statistics Office (CSO) of Yemen, with 7395 of these cases from the Hadhramaut governorate.⁴ No exact figures on mortality are available in Yemen. In Yemen little is known on the morbidity, etiology, and risk factors of diarrhea. Risk factors for childhood diarrhea in industrialized countries are not well characterized, although diarrhea remains an important cause of morbidity and mortality.⁵⁻¹⁰ Socioeconomic factors such as overcrowding, poor sanitation, low maternal education, low body weight, and failure to breast feed exclusively for the first 6 months of life were associated with a higher incidence of diarrheal diseases in early infancy as shown in several previous studies.¹¹⁻¹⁵ Yemen is an economically poor country in comparison with nearby states, with overcrowding and inadequate infrastructures. The health system suffers because of shortages of resources and proper planning, which are adversely reflected on the health of children. The Maternity and Child Hospital (MCH) in Mukalla city serves 3 Governorates (Hadhramaut, Al-Mahra, and Shabwa) with a total of approximately 1000 children attending the MCH

hospital per month. In addition, many health centers in Mukalla city serve a large number of children in the city (both sick and healthy children). The aim of this study is to identify the risk factors associated with acute diarrhea among children below 5-years-old, and to discuss potential control measures of diarrheal diseases in light of these factors.

Methods. A case-control study was conducted in the Maternity and Child Hospital (MCH), and Health center clinics in Mukalla city (approximately 750 km southeast of Sanaa), Hadhramaut Governorate, Yemen, between February and April, 2013.

Sample size and collection. The sample comprised 200 children of both genders under the age of 5. Of these children, 100 had diarrhea (cases, 52 males, and 48 females) and 100 did not have diarrhea (controls, 48 males and 52 females), but had other health issues. The sample size was calculated using the Epi Info program, version 7.1.0.6 (CDC, Atlanta, GA, USA). In line with previous studies^{3,5,14,15} we used: Two-sided confidence level = 95%, power = 80%, ratio of controls to cases = 1; percent of controls exposed = 15%; odds ratio = 3. Accordingly, the sample size was calculated as 170 (85 cases and 85 control). Adding 20% for potential dropouts, we recruited 200 (100 cases and 100 controls) patients to avoid the effects of defaulters confounding the results.

Inclusion criteria. Children aged less than 5 years with acute diarrhea attending the MCH and outpatient clinics in Mukalla city and health centers. Acute diarrhea was defined by the passing of 3 or more loose or watery stools, or at least one bloody loose stool within the last 24 hours prior to presentation. Controls were children who did not fulfill this case definition during the last 3 months preceding entry to the study, but presented with other complaints. One control was selected for each case recruited at the MCH and health centers in Mukalla. The defined age groups were <1 year, 1-3 years, and 4-5 years. The data was obtained by interviewing the mothers of children (cases and controls) who responded to questionnaires containing the following variables; age, gender, residency, mother's education, crowded houses (5 members & more), animal contact, contact of patient with diarrhea, family income according to CSO Yemen publication,⁴ traveling, child feeding

(breast feeding, bottle feeding, mixed feeding), family diet, birth-weight (which plotted on a growth chart of both genders from birth to 5-years according to the WHO Growth Chart 2006,¹⁸ exposure to diseases, health issues such as measles, recurrent respiratory tract infection (RTI), allergies, history of recurrent diarrhea in the past 3 months, and the vaccination status, which was described as complete or incomplete according to the Yemen Immunization Schedule adopted by the Ministry of Health. The response rate was 100%.

Exclusion criteria. Children taking antibiotics in the previous 2 weeks, children with diarrhea lasting 2 weeks or more, and children with non-consenting caregivers were excluded from the study.

Ethical consent. The research protocol and the questionnaires were conducted according to principles of the Declaration of Helsinki, as well as reviewed and approved by the College Ethical Research Committee. Verbal consents were also taken from the parents and caregivers of children involved in the study.

Statistical methods. The data were processed and analyzed using the Statistical Package for Social Sciences version 16 (SPSS Inc., Chicago, IL, USA. Multivariate logistic regression test was used to analyze risk factors. A p-value <0.05 was considered significant, and the confidence interval was set at 95%.

Results. Table 1 summarizes the socio-demographic features of studied children in both groups. Most affected children are in the age group below one year, and although statistically insignificant, this group constitutes 75% (OR=1; $p=0.23$, CI: 0.63-7.32). More males are affected than females (52% versus 48%) (OR=1.22; CI: 0.68-2.21). Children from urban areas constitute 61% of cases, while rural areas constituted 39% (OR=1.37; $p=0.145$; CI: 0.73-2.99). The overcrowded homes were more prevalent in the diarrheal group OR=2.02; $p=0.020$; CI: 1.03-4.01). The mother's education had an insignificant relation with diarrheal disease as a risk factor, where 44% of mothers of children with diarrhea were illiterate (OR=3.80; $p=0.145$; CI: 0.44-21.84). Table 2 illustrates the relationship of diarrheal disease to type of feeding and body weight in both groups of children. The type of feed had an insignificant relation to diarrheal disease (OR=1.68; $p=0.205$; CI: 0.75-3.79). The average body weight of children who have diarrhea was less than the average body weight of children who have no diarrhea, although statistically insignificant (OR=2.06; $p=0.096$; CI: 0.42-4.65). Table 3 shows the associated clinical conditions and health issues with diarrheal disease, where recurrent diarrhea has a significant relation as a risk factor for future diarrhea

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(OR= 6.61; $p=0.001$; CI: 3.41-12.9). Forty-four percent of the diarrheal group was incompletely vaccinated, which is statistically significant (OR=2.02; $p=0.027$; CI: 1.08-3.80).

Discussion. Diarrhea remains one of the most common illnesses of children, and one of the major causes of morbidity and mortality in developing countries.^{1,2,7,15,16} In this study, we tested 14 possible risk factors for diarrhea among children below 5 years old. The first risk factor detected in this study is recurrent diarrhea, which is associated with malnutrition, failure to thrive, and adversely affects immunity so the child will be more susceptible to diarrhea ($p=0.001$; OR=6.61; 95% CI: 3.41-12.90), which is similar to other

studies.¹³⁻¹⁷ The other risk factor is living in crowded houses, which increases susceptibility to diarrheal diseases (OR=0.02; 95% CI 1.03-4.01), which is similar to other studies.^{6,8,11,14} Children who were incompletely vaccinated or not vaccinated at all were at risk for diarrheal diseases ($p=0.027$; OR=2.02; CI: 1.08-3.80), again in agreement with other studies.^{5,11-13,15} As lack of vaccination made children more susceptible to different diseases such as measles, whooping cough, and TB, so this will affect their health adversely, making them vulnerable to different diseases including diarrhea. In previous studies,^{5,11,12,15-17} it was found that diarrhea was more prevalent among children below one year, due to cessation of breast feeding and/or introduction of bottle feeding in the early months of life, while in our

Table 1 - Socio-demographic features of children in both groups (cases and controls) in Al-Mukalla city, Yemen between February and April 2013.

Variable	Cases n=100	Controls n=100	P-value	OR	95% CI for OR
<i>Gender</i>					
Males	52	48	0.335	1	Reference group
Females	48	52	0.335	1.22	0.68-2.21
<i>Age groups (years)</i>					
<1	75	69	0.230	1	Reference group
1-3	17	16	0.50	2.13	0.63-7.32
4-5	8	15	0.091	2.52	0.72-8.23
<i>Residency</i>					
Urban	61	58	0.083	1	Reference group
Rural	39	42	0.386	1.37	0.73-2.99
<i>Mother education</i>					
University	2	5	0.145	1	Reference group
Secondary school	14	24	0.052	1.45	0.20-12.65
Primary school	40	31	0.118	3.22	0.50-25.97
Illiterate	44	40	0.333	3.80	0.44-21.84
Crowded house	35	21	0.020	2.02	1.03-4.01
Drink safe water	36	39	0.385	0.88	0.48-1.62
Animal contact	46	36	0.098	1.51	0.83-2.78
Contact with patient with diarrhea	34	30	0.325	1.20	0.64-2.28
Low family income	80	71	0.552	0.61	0.30-1.23
Travelling from area to another	21	16	0.233	1.39	0.64-3.34

OR - odds ratio, CI - confidence intervals, Reference group - group that has odds ratio =1

Table 2 - Relationship of diarrheal disease to type of feeding and body weight in both groups of children in Al-Mukalla city, Yemen between February and April 2013.

Child feeding	Case	Control	P-value	OR	95% CI for OR
Breast feeding only (<2 years old)	17	24	0.205	1	Reference group
Artificial feeding	23	20		1.66	0.62-4.50
Breast and artificial feeding	50	39		1.68	0.75-3.79
Family diet	10	17		1.08	0.37-3.12
<i>Birth weight</i>					
Average	74	86	0.096	1	Reference group
Low	22	13		2.06	0.42-4.65
Overweight	3	1		3.49	0.31-88.91

OR - odds ratio, CI - confidence intervals, Reference group - group that has odds ratio =1

Table 3 - Associated clinical conditions and health issues with diarrheal disease in both groups of children in Al-Mukalla city, Yemen between February and April 2013.

Exposure to diseases & health issues	Case	Control	P-value	OR	95% CI for OR
Measles	6	4	0.001	1	Reference group
Allergy	17	13		1.37	0.59-3.22
RTI	47	58		0.64	0.35-1.17
Recurrent diarrhea	72	28		6.61	3.41-12.9
<i>Vaccination status</i>					
Complete	56	72	0.027	1	Reference group
Incomplete	44	28		2.02	1.08-3.80

RTI - respiratory tract infection, OR - odds ratio, CI - confidence intervals, Reference group - group that has odds ratio =1

study it is apparently more prevalent, but statistically insignificant ($p=0.230$). Cases and controls probably have the same pattern of feeding, although breast-feeding exclusively protects against diarrhea and other diseases. Most children in this study (cases and controls) were on mixed feeding (breast and artificial feeding), but this factor appears to be insignificant in both groups in association with diarrheal disease ($p=0.203$; OR=1.68; 95% CI: 0.75-3.78). Although the introduction of bottle-feeding is a risk factor for diarrhea, as shown in different previous studies,^{1,4,5,12,16,17} this may be due to different cultures and life styles of population. The males were more affected than females, although it is statistically not significant ($p=0.180$; OR=1.22; CI: 0.68-2.21) as it was seen in other studies^{4,13,14,17} and probably due to different sampling technique and size.

Illiterate mothers was found in 44% of cases, which is an insignificant risk factor for diarrhea ($p=0.145$; OR=1; CI: 0.44-2.84), as the mothers of cases and control both have low education levels according to CSO Yemen. This is in contrast with other studies carried out, where lack of education is an important risk factor for acquisition of diarrhea.^{7,11,13,15,16} Children with low birth weight are more susceptible to diarrhea as shown previously in many studies,^{5,13,14} but in our study there was no significant association with diarrhea ($p=0.096$; OR=2.06; CI: 0.42-4.65). This may be due to the high incidence of low birth weight and poor nutrition in our community where the sample drawn.⁴ Children who have a safe water supply are relatively protected against diarrhea, but we found no significant association with diarrheal disease (OR=0.88; 95% CI: 0.48-1.62), which is in contrast to other studies^{1,2,5,11,13} since both cases and controls have the same source of water supply where the sample was taken. Regarding the clinical conditions associated with diarrheal disease, it was found that measles is not significantly associated with diarrhea in comparison of the 2 groups (OR=1.53; 95% CI: 0.37-6.7), which is in contrast to other studies^{13,15} where measles was a significant factor in association

with diarrheal disease. This may be due to the state of under immunization of both groups in the study. Different types of allergy were found in both groups, which has no significant association with diarrheal disease (OR=1.37; 95% CI: 0.59-3.22), while in other studies^{10,11,14} allergy was significantly associated with diarrheal disease. People in Mukalla city used to rear different animals (like sheep, goats, cows, and so forth) at home or nearby, and children have daily contact with these animals. However, in this study we found animal contact had no significant association with diarrheal disease ($p=0.098$; OR=1.51; 95% CI: 0.83-2.78), as also seen in other studies.¹³⁻¹⁵ Diarrhea in children may be contracted from other patients with diarrhea, in our study we did not find a significant relation of this factor to occurrence of diarrhea, it probably depends upon degree and duration of this contact ($p=0.325$; OR=1.20; CI: 0.64-2.28). Similar findings in other studies were noted.^{5,13,16,17} According to CSO Yemen, the average monthly income of most families ranges from 62,000-100,000 Yemini Rial, which is low in comparison with the cost of living since Yemen is considered poor country in comparison to nearby Gulf states. As both groups (cases and controls) come from low-income families, no significant association was found regarding this risk factor ($p=0.552$; OR=0.61; CI: 0.30-1.23). People from Mukalla city travel from the coastal area to the central areas during holidays and other occasions, and we tested this factor regarding its effect on occurrence of diarrhea and found no significance ($p=0.233$; OR=1.39; CI: 0.64-3.34). This in accordance with other studies,^{10,11,13} as both cases and control share the same level of activity regarding this variable.

Study limitations. First, the selection of controls with illnesses other than acute diarrhea from the hospital clinics and health care centers may mean that the results may not be applicable to the general population. Second, our results may underestimate the protective effect of breastfeeding and safe water supply in the general population, since both practices can reduce the

risk of many infectious diseases. We would expect that the breastfeeding practices of our cases and controls are more similar to each other and not optimal. Third, the small sample size, and the possibility of recall bias are further limitations.

Considering the usually scanty resources available in the developing countries, a reduction in diarrhea-related mortality maybe possible by identifying high-risk subjects and targeting them for intensive intervention. Ensuring optimal levels of vaccination according to the WHO schedule will decrease the risk of developing diarrhea. An improvement of infrastructures and the health care system in Yemen will relieve the overcrowding level, and thus will indirectly reduce morbidity and mortality.

In conclusion, diarrheal diseases are strongly associated with incomplete vaccination, recurrent diarrheal disease, and crowded housing, and modification of these factors will lead to a reduction of the incidence of diarrheal disease in children below 5 years of age. Most of the mother's education levels in cases and control were primary school and illiterate. A high percentage of children (in cases and controls) had upper respiratory tract infections. The distribution of children in urban and rural areas was approximated in cases and controls; the drinking of safe water also was approximated in cases and controls. After having a proper center for controlling infectious diseases, this study may be applied to other high burden infectious diseases.

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