Data Article

A retrospective study to examine nutrition based risk and protective factors in relation to diarrhoea incidence in children aged less than two years in Tanzania

Abstract

Background: Diarrhea disorders account for a significant portion of the morbidity and mortality burden among children in resource-constrained settings, and they are economically significant to both families and health systems. In real sense, any intervention that has shown the potential to reduce diarrhea-related mortality and morbidity is valuable in terms of the global child health agenda**. Objective:**To explore the role of nutrition based risk and protective factors on diarrhea morbidity among children aged less than two years in Tanzania, **Methods**: we analyzed household-based data on risks and preventive interventions including exclusive breastfeeding, complementary feeding, water, sanitation hygiene, and vitamin A supplementation. Data from the Tanzania Demographic Health Survey (TDHS) of 2015/2016 were used to describe odds of diarrhoea morbidity in children aged 0-5 months and 6-23 months. Multivariate logic regression models were developed to identify risk factors. **Results:** Children aged less than 5 months, who were exclusively breastfed experienced a reduction in the odds of having diarrhoea by 72% (*P*-value <0.001), compared to those who were not exclusively breastfed. Children aged between 6 months and less than 23 months, from families with detergent at hand washing facility, experienced a reduction in the odds of having diarrhoea by 37% (*P*-value <0.01), compared to their peers in the other group. Diarrhoea odds were predicted to be higher in higher wealth quintile as compared to lowest group by 1.39 (*P*-value =0.028), 1.53 *(P*-value <0.01), 1.74 (*P*-value <0.01) and 1.78 (*P*-value =0.01) for second, middle, fourth to highest groups respectively. **Conclusions:** The data has demonstrated the important role of exclusive breastfeeding and sanitation on diarrhoea occurrence amongst children aged less than 23 months in Tanzania. Yet there are areas for which it remains inconclusive and requires further work to improve insights and strength of available evidence so far.

Keywords: Exclusive Breastfeeding, Vitamin A supplementation, Water Health Sanitation

Introduction

Children in settings with limited resources experience a disproportionately high burden of morbidity and mortality due to diarrheal diseases.Although the number of deaths from this disorder have dropped globally by more than 55% since 2000 (Kirk MD, 2015) (Liu L, 2015), the effects it imposes on morbidity and mortality are still significant. (Troeger C, 2018) and economically of significant importance, both to families and the health systems (Ranju Baral, 2020). For that matter, any interventions that have shown the potential to reduce diarrhea-related mortality and morbidity are valuable as far as the global child health agenda is concerned. Global consensus for diarrhea management in children so far includes, among several, those in the preventative and nutritional-related category such as complementary feeding, exclusive breastfeeding, water, sanitation, and hygiene (WASH), and vitamin "A" supplementation. Yet, significant diarrhea morbidity is reported, particularly in resource-limited settings (Christopher Troeger, 2018) even in the midst of such a global consensus on effectiveness as well as availability, generally, of the said interventions (Robert Black, 2019). The need for sustained efforts, as such, towards mitigation of nutrition-related diarrhea morbidity, remains a matter of public health importance, and further inventions of evidence products on this agenda is one of the plausible ways for informing policy and actions on the ground, as far as nutrition and diarrhea in children are concerned.

Using household-based data, we described the role of selected nutrition as well as health system interventions on diarrhea morbidity among children aged less than, six months and 6-23 months in Tanzania.

Methods

Study area and data source: Data came from the Tanzania Demographic Health Survey of 2015/2016 (TDHS-2015/2016). The TDHS provided household-based data on nutrition risk and protective factors and morbidity outcomes, as well as on a variety of other social and economic variables (National Bureau of Statistics, 2016). All processes, survey design, and data collection approaches were governed by a set of norms and procedures, further detailed elsewhere (National Bureau of Statistics, 2016).We concentrated on the following nutritional risk (WASH) and protective (Vitamin A supplementation (VAS) and exclusive breast feeding (EBF) factorsto describe diarrhea morbidity profile in children aged less than two years, based on existing evidence, elsewhere in similar settings (Robert Black, 2019) (Das, Salam, & Bhutta, 2014). Table

1 shows a details of nutrition related risks and protective factors on diarrhea incidence in children less than two years (0-23 months).

Table 1: Summary of Dependent and independent variables

Variables Name	Description	Dependent	Independent
Diarrhea	Occurrence of diarrhea in the past two weeks	√	
Source of water (A)	**Category of water sources -** Bottled water, bowser, Rainwater harvesting, River, unprotected well, protected well, Tape water, and others among the sources mentioned.		√
Type of toilet(B)	**Type of toilet** used in the household mentioned (No toilet, Pit with no slab, pit with slab, water closet and others in including composting)		√
Hand washing Facility(C)	Place where household wash their hands (Just look if there was detergent)		√
Availability of detergent/soap(D)	Detergent/soap available or not available at the place of washing hands.		
Breastfeeding (E)	children aged 0-6 months are exclusively breastfed or not (*extracted from the information when was the first time to give your child something else than your breast milk*)		√
Vitamin A supplementation(F)	Received vitamin A most recently, 6 month ago or not received during that period for children six months old to five years.**(*Vitamin A is given twice a year in Tanzania, June and December each year*)**		√
Breastfeeding and other foods(G)	Other thing given other than breast milk/ ever breastfed or currently breastfeeding		√

Independent variables were chosen based on existing evidences of potential association with dependent variable

Figure 1 is a map of Tanzania, within Africa, showing the mainland and islands sides, to reflect the country's main two administrative areas. There are 26 and 5 regions in the mainland and islands sides of the analysis respectively.

Figure 1: Map of Tanzania, within Africa, showing the mainland and islands sides

Inclusion and exclusion criteria: Children under the age of two years were included and considered in two groups of (1) those aged less than two years who had data records for their mother and homesteads – the "under 23 months cohort" – and from within them (1) those aged less than 6 months and (2) “aged between 6 and 23 months” cohorts. The TDHS-MIS(2015-2016) data model uses unique identifiers to link data of children with that of their mothers and households along with other characteristics related to diarrhea and nutrition factors from children, women (mothers or caregivers), and households data files.

Statistical methods: Statistical analyses were performed using Stata 15.0 and the WASH, VAS, and BF were included as nutrition-related factors for diarrhea. They were analyzed for the two children cohorts for whom diarrhea morbidity was investigated as an outcome variable for the selected nutrition-related factors. Stepwise regression was used to perform step-by-step iterative construction of a regression model that involves the selection of independent variables by adding those with a *P*-value less than 0.25% to the final model.

Separate regression models were estimated for the “under 6 months”, “aged between 6 and 23 months” and “the under 23 months”, cohorts. . Tables were used to describe the findings, and Microsoft Word was used to write the narration.

Results and Discussion

The distribution of the demographic and socioeconomic characteristics of the study's participants is summarized in Table 2. There were 4,557 children, and 76.0 percent of them are from rural areas. The distribution of the children by age was somewhat symmetrical by six-month age bands and sex, with nearly one-third (28.0 percent) of the infants being under six months old. The majority of the women had completed their primary educations when the majority of the children (64.4%) were born at the health facility (46.0 percent).Households were somewhat evenly spread across the five wealth quintiles with more than half having Pit latrine without slab/others (57.86%) and slightly lower than two quarters (44.85) had Unprotected well/borehole/spring/others as their source of water. Overall diarrhea prevalence for children aged less than 23 months, 6 to 23 months, and below six months were 17.43%, 21.0%, and 7.9%, respectively.

Table 2: Distribution of the demographic and social-economic characteristics of the children in the study

Variables	Number	Percentage (%)
Age of child (Months)		
0-6 months	1,275	27.98
7 - 12 months	1,052	23.09
13 - 18 months	1,207	26.49
19-24 months	1,023	22.45
Type of residence		
Urban	1,091	23.94
Rural	3,466	76.06
Sex of the child		
Male	2,280	50.03
Female	2,277	49.97
Wealth Index		
Poorest	266	25.17
Poorer	217	20.53
Middle	189	17.88
Richer	223	21.10
Richest	162	15.33

Number of children in the household		
1 child	1,510	33.14
2 - 4 children	2,184	47.93
5 - 7 children	760	16.68
More than 7 children	103	2.26
Diarrhea prevalence		
under two all (n = 4,216)	735	17.43
6 months to less than two years (n = 3,183)	668	20.99
less or equal to six months (n =1,228)	97	7.9
Education of the mother		
No education/Primary incomplete	1454	33.07
Primary complete	2022	45.99
Secondary+	921	20.95
Place of Delivery		
Home	1566	35.62
Facility	2831	64.38
Toilet Type		
No facility	601	13.67
Flash toilet	555	12.62
Pit latrine with slab	697	15.85
Pit latrine without slab/others	2544	57.86
Source of Water		
Piped	1623	36.91
Protected well/borehole/spring	802	18.24
Unprotected well/borehole/spring/others	1972	44.85
Weight at birth	195	4.43
Under weight (< 2.5kg)	4,202	95.57
Acceptable weight (>= 2.5kg)		

Results on diarrhea occurrence among children aged < 2 years are shown on Table 3. Most independent variables were not included in a final model because their level of significance were relatively high as estimated during the stepwise regression process. Children aged less than 6 months, who were exclusively breastfed experienced a reduction in the odds of having diarrhea by 72.0% (*P*-value <0.001), compared to those who were not exclusively breastfed. Children aged

between 6 months and two years and less than 2 years, from families with detergent at hand washing facility experienced a reduction in the odds of having diarrhea by 37.0% (*P*-value <0.01), compared to their peers in the other group. Diarrhoea odds were predicted to grow with higher up wealth quintile as compared to poorest group by 1.39 (*P*- value =0.028), 1.53 (*P*- value <0.01), 1.74 (*P*-value <0.01) and 1.78 (*P*- value =0.01) for poorer, middle, richer to richest groups respectively.

Table 3: Results on Diarrhea occurrence among children aged less than 2 years

	< 6 Months			6 -23 Months			0-23 Months		
Variables	Odd Ratio	*P* value	95% Conf. Interval	Odd Ratio	*P* value	95% Conf. Interval	Odd Ratio	*P* value	95% Conf. Interval
Exclusive breast feeding	0.278	**0.000**	0.161 - 0.481	x	x	x	x	x	x
Vitamin A supplementation	x	x	x	x	x	x	x	x	x
Education of the mother									
Primary completed	1.408	0.218	0.816 - 2.430	x	x	x	x	x	x
Secondary +	1.748	0.151	0.816 - 3.745	x	x	x	x	x	x
Detergent at hand washing facility									
missing values	0.827	0.491	0.482 - 1.419	0.734	0.011	0.579 - 0.931	0.748	**0.010**	0.599 - 0.933
In place	0.508	0.085	0.235 - 1.098	0.626	0.003	0.459 - 0.854	0.647	**0.003**	0.484 - 0.865
Water Source									
Protected well, borehole	1.883	0.062	0.968 - 3.660	x	x	x	1.062	0.674	0.801 - 1.409
Unprotected well, spring, other	1.238	0.476	0.690 - 2.2236	x	x	x	1.218	0.104	0.969 - 1.545
Type of place of residence									
Rural	0.719	0.244	0.413 - 1.252	x	x	x	x	x	x
Wealth Index									
Poorer	x	x	x	1.303	0.092	0.958 - 1.774	1.392	**0.028**	1.037 - 1.869
Middle	x	x	x	1.352	0.072	0.974 - 1.879	1.533	**0.008**	1.119 - 2.100
Richer	x	x	x	1.553	0.010	1.113 - 2.166	1.745	**0.002**	1.219 - 2.498
Richest	x	x	x	1.618	0.006	1.145 - 2.287	1.787	**0.015**	1.118 - 2.855
Toilet Type									
Flash Toilet	x	x	x	x	x	x	1.015	0.954	0.612 - 1.683
Pit latrine with slab	x	x	x	x	x	x	0.767	0.265	0.481 - 1.222
Pit latrine without slab	x	x	x	x	x	x	0.822	0.188	0.613 - 1.101

X no data, where omitted on multivariate analysis in the final modal

The public health potential of Water Sanitation and Health (WASH) and other nutrition-related factors for diarrhea in children has been re-confirmed (Akina, Jeanne, Dikshya, Sara, & Regula, 2020) (C.Dey, MahmoodParvez, & Raiha, 2019)(Ayub B T, Leonie D N & Nchang A N, 2015). Our data have demonstrated a reduced risk of diarrhea amongst children aged less than 6 months, with exclusive breastfeeding and elsewhere, not exclusive breastfeeding was associated with excess risk of diarrhea mortality in infants 0-5 months and children aged 6-23 months (RR: 2.18) (Laura M Lamberti, 2011) (Bethel Getachew, 2018) . The importance of breastfeeding to protect against diarrhea-specific morbidity in young children is once again re-emphasized in the Tanzania context.

Having detergents as hand washing material at washing places has been highlighted as an important factor, although an enormous number of missing data on this variable (20.1%) was one of the limitations.

It is in conformity with reasonable expectations as well as from previous works elsewhere, in comparable settings, that wealthier households could be protective for diarrhea in children <5 years (Umuhoza Claudine, 2021) (Diana Mutuku Mulatyaa, 2020) (Enakshi Ganguly, 2015) (ITrungVu Nguyen, 2006). However, findings from this study has shown a reverse relationship with higher odds among highest relative to lowest wealth quintile. This is speculated can be due to some of high wealth quintile households can hire maid to look after their child whom can be ignorant to observe sanitation while handling food or utensils or may prioritize their economic pursuits more, leaving their young children in the care of older siblings who are unable to provide the same level of care that they can.Additional efforts, observational as well as analytical processes, are suggested in order to generate further insights on this relationship. Looking further on this relationship of household wealth and diarrhea along with a relatively much wider range of nutritional related factors for diarrhea in children than it was in this data set, might be of additional value.

Conclusion: The data has demonstrated the role of various factors of diarrhea occurrence in Tanzanian children. While acknowledging that some of the findings herein do emphasize for due practical actions on the ground, yet there are areas for which matters remain inconclusive and require equally national-wide or at least sentinel site level of profound work to mitigate the

limitations and improve the value of evidence. National panel surveys, even though are organized for much wider agendas, can be of use to generate insights on specific issues on child health.

Conflict of interest statement: All authors declare no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; any other relationships or activities that could appear to have influenced the submitted work section. Furthermore, the authors declare no non-financial competing interests in political, personal, religious, ideological, academic, and intellectual spheres.

References

1. Abera Aregawi Berhe, A. D. (2020). Knowledge, Attitude, and Practices on Water, Sanitation, and Hygiene among Rural Residents in Tigray Region, Northern Ethiopia. *Journal of environment and public health*.
2. Akina, S., Jeanne, S., Dikshya, D., Sara, M., & Regula, M. (2020). Association of nutrition, water, sanitation and hygiene practices with children's nutritional status, intestinal parasitic infections and diarrhoea in rural Nepal: a cross-sectional study. *BMC Public Health* (n.d.)
3. Ayub B T, Leonie D N & Nchang A N (2015). Childhood Diarrhea Determinants in Sub-Saharan Africa: A Cross Sectional Study of Tiko-Cameroon. (n.d.).
4. Bethel Getachew, B. M. (2018). Factors Associated with Acute Diarrhea among Children Aged 0-59 Months in Harar. *East African Journal of Health and Biomedical Sciences*.
5. C.Dey, N., MahmoodParvez, & Raiha, M. (2019). Effectiveness of a community-based water, sanitation, and hygiene (WASH) intervention in reduction of diarrhoea among under-five children: Evidence from a repeated cross-sectional study (2007–2015) in rural Bangladesh;*International Journal of Hygiene and environmental health*, 1098-1108.
6. ChristopherTroeger. (2018). Estimates of the global, regional, and national morbidity, mortality, and etiologies of diarrhoea in 195 countries: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet; Infectious diseases*, 1211-1228.
7. Das, J. K., Salam, R. A., & Bhutta, Z. A. (2014). Global burden of childhood diarrhea and interventions. *Current opinion in infectious diseases*.
8. Diana Mutuku Mulatyaa, C. O. (2020). Disease burden and risk factors of diarrhoea in children under five. *International Journal of Infectious diseases*.

9. Effectiveness of a community-based water, sanitation, and hygiene (WASH) intervention in reduction of diarrhoea among under-five children: Evidence from a repeated cross-sectional study (2007–2015) in rural Bangladesh. (n.d.).
10. Enakshi Ganguly, P. K. (2015). Prevalence and risk factors of diarrhea morbidity among under-five children in India: A systematic review and meta-analysis. *Indian J Child Health (Bhopal). 2015 Oct-Dec; 2(4)*, 152–160.
11. Gebremedhin, S. (2017). Vitamin A supplementation and childhood morbidity from diarrhea, fever, respiratory problems and anemia in sub-Saharan Africa. *Nutrition and Dietary Supplements*.
12. ITrungVu Nguyen, P. V. (2006). Etiology and epidemiology of diarrhea in children in Hanoi, Vietnam. *International Journal of Infectious Diseases*, 298-308.
13. Kelly K. Baker, F. D. (2014). Association between Moderate-to-Severe Diarrhea in Young Children in the Global Enteric Multicenter Study (GEMS) and Types of Hand washing Materials Used by Caretakers in Mirzapur, Bangladesh. *American Journal of Tropical Medicine and Hygiene*.
14. Kirk MD, P. S. (2015). World Health Organization estimates of the global and regional disease burden of 22 foodborne bacterial, protozoal, and viral diseases, 2010: a data synthesis. *PLOS MEDICINE*.
15. Ko, S. H., & Sakai, H. (2021). Water sanitation, hygiene and the prevalence of diarrhea in the rural areas of the delta region of Myanmar. *Journal of water and health*.
16. Laura M Lamberti, C. L. (2011). Breastfeeding and the risk for diarrhea morbidity and mortality. *BMC Public Health*.
17. Liu L, O. S. (2015). Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis2015. *Lancet*.
18. National Bureau of Statistics. (2016). *Tanzania Demographic Health Survey and Malaria Indicator Survey*.
19. R. P. Shier, N. D. (1996). Drinking water sources, mortality and diarrhea morbidity among young children in Northern Ghana. *Tropical Medicine & international Health*.
20. Ranju Baral, J. N. (2020). Cost of illness for childhood diarrhea in low- and middle-income countries: a systematic review of evidence and modelled estimates. *BMC Public Health*.

21. RB Rayamajhi, S. B. (2014). A study on sanitary and hygiene practices in Chungwang VDC of Dhankuta District, Eastern Nepal. *Journal of Chitwan Medical Collage*.
22. Robert Black, O. F. (2019). Drivers of the reduction in childhood diarrhea mortality 1980-2015 and interventions to eliminate preventable diarrhea deaths by 2030. *Journal of Global Health*.
23. Sibiya, J. E. (2013). Knowledge, Attitude and Practices (KAP) Survey on Water, Sanitation and Hygiene in Selected Schools in Vhembe District, Limpopo, South Africa. *Int Journal of Envirom. res and Public health.*
24. Tambe, A. B., Nzefa, L. D., & Nicoline, N. A. (2015). Childhood Diarrhea Determinants in Sub-Saharan Africa: A Cross Sectional Study of Tiko-Cameroon. *MPDI.*
25. Troeger C, B. B. (2018). Estimates of the global, regional, and national morbidity, mortality, and etiologies of diarrhoea in 195 countries: a systematic analysis for the global burden of disease study 2016. *Lancet*.
26. Umuhoza Claudine, J. Y.-M.-S. (2021). Association between Sociodemographic Factors and Diarrhea in Children Under 5 Years in Rwanda. *Korean J Parasitol*, 61–65. .
27. Wiwi Rumaolat, M. L. (2019). Factors Associated With Mother In Doing Diarrhea Prevention Efforts In Toddler Village Iha: Work Area Community Health Center Amahai. *International journal of scientific & technology research*.