Risk of Bidirectional Diarrhea-Malnutrition among Under-Five-Year-Old Children Admitted in Referral Hospitals in Western Kenya

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Abstract

BACKGROUND

Diarrhea leads to malnutrition while malnutrition aggravates the course of diarrhoea. In addition, it has been observed that children with moderate-severe diarrhoea cases are more likely to be malnourished compared to those with mild cases, and the bidirectional relationship of the conditions occurs in situations where either malnutrition or diarrhoea has become chronic. However, there is scanty information on the risks of bidirectional diarrhoea-malnutrition among under-fives from high-burden areas in the informal settlements of Western Kenya.

MATERIALS AND METHODS

A cross-sectional design using a quantitative approach to collect primary and secondary data was applied to determine the occurrence of malnutrition, diarrhoea, and bidirectional diarrhoea malnutrition and further investigated the risk of bidirectional diarrhoea malnutrition among 105 under-fives admitted in two referral hospitals of Western Kenya between August 2020 to April 2021. The under-five children who met the inclusion criteria comprised those experiencing either acute or chronic malnutrition, as well as severe diarrhoea with dehydration or those at risk of dehydration due to malnutrition and diarrhoea, respectively. Primary and secondary data were collected using a semi-structured questionnaire and a data abstraction tool respectively.

RESULTS

Out of 105 patients aged 0-59 months admitted to the hospital, 52 had malnutrition, and 53 had diarrhoea. The high occurrence of malnutrition and diarrhoea ranged between 71.7% and 78.85% in the age groups of 6-23 months whereas other age groups had 13.46-18.87% < 6 and 7.69- 9.43% in 24-59 months. Of the 33 cases with bidirectional diarrhoea-malnutrition, n=28 (84.85%) cases were observed in the age group of 6-23 months, and the majority, 21 (63.64 %) had diarrhoea and then developed malnutrition. The findings showed that the risk for bidirectional diarrhoea-malnutrition among under-fives was untrimmed fingernails AOR= 2.73, 95% CI=0. 1.04-7.17, P-value=0.041 and having more than 3 under-fives in a household (AOR=3.44, 95% CI= 1.15-24.65, P-value=0.032)

CONCLUSION

The study findings show a high occurrence of malnutrition, diarrhoea, and bidirectional diarrhoea malnutrition among children aged 6-23 months. Untrimmed fingernails and the number of under-fives in a household were associated with bidirectional diarrhoea-malnutrition. The study suggests that the occurrence of bidirectional diarrhoea-malnutrition can be reduced with the best household health practices.

Keywords: *Under-fives, Bidirectional, Malnutrition, Diarrhea, Risks*

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Introduction

Malnutrition and diarrhoea account for significant mortality and morbidity rates among under-fives, worldwide, with a higher burden in low-income countries (1) Globally, under-five malnutrition remains high with stunting and wasting registered at 150 and 50 million cases per year, respectively (2). The sub-Saharan region has posted a rise in malnutrition among under-fives from 50.3 million to 58.8 million cases in a year and with this kind of disease burden, it may be difficult for the region to achieve WHO targets of a 40% reduction in childhood stunting, a less than 5% prevalence of wasting by the year 2025 (2).In Kenya, Nairobi County in particular, a study reported that 26.3%, 6.3%, and 13.16% of stunted, wasted, and underweight respectively (3) In Kisumu County, 18%, 0.8%, and 7% of under-fives are stunted, wasted, and underweight respectively (4).In addition, a study has reported malnutrition as the leading cause of mortality in the informal settlement of Kisumu County in Kenya (5). The high cases of malnutrition in the informal settlements are attributed to feeding on food sold by the roadside food kiosks such as *chapatis*, *bhajia*, and french fries (6).

Malnutrition and diarrhoea among under-fives are associated with poor sanitation, unsafe drinking water, poor hand hygiene, and improper infant and young child feeding practices among caretakers (1). Moreover, studies have shown that the two conditions have a bidirectional relationship (1) Essentially, diarrheal disease significantly affects the nutritional status of under-fives by interfering with the intestinal absorption of nutrients, and, conversely, under-nutrition might be a predisposing factor to the onset of diarrheal diseases by inducing an alteration of the host's immunity (7). Pre-existing malnutrition is associated with decreased turnover of epithelial cells resulting in delayed recovery which may prolong an episode of infectious diarrhoea by itself (8). In 2010, UNICEF reported that 51% of Mozambican under-fives with stunting had diarrhoea in a maximum period of two weeks before the data collection (9). According to Ferdous *et al* (2013) (10), under-fives with moderate-severe disease(MSD) were more likely to be malnourished compared to those with mild disease (MD) in proportions of 35% versus 24% respectively. Diarrhoea can exacerbate weight loss in malnourished children, poor nutrition can worsen the severity and duration of diarrhoea, and even after recovering from illness, malnourished children may not experience significant catch-up growth (7, 11).

There are several studies on risk factors for malnutrition and diarrhoea among children under five, however, there is scanty literature on bidirectional diarrhoea malnutrition and associated risk factors among under-fives living in informal settlements. Of note is that a bidirectional relationship occurs in situations where either malnutrition or diarrhoea has become chronic (1), implying that it is a complication. Determining risks associated with bidirectional diarrhoea malnutrition could provide information to inform policy formulation and public health interventions necessary for improving the outcome of malnutrition and diarrhoea among children under five years. Also, the study findings will provide valuable information and contribute to the body of knowledge regarding bidirectional diarrhoea malnutrition among under-fives. The study, therefore, determined the occurrence of bidirectional diarrhoea malnutrition among under-fives living in the informal settlements of Kisumu County.

Materials and methods

Study area

The study was conducted in Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) and Kisumu County Referral Hospital (KCRH) within Kisumu County, Western Kenya. The two hospitals admit children aged 0 weeks to

14 years with acute, chronic malnutrition and severe diarrhoea with signs of dehydration, more than 62% of Kisumu County is under informal settlements (12). Moreover, 82% of households in Kisumu are not connected to the sewerage system and rely on pit latrines and /or septic systems for faecal waste disposal (13). The prevalence of diarrhoea among under-fives is 15.5% (14) as 18%, 0.8% and 7% of the children are stunted, wasted and underweight respectively(15).

Study design

This was a cross-sectional study design applying a quantitative approach of data collection to determine risks for bidirectional diarrhoea-malnutrition among under-fives of informal settlements. The study relied on both primary and secondary data sources. Children with HAZ, WAZ, and WHZ below −2 SD of the median of the reference population were considered stunted, underweight, and wasted, respectively (WHO, 2024). Children with upper arm circumference (MUAC) measurements of < 11.5 and 11.5-12.5 cm were considered to have severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) (16). Acute diarrhoea is characterized by the passage of 3 or more loose stools in a day, which lasts up to two weeks or less (17).

Study population

The target population were children under five years admitted at JOOTRH and KCRH with malnutrition and diarrhoea from the informal settlements. Under-fives included in the study were those who met the criteria for admission of having acute or chronic malnutrition, and severe diarrhoea with signs or risk for dehydration respectively.

Eligibility criteria

All caregivers of children aged 0-59 months living in informal settlements of Kisumu County who were admitted to JOOTRH and KCRH with malnutrition and diarrhoea during the study period were deemed eligible to participate in the study, unless they declined. Additionally, caregivers of children aged 0-59 months who were mentally ill or under the age of 18 were also excluded.

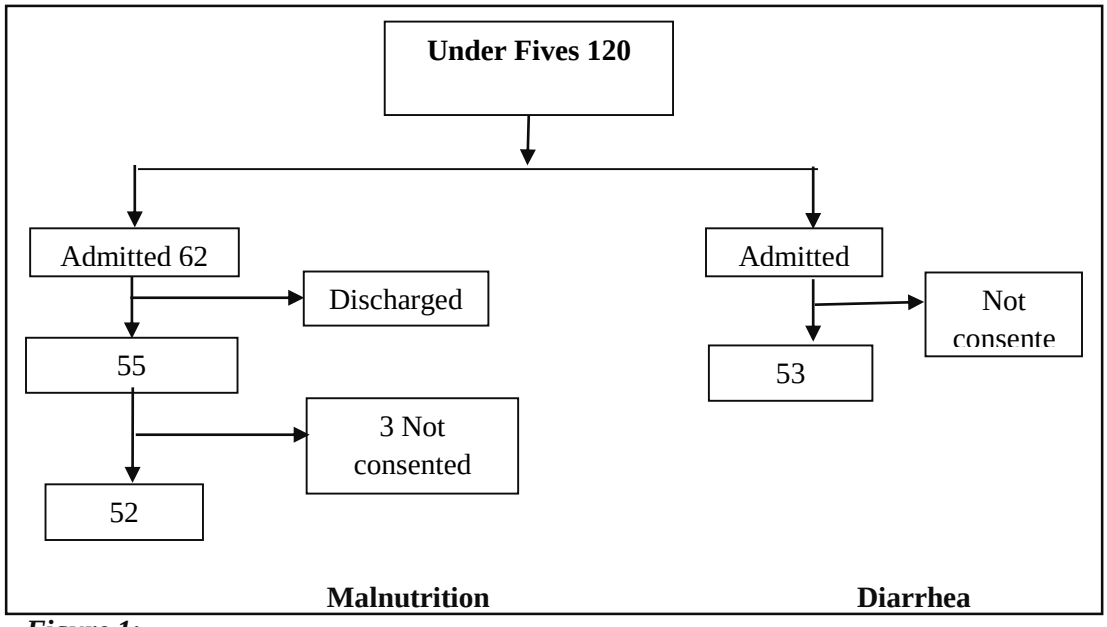

Figure 1:
Sample size determination flowchart

The hospital admission registers had a total of 120 under-fives living in informal settlements admitted with malnutrition and diarrhoea during the study period. Of those admitted with malnutrition in both hospitals 62 out of whom 7 got discharged while 3 did not consent to be part of the respondents. The seven were discharged on different days of the study period before the research assistants collected data from them. Therefore, the number of under-fives with malnutrition involved in the study was 52. On the other hand, 58 under-fives living in informal settlements were admitted with diarrhoea during the period of study. However, 5 caregivers did not consent to be part of the study while 53 participated (Figure 1)

Sampling technique

Caregivers of under-fives who participated in the study were sampled through census and purposive approaches. The census method was preferred because the target population was small, based on previous hospitals' records and the criteria for admissions that under five had to meet such as having acute or chronic malnutrition and severe diarrhoea with signs or risk for dehydration respectively and living in an informal settlement. Furthermore, data was collected during the period of restrictions due to the COVID-19 pandemic leading to fewer caregivers seeking healthcare services for the sick under-fives.

Data collection instruments and procedures

A semi-structured questionnaire was used to collect both quantitative and qualitative data from caregivers of under-fives admitted with malnutrition and diarrhoea, in a face-to-face interview that lasted at least 40 minutes. The questionnaire was adapted from previous similar studies conducted by Wasihun and others (1), regarding risk factors for diarrhoea and malnutrition among children under the age of 5 years in the Tigray Region of Northern Ethiopia and that of Ferdous *et al* 2013 (10) which aimed to determine the association between the severity of diarrheal illnesses and malnutrition among under 5-year-old children in Bangladesh, and customized accordingly. The prevalence of diarrhoea was assessed using a two-week recall approach, where caregivers were asked to report if children under the age of five had experienced diarrhoea episodes before the onset of malnutrition. Likewise, a 24-hour dietary recall method was employed to examine food consumption within the preceding (18). This dietary recall method was utilized to evaluate the food intake of children under the age of five.

Data analysis and management

Data management began with cleaning the raw data by scrutinising for completeness, inconsistencies incorrectness (19). In this study, all 105 questionnaires had complete data and these were entered into a password-protected Microsoft Access, and exported to Social Sciences Statistical Package (SPSS version 28). Descriptive and inferential data analysis tests were performed for all the quantitative variables. Chi-square, bivariate and multivariate logistic regression statistical analysis tests were used to assess for associations at a 95% confidence interval.

Ethical considerations

Before beginning data collection, permission to conduct research was sought from Jaramogi Oginga Odinga University of Science and Technology and the Department of Health, Kisumu County. Ethical approval was granted by the Institutional Ethics Review Committee (IERC) of JOOTRH and National Commission for Science, Technology & Innovation (NACOSTI) permit numbers IERC/JOOTRH/203/20 and License No: NACOSTI/P/20/5101respectively. No contact with study participants occurred before the approval was granted (20) and a detailed explanation of the study, was provided by research assistants in seeking the consent of

caregivers, to participate in the study. The study respondents were informed that their involvement was voluntary and that they could drop off at any moment of the study (21). The study refrained from gathering information directly from children or caregivers under the age of eighteen due to their vulnerable status. Interviewing this demographic would constitute a breach of ethical codes. During data analysis, all results were included, and there was no fabrication or falsification of information which could lead to misinterpretation by readers hence misleading them. Throughout this study, privacy and confidentiality were emphasized and maintained (22) by collecting data in a private setting, and restricting access to data to the principal researcher and the research assistants only by storing it in a password-protected file. Anonymity was ensured by not collecting identifying information such as names from participants, instead, assigning unique codes to study respondents. At the end of the study, all data was kept in password-protected software to avoid unauthorized access which could have resulted in a breach of participants' privacy.

Results

Socio-demographic characteristics

The average age of malnourished under-fives was 12.52±10.35 months and 55.77% (n=29) were male. For diarrhoea cases, the average age of the under-fives was 12.34± 8.40 months with 67.92% (n=27) being male. The occurrence of bidirectional diarrhoea-malnutrition was 25.0% among those < 6 months, 44.44% among 24-59 months old and 32.5% among female under-fives. For caregivers, 52.38% attained a primary level of education and 72. 38% were married. On monthly income, 60% of caregivers earn Kenya shillings < 10,000 per month while 40% earn >10,000 (Table 1).

Table 1:
Socio-Demographic Characteristics

Characteristics	Malnutrition, N=52	Diarrhea, N=53	Bio-directional malnutrition – diarrhoea, N=105	
	n(%)	n(%)	No n(%)	Yes n(%)
Age in months,				
< 6	7(13.46)	10(18.87)	45(75.00)	15(25.00)
6-23	41(78.85)	38(71.70)	22(61.11)	14(38.89)
24 -59	4(7.69)	5(9.43)	5(55.56)	4(44.44)
Gender of the child				
Male	29(55.77)	36(67.92)	27(67.50)	13(32.50)
Female	23(44.23)	17(32.08)	45(69.23)	20(30.77)
Caregiver's level of education				
None	2(3.85)	0(0.00)	0(0)	2(6.06)
Primary	34(65.38)	20(37.74)	36(50.00)	19(57.58)
Secondary	10(19.23)	22(41.51)	23(31.94)	9(27.27)
College/University	6(11.54)	11(20.75)	13(18.06)	3(9.09)
Marital Status of the caregiver				
Single	9(17.31)	13(24.53)	16(22.22)	6(18.18)
Married	38(73.08)	38(71.70)	52(72.22)	24(72.73)
Separated	2(3.85)	1(1.89)	2(2.78)	1(3.03)
Widowed	3(5.77)	1(1.89)	2(2.78)	2(6.06)
Monthly income of the Caregiver				
<10000	29(55.77)	34(64.15)	42(58.33)	21(63.64)
>=10000	23(44.23)	19(35.85)	30(41.67)	12(36.36)

Figure 2, shows that the occurrence of malnutrition and diarrhoea among under-fives aged 6-23 was 78.85% and 71.7% respectively. For those aged <6 months and 24- 59 months the occurrence was 13.46%, 18.87% and 7.69%, 9.43% respectively.

Occurrence of bidirectional diarrhea-malnutrition among under-fives

In Table 2, the occurrence of bidirectional diarrhoea-malnutrition among under-fives admitted to JOOTRH and KCRH was found to be 31.43% (95%CI=0.23-0.41) of the 105 under-fives in the study, 12(11.43%) had malnutrition followed by diarrhoea and 21 (20.00%) had diarrhoea then followed by malnutrition.

Risk factors for bidirectional diarrhoea -malnutrition

In Table 3, a bi-variate analysis for binary logistic regression was done to determine risk factors for bidirectional diarrhoea-malnutrition among under five admitted with malnutrition and diarrhoea at 95% confidence interval. The number of under-fives living in the same household and fingernail hygiene were found to be statistically significant factors. Having three or more children below 5 years in a household was found to be 3.4 times more likely to suffer from bidirectional diarrhoea and malnutrition as compared to one child under-fives in the household (AOR=3.44, 95%CI= 1.15-24.65, P-value=0.032).

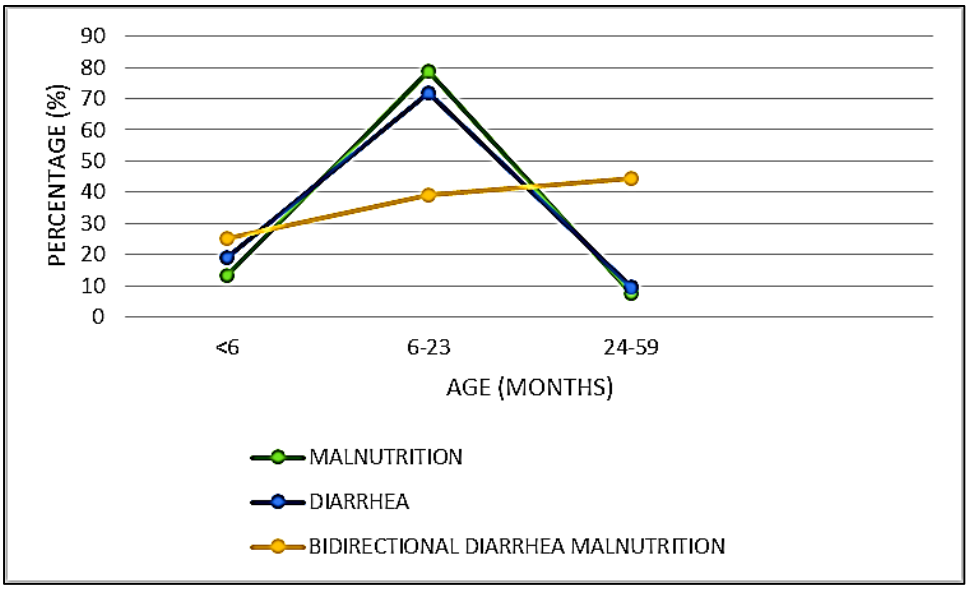

Figure 2:
Occurrence of Malnutrition and Diarrhoea among Under-Fives by Age

Table 2:
Occurrence of Bidirectional Diarrhea-Malnutrition

	Frequency (n)	Percentage (%)	95%CI
Overall bi-directional	33	31.43	0.23-0.41
Malnutrition followed by Diarrhea	12	11.43	0.07-0.19
Diarrhea followed by Malnutrition	21	20.00	0.13-0.29

With regards to under-five fingernails, 40.98% of those with untrimmed fingernails had bidirectional diarrhoea and malnutrition and 18.18% of under-fives with trimmed fingernails suffered bidirectional diarrhoea and malnutrition. Under-fives with untrimmed fingernails were found to be 3 times more likely to have bidirectional diarrhoea and malnutrition (AOR= 2.73, 95%CI=0. 1.04-7.17, P-value=0.041).

Discussion

The current study found that a section of under-fives admitted had bidirectional diarrhoea malnutrition. The finding is congruent with that of (9) which states that under-fives with severe acute malnutrition are more likely to present to hospitals with childhood diarrhoea. Furthermore, diarrhoea cases were also associated with stunting.

Table 1:
Bivariate Logistic Regression Analysis For Factors Associated With Bidirectional Diarrhea-Malnutrition Among Under-Fives

	Bi-directional diarrhoea – malnutrition		Bi variate analysis			Multivariate analysis		
	No, N=72	Yes,N=33						
	n(%)	n(%)	COR	95%CI	P-value	AOR	95%CI	P-value
Number of under 5 years								
1	43(59.72)	14(42.42)	Ref			Ref		
2	25(34.72)	13(39.39)	1.60	1.13 -1.45	0.309	1.66	0.67-4.15	0.275
3 and above	4(5.56)	6(18.18)	4.61	1.13 -18.71	0.033	3.44	1.15-24.65	0.032
Mother HIV status								
Positive	27(75.00)	(25.00)	Ref					
Negative	43(65.15)	23(34.85)	1.60	0.65-3.98	0.308			
Don't know	2(66.67)	1(33.33)	1.50	0.12- 18.57	0.752			
Diet child								
Exclusive breastfeeding	16(76.19)	5(23.81)	Ref					
Complementary feeding	15(75.00	5(25.00)	1.07	0.26-4.44	0.929			
Family diet	40(63.49)	23(36.51)	1.84	0.56-5.68	0.289			
Start complement feeding								
Yes	53(67.95)	25(32.05)	Ref					
No	18(75.00)	6(25.00)	0.71	0.25-2.00	0.513			
Eat vegetables								
Yes	7(77.78)	2(22.22)	Ref					
Sometimes	35(63.64)	20(36.36)	2.00	0.39-10.57	0.414			
Never	29(72.50)	11(27.50)	1.33	0.24-7.39	0.746			
Child fingernails								
Trimmed	36(81.82)	8(18.18)	Ref			Ref		
Untrimmed	36(59.02)	25(40.98)	3.13	1.24-7.85	0.015	2.73	1.04-7.17	0.041
Breastfeeding								
No	27(61.36)	17(38.64)	1.77	0.76- 4.07	0.179			
Yes	45(73.77)	16(26.23)	0.56	0.25-1.30	0.179			
Age at which breastfeeding stopped								
Less than 6 months	13(61.90)	8(38.10)	1.23	0.35-4.36	0.748			
More than 6 months	14(66.67)	7(33.33)	Ref					

COR=Crude odds ratio, CI=confidence interval, Ref=Reference category,
Only Significant factors in bivariate analysis (number of under 5 in the household and trimming of fingers) were taken to multivariate analysis

In a separate study done in Mozambique to characterize undernourished under-fives with diarrhoea, more than half of the under-fives taking part in the study were undernourished (7). Also, in an analytical cross-sectional study done by The community-based Global Enteric Multi-center Study (GEMS), it was determined that under-fives with diarrhoea were associated with stunting (9).

In the current study, bidirectional diarrhoea occurrence was reported to increase with advancing age of the under-fives. The finding is congruent with that of (1) which states that the prevalence of moderate to severe dehydration was more severe in malnourished under-fives aged 24–59 months, than those who are younger implying that malnourished under-fives who are aged 24–59 months susceptible to severe diarrhoea disease compared to their counterpart who is well nourished. The increasing prevalence of bidirectional diarrhoea malnutrition with an increase in the age of under-fives could be associated with cessation of breastfeeding. Breast milk is a source of antibodies that protect against malnutrition and diarrhoea among under-fives. This finding is however contrary to other related studies of the effect of acute malnutrition on enteric pathogens, moderate-to-severe diarrhoea, and associated mortality in the Global Enteric Multi-center Study cohort: a posthoc analysis, which states that the occurrence of bidirectional diarrhoea-malnutrition was more common among under-fives aged between 0-23 than 24-59 months (23).

In the current study, we found that the number of under-fives in a household had a statistically significant influence on bidirectional diarrhoea and malnutrition. One Under five in a household was less likely to suffer from bidirectional diarrhoea and malnutrition as compared to at least 3 under 5years children in one household, The current study further revealed that under-fives with untrimmed fingernails suffered bidirectional diarrhoea malnutrition more as compared to those with trimmed fingernails. This finding is in line with that of (1) which states that the odds of suffering bidirectional diarrhoea malnutrition among under-fives with untrimmed fingernails is 1.576 suggesting that untrimmed fingernails are a risk factor for bidirectional diarrhoea and malnutrition.

In the present study, bivariate analysis for the association of human waste management systems on bidirectional diarrhoea and malnutrition revealed that the disposal of under-five faeces was a significant risk factor for bidirectional diarrhoea and malnutrition. The under-fives whose faeces were disposed of by caregivers in the open yard were more likely to have bidirectional diarrhoea and malnutrition as compared to those whose caregivers were using pit latrines. Moreover, under-fives whose caregivers were practicing hand washing were less likely to have bidirectional diarrhoea and malnutrition as compared to those whose caregivers were not practicing all the five critical hand washing moments. The association between bidirectional diarrhoea malnutrition among under-fives and water shortage, drinking untreated water and mothers' hand washing were found to be statistically significant. Under-fives of the caregivers who were experiencing water shortage were more likely to have bidirectional diarrhoea and malnutrition as compared to those who did not have water shortage with regards to drinking water, under-fives whose caregivers treated drinking water were less likely to have bidirectional diarrhoea and malnutrition than those who were drinking untreated water.

We further applied multivariate regression analysis to determine the association of bidirectional diarrhoea and malnutrition among under-fives and found out that the number of under 5 years old in a household, disposal of under-fives faeces, water shortage, treatment of drinking water and mothers hand washing at all five critical moments were found to be significant

risk factors for bidirectional diarrhoea and malnutrition among under-fives. The children of caregivers who were experiencing water shortage in their residence were found to be more likely to have bidirectional diarrhoea and malnutrition as compared to those whose caregivers did not experience water shortage. The finding is in line with other studies which concluded that under-fives whose mothers did not wash their hands at all the critical times had higher odds of developing diarrhoea compared to those whose caregivers washed at the critical times (1). The findings imply that having more than one under five in a household translates to reduced attention including feeding, and resources needed to access health care for every individual child making them susceptible to malnutrition that may lead to diarrhoea. Likewise, poor hygiene and sanitation predispose an under five to contamination leading to transmission of disease-causing agents from caregivers to the under-fives and diarrhea setting in. Since diarrhoea causes the loss of appetite the under-fives, caregiver withholding feeds during such episodes and wastage of nutrients with every bowel movement, the under-five develops malnutrition. Furthermore, drinking water that is not treated is likely to be contaminated with disease-causing pathogens which lead to diarrhea and subsequent malnutrition among under-fives.

The findings of the study show a high occurrence of malnutrition, diarrhoea, and bidirectional diarrhoea malnutrition among children aged 6-23 months. The number of under 5-year-olds in a household, disposal of under-fives faeces, water shortage, treatment of drinking water and mothers' hand washing at all five critical moments were found to be significant risk factors for bidirectional diarrhoea and malnutrition among under-fives. National and County governments to put in place strategies that focus on the prevention of bidirectional diarrhoea malnutrition among under-fives. A prospective study be conducted to further determine risks for bidirectional diarrhoea malnutrition among under-fives.

Conclusion

The findings of the study show a high occurrence of malnutrition, diarrhoea, and bidirectional diarrhoea malnutrition among children aged 6-23 months. Untrimmed fingernails and the number of under-fives in a household were associated with bidirectional diarrhoea and malnutrition. Our study shows that the occurrence of both diarrhoea and malnutrition can be drastically reduced with the best household health practices.

Recommendations

We recommend that a longitudinal study be done to identify risk factors for bidirectional diarrhoea malnutrition among under-fives with malnutrition and diarrhoea. Moreover, community health assistants and sub-county community health service coordinators should focus on health promotion and prevention of malnutrition, diarrhoea and bidirectional diarrhoea malnutrition among under-fives living in informal settlements.

References

1. **Wasihun AG, Dejene TA, Teferi M, Marugan J, Negash L, Yemane D, *et al.*** Risk factors for diarrhoea and malnutrition among children under the age of 5 years in the Tigray Region of Northern Ethiopia. *PloS one*. 2018;13(11):e0207743.
2. **Obasohan PE, Walters SJ, Jacques R, Khatab K.** Risk Factors Associated with Malnutrition among Children Under-Five Years in Sub-Saharan African Countries: A Scoping Review. *International journal of environmental research and public health*. 2020;17(23).
3. **De Vita MV, Scolfaro C, Santini B, Lezo A, Gobbi F, Buonfrate D, *et al.*** Malnutrition, morbidity and infection in the informal settlements of Nairobi, Kenya: an epidemiological study. *Italian journal of pediatrics*. 2019;45(1):12.
4. **KCHD**. Nutrition Action Plan 2021-2023. Agriculture, Education, ICT & HRD, Health,

News Item. Kisumu County: *Kisumu County Health Department*; 2022.
5. **Reynolds EC, Onyango D, Mwando R, Oele E, Misore T, Agaya J, *et al***. Mothers' Perspectives of Complementary Feeding Practices in an Urban Informal Settlement in Kisumu County, Western Kenya. *Current developments in nutrition*. 2021;5(5):nzab065.
6. **Nasongo S. A.A O-OJB**. Women Food Entrepreneurship(WFE) in Kenya and Burkina Faso Building Inclusive Business Models for Food Security in the City Slums of Kisumu and Ouagadougou food and nutrition baseline survey report. Kisumu.Kenya *The University of Amsterdam, the Netherlands; 2*017.
7. **Sambo J, Cassocera M, Chissaque A, Bauhofer AFL, Roucher C, Chilaule J, *et al*.** Characterizing Undernourished Children Under-Five Years Old with Diarrhoea in Mozambique: A Hospital Based Cross-Sectional Study, 2015-2019. *Nutrients*. 2022;14(6).
8. **Liu J, Bolick DT, Kolling GL, Fu Z, Guerrant RL.** Protein Malnutrition Impairs Intestinal Epithelial Cell Turnover, a Potential Mechanism of Increased Cryptosporidiosis in a Murine Model. *Infection and immunity*. 2016;84(12):3542-9.
9. **Walson JL, Berkley JA.** The impact of malnutrition on childhood infections. *Current opinion in infectious diseases*. 2018;31(3):231-6.
10. **Ferdous F, Das SK, Ahmed S, Farzana FD, Latham JR, Chisti MJ, *et al*.** Severity of diarrhea and malnutrition among under five-year-old children in rural Bangladesh. *The American journal of tropical medicine and hygiene*. 2013;89(2):223-8.
11. **Koshy B, Srinivasan M, Gopalakrishnan S, Mohan VR, Scharf R, Murray-Kolb L, *et al*.** Are early childhood stunting and catch-up growth associated with school age cognition?-Evidence from an Indian birth cohort. *PloS one*. 2022;17(3):e0264010.
12. **P. A.** Data Hub:Kisumu, Nairobi top in informal settlements. 2019.
13. **KIWASCO**. Annual report. 2017.
14. **Owiti BA, Asweto, C. O., Oyieke, J. A., Aluoch, J. R., & Obonyo, C. O.** Dehydration Knowledge and Dairrheal Perception are Predictors of Dairrheal Home Management: A Cross-Sectional Study of Caregivers in West Seme, Kisumu County. Kenya. *AJPH*. 2021;9(2):57-62.
15. **Department KCH**. Nutrition Action Plan 2021-2023. Agriculture, Education, ICT & HRD, Health, News Item. 2022.
16. **Rana R, Barthorp, H., Murphy, M. T., & Beri, A**. Implementing the family-MUAC approach for infants under 6 months in the context of COVID-19 in Ethiopia. *Field Exchange* 2021;64:64.
17. **WHO.** WHO report on Diarrhea accessed on 16 January 2024.
18. **Huang K, Zhao L, Guo Q, Yu D, Yang Y, Cao Q, *et al***. Comparison of the 24 h Dietary Recall of Two Consecutive Days, Two Non-Consecutive Days, Three Consecutive Days, and Three Non-Consecutive Days for Estimating Dietary Intake of Chinese Adult. Nutrients. 2022;14(9).
19. **L E.** The Five Stages Of The Data Analysis Process. 2020.
20. **Angell E, Dixon-Woods M.** Do research ethics committees identify process errors in applications for ethical approval? *Journal of medical ethic*s. 2009;35(2):130-2.
21. **Miller F, & Wertheimer, A.** The ethics of consent: theory and practice. *Oxford University Press*. 2010.
22. **Lowrance WW**. Privacy, confidentiality, and health research. Cambridge University Press. 2012;Vol. 20.
23. **S. R.** Prevalence of Diarrhea and Status of Water used by households of Bandani Informal Settlement in Kisumu County, Kenya. 2022.