

# Determinates of diarrhea among under-five children in Northwest Ethiopia

**Habtamu Dessie Mitiku**

Department of Statistics, Faculty of Natural and Computational Science, Woldia University, Woldia, Ethiopia,

Email:- habtamudessie54@gmail.com

## Abstract

*This study aimed to assess the determinants of diarrhea among children under-five in Jabitehnan district, Northwest Ethiopia. A community based cross-sectional study was done using a cluster sampling technique. The study was done in Jabitehnan district from April to July 2019. The study was done among women who had children under five during the survey who settled in Jabitehnan district. The main outcome measure was the occurrence of diarrhea. A binary logistic regression was used to identify factors associated with diarrhea. The prevalence of diarrhea was found to be 19.8%. Child lived with whose non-biological mother were 32.44 times more likely to be exposed to diarrhea compared to the child who lived with whose biological mother. The odds of being diarrheal for a child whose mother does not wash her hand after latrine was 7.91 times higher than its counterpart. A child whose mother pregnant was 5.66 times higher risk of developing diarrhea than whose mother do not pregnant. The likelihood of diarrhea for children drinking unprotected water were 14.1 times higher than its counterpart. Magnitude of reported diarrhea was high. Child age, residence, drinking water, pregnant mother, toilet facility, washing hand after latrine, and child live with whom were the main determinates of diarrhea. Addressing these factors will help to prevent future morbidity and mortality of child and will assist in alleviating hygiene and refining their quality of life. Moreover, trend based sampling design might be considered for a better understanding.*

**Keyword:** Diarrhea, under-five children, Jabitehnan district, Ethiopia

## Introduction

Diarrhea is a public health problems of observing the passage of three or more loose or liquid stools within a day or more frequent passage than is normal for the individual[1-4]. Now a day's diarrheal diseases are the second major cause of death among children under-five globally[5, 6] and it responsible for kills about 2.5 million people in a year, of these around 60–70% are children of age under five. Moreover, world health organization (WHO) estimated 1.5m children were died from diarrheal disease each year, almost half of them were in Africa. The most vulnerable children are the youngest ones, particularly before their second birthday[7, 8] as cited in[5]. Even though there is a global decline in the death rates of under-five children, WHO report shows that the risk of a child for dying before the age of 5 years remains the highest in

African (90 per 1000 live births), which is nearly 7 times higher than in European (12 per 1000 live births) [9]. Among the death proportion of children under five years around 82% deaths was observed in Africa and south Asia [10]. From all deaths worldwide, about half of them due to pneumonia and diarrhea occur in just five most poor countries: namely India, Nigeria, the Democratic Republic of Congo, Pakistan, and Ethiopia [4]. This implies the event of diarrhea is high in developing countries.

Sub Saharan African countries experiences more suffered in diarrhea, even though there is an improvement of prevention and treatment, it continues to cause for substantial morbidity and mortality in developing countries [6, 11-13] still now.

In Ethiopia particularly, diarrheal diseases alone accounted 23% caused for child mortality, which is greater than the annual deaths due to malaria, HIV/AIDS and measles all together [5, 14]. Hence, to overcoming this problem the government of Ethiopia in collaboration with NGO and private organization, tried to performing several interventions [15-17]. Even if these intervention program was started the event still continues for causes of death for child in Ethiopia particularly severe in the study area Jabitehnan district.

Even though, more research is need to refine the quality of life, almost all previous studies suggests that improving the communities standard of living, advances in sanitation [18], water treatment, improved hygiene and food safety awareness and education helps to reducing the event of diarrhea occurrences [19-23]. On the other hand, all these studies did not consider the climate [24-27] and place specific variations. This may up or down the actual estimation of diarrhea prevalence. As a result in the present study tried to incorporate climate variation in the study period, which insight new look for implementing the right prevention strategies. However, in Jabitehnan District, no study is available on the prevalence of diarrhea among under-five children at community level and there were an observed evidence that diarrhea is a major health problem in the study area. Therefore, this study aims to assess the prevalence of diarrhea and associated factors among age under-five children in Jabitehnan District, Northwest Ethiopia.

## **Materials and Methods**

### **Study settings**

The study was conducted among women who had children under five in Jabitehnan district, Northwest Ethiopia from April to July 2019. Jabitehnan district is one of the northwest district of Ethiopia which is found at 383Km northwest of the capital city of Ethiopia, Addis Ababa. According to the National central statistics agency of Ethiopia 2007 census report the district has 3 town and 128 kebeles with an estimated population of 179,342 of whom 89,523 are men and 89,819 women; 12,609 or 7.03% are urban inhabitants [28].

### **Study design**

A community based cross-sectional study design was used.

### Participants

All women who were based in Jabitehnan district with those who had children under five during the survey were included in the study. Mothers or caregivers who were mentally ill, have a problem of hearing, and mothers with a critically ill child were excluded from the study.

The sample size was calculated from a previous study, where the prevalence of diarrhea was reported,  $p=14.5\%$  in Bahir Dar city[29]. Using 3% marginal error, 95% CI and 1.5deff by the following formula:

$$n = \frac{z_{\alpha}^2 p(1-p)}{d^2},$$

Where: n= minimum sample size required

Z= standard score corresponding to 95%CI

P= assumed prevalence of diarrhea among children under five

d= margin of error(precision) 3%

deff= design of effect for kebeles 1.5

$n = 3.84 * \frac{0.123975}{0.0009} = 528.96 \approx 529$ , since measurements was taken from different kebeles, the minimum sample size was multiplied by 1.5 design effect to remove heterogeneity between kebeles(i.e.,  $529*1.5=794$ ). By adding 10% contingency for non-response, the optimum sample size was  $794+59=873$ .

### Sampling procedures

A sampling frame was constructed by kebeles which obtain from the administrative office of the district and it was used as a cluster. The frame was subdivided into kebeles, then, by lottery method and as a rule of thumb (25%), 32 kebeles were selected. Furthermore, the study subjects were proportionally allotted to each 32 kebeles. Household numbers having under-five children were taken from health extension workers registration books. Then, study subjects were selected using Systematic sampling technique. The first household was selected using the lottery method among five households, while the rest households, were selected every fifth interval. For households with twins children under 5 year of age, the index child was selected by a lottery method and the youngest child was selected for a household having two or more under 5 years of children.

### Data collection tools and techniques

Data was collected through pretested and structured interviewer-administered questionnaire. It was first prepared in English and translated to Amharic (the local language), and back-translated to English again. A total of 10 data collectors (BSc. in Midwifery) were involved in the data collection process. The purposes and objectives of the study were clearly explained to participants before data collection.

### Patient and public involvement

Women who have children under five in Jabitehnan district were involved in the study.

### Data quality control

The questionnaire was pretested on 61 women who had children age under five in Banja district, Northwest Ethiopia. based on the pretest findings, necessary corrections were made to the questionnaire. Interviewers received a total of 3 days of intensive training before data collection. Adequate supervision was undertaken by the supervisors and principal investigator during the data collection. Also, continuous

check up was made about the filled questionnaires for errors or any incompleteness. During data collection, any personal identifiers were not recorded.

#### Data processing and analysis

After the data collection, data was entered in Epi Data 3.10 and exported to SPSS version 23 for analysis. Values of categorical variables were presented as frequencies and percentages. All statistical tests were performed at the 5% significance level. The dependent variable was the occurrence of diarrhea among children under five within five years from the data collection which was dichotomized into yes (labeled '1') and no (labeled '0'). To prevent recall bias respondents were reinforced to remember the occurrence of diarrhea among children under five in the previous 5 years. Each independent variable was cross-tabulated and further evaluated for association in the bivariate logistic regression. In bivariate logistic regression analysis, variables with p-value less than 0.20 were considered into the multivariable analysis to control the possible effect of confounders. Adjusted odds ratio (AOR) with a 95% confidence interval (CI) was calculated to see the strength and significant association. Variables having a p-value less than 0.05 in the multivariable logistic regression analysis were considered as statistically significant. Finally, model fitness was checked using the Hosmer Lemeshow test.

#### Ethical Considerations

Ethical clearance was obtained from institutional review board of Woldia University, Faculty of Natural and computational Sciences. Official letter of permission was written to the respective study; district and administrative office at the selected Keble's were communicated through formal letters. Participants were informed about the purpose, benefit, risk, confidentiality of information, and the voluntary nature of participation in the study. Participants were informed that they had the right to withdraw from the study at any time and also informed verbal consent was obtained from respondents before interviewing.

## Results and Discussion

#### Socio demographic, Medical and Behavioral characteristics

A total of 873 women were interviewed, which makes a response rate of 100%. The majority (70.4%) of the women were in the age range of 21–34 years. About 67.8% and 81% of women lived in rural areas and married, respectively. Moreover, 82.2% of women were housewives and 14.4% were pregnant. Likewise 52.8 and 80.2% of children of age under five were male and had no experience of diarrhea, respectively. The majority of 77.8%, 55.7% and 85.3% of the children had access to drink protected water, had not good toilet access and washing their hands after latrine, respectively. Likewise 92.7 and 74.5% of child live with their biological parents and had a complete vaccine of measles, respectively (Table 1).

Table 1 Socio demographic, medical and behavioral characteristics of respondents in Jabitehnan district, northwest Ethiopia, 2019 (n=873)

Variable	Frequency	Percentage
Sex of child		
Male	461	52.8
Female	412	47.2
Age of child in years		
≤1	785	89.9
2-3	71	8.1
4-5	17	1.9
Household family size		
4 and below	757	86.7
More than 4	116	13.3
Residence		
Rural	592	67.8
Urban	281	32.2
Age of mothers		
Less than 20	122	14
21 -34	615	70.4
35 and above	136	15.6
Marital status of mothers		
Married	707	81
Others	166	19
Highest educational attainment of mothers		
No education	444	50.9
Primary(Grade1-8)	257	29.4
Secondary(Grade9-12)	95	10.9
Diploma and above	77	8.8
Occupation of mother		
Employed	100	11.5
Housewives	718	82.2
Others	55	16.3
No_ of under five children in the house		
One child	707	81
Two an above	166	19
Child lived with whom		
Parents/family	809	92.7
Other	64	7.3
currently pregnant of mothers		

Yes	747	85.9
No	126	14.4
source of drinking water		
Protected(unsafe)	679	77.8
Unprotected(safe)	194	22.2
Type of toilet facility		
Present	387	44.3
Not good	486	55.7
Hand washing after latrine		
No	128	14.7
Yes	745	85.3
Measles vaccine		
Yes	650	74.5
No	223	25.5
Prevalence of Diarrhea occurrence		
Yes	173	19.8
No	700	80.2

#### Prevalence of diarrhea Occurrence

The overall prevalence of diarrhea among children age of under five in west Jabitehnan was 19.8% (95% CI 11.9%, 17.1%).

#### Factors Contributing to Prevalence of diarrhea disease

Both bivariable and multivariable logistic regression analyses were done to see the effects of the selected variables on diarrhea occurrence among children of age under five. As it is shown in Table 2, sex of child, child age, no\_ of children under five in the family, no\_ of family in the household, residence, age of mother, source of drinking water, Type of toilet facility; Measles vaccine,; current pregnant of mothers, marital status, mother education, mothers occupation, washing hands after latrine and child lived with whom had significant associations with diarrhea disease in the bivariable analysis. However, in the multivariable logistic regression analysis child age, residence, mother age 21-34, mother education, mother occupation, child lived with whom, current pregnant of mothers, source of drinking water, Type of toilet facility, washing hands after latrine and Measles vaccine were significantly and independently associated with diarrhea occurrence. Accordingly, child who lived with his/her non biological mother were 32.44 times(AOR=32.44; 95% CI 14.07,74.80) more likely to be exposed to diarrhea compared to child lived with biological mother. In this study, the higher odds of developing diarrhea disease were also observed among children of age under five whose source of drinking water unprotected(unsafe)(AOR=14.01; 95% CI 7.50,26.15) than those who have protected(safe) drinking water source. Moreover, the odds of developing diarrhea among children of age under five whose mother currently pregnant were 5.66 times (AOR5.66; 95% CI 2.67,11.99) higher compared to children of age under five whose mother not currently pregnant. Likewise, the odds of exhibited diarrhea disease among children of age under five years with

not washing their hands after latrine were 7.91 times (AOR=7.91, 95% CI, 2.77,22.59) higher compared to its counterpart and the youngest one were more prevalent (Table 2). The Hosmer-lemnshow test gives  $P=0.236$ , indicating no evidence of poor fit. This is good, since here we know the model is indeed correctly specified (Table 3).

Table 2 bivariable and multivariable analyses of diarrhea among children under five age in Jabitehnan district, northwest Ethiopia, 2019(n=873)

Variables	Prevalence of Diarrhea		COR(95%)	AOR(95%)
	No	Yes		
Sex of child				
Female	314	98	1.0	1.0
Male	386	75	0.19(0.15,0.25)	0.93(0.55,1.58)
Age of child in years				
1 and below	625	160	1.0	1.0
2-3	60	11	0.18(0.10,0.35)	0.10(0.02,0.41) <sup>a</sup>
4-5	15	2	0.13(0.03,0.58)	0.11(0.01,0.91) <sup>a</sup>
Household family size				
4 and below	634	123	1.0	1.0
More than 4	66	50	0.76(0.53,1.09)	2.18(0.97,4.91)
Residence				
Urban	273	8	1.0	1.0
Rural	427	165	0.38(0.32,0.46)	2.99(1.30,6.90) <sup>a</sup>
Age of mothers				
Less than 20	59	63	1.07(0.75,1.52)	1.33(0.55,3.18)
21 -34	534	81	0.15(0.12,0.19)	0.40(0.21,0.78) <sup>a</sup>
35 and above	107	29	1.0	1.0
Marital status of mothers				
Married	580	127	1.0	1.0
Others	120	46	0.38(0.27,0.54)	0.47(0.21,1.10)
Highest educational attainment of mothers				
No education	383	61	1.0	1.0
Primary(Grade1-8)	203	54	0.27(0.20,0.36)	0.09(0.03,0.25) <sup>a</sup>
Secondary(Grade9-12)	64	31	0.16(0.12,0.21)	0.10(0.05,0.2) <sup>a</sup>
Diploma and above	50	27	0.54(0.34,0.86)	0.20(0.10,0.41) <sup>a</sup>
Occupation of mother				
Employed	71	29	1.0	1.0
Housewives	583	135	0.23(0.19,0.28)	0.05(0.02,0.10) <sup>a</sup>



Others	46	9	0.20(0.1,0.40)	0.07(0.02,0.28) <sup>a</sup>
Child lived with whom				
Parents/family	677	132	1.0	1.0
Other	23	41	1.78(1.07,2.97)	32.44(14.07,74.80) <sup>a</sup>
currently pregnant of mothers				
No	628	119	1.0	1.0
Yes	72	54	0.75(0.53,1.07)	5.66(2.67,11.99) <sup>a</sup>
source of drinking water				
Unprotected(unsafe)	83	111	1.34(1.01,1.78)	14.01(7.50,26.15) <sup>a</sup>
protected(safe)	617	62	1.0	1.0
Type of toilet facility				
Not good	338	148	0.44(0.36,0.53)	2.74(1.27,5.89) <sup>a</sup>
Present	362	25	1.0	1.0
Hand washing after latrine				
No	90	38	0.42(0.29,0.62)	7.91(2.77,22.59) <sup>a</sup>
Yes	610	135	1.0	1.0
Measles vaccine				
No	126	97	0.77(0.59,1.00)	3.91(2.26,6.77) <sup>a</sup>
Yes	574	76	1.0	1.0

<sup>a</sup>Significantly associated factors at a p-value < 0.05

#### Abbreviations

AOR: Adjusted Odds Ratio; CI: Confidence interval; COR: Crude Odds Ratio;

Table 3 Hosmer and lemeshow test for model goodness of fit

step	Chi-square	df	Sig.
1	10.427	8	.236

#### Discussion

The overall prevalence of diarrhea occurrence was found to be 19.8% (95% CI:11.9%, 17.1%). This finding is higher than those of studies conducted in Bahir Dar 14.5% [29], Kamashi district 14.5% [5], Farta Wereda, South Gondar 16.7% [11], the 2016 EDHS report, 11.2% [15], Yaya Gulele 13.4% [22], Jigjiga, East Ethiopia 14.6% [27], Adama town, Central Ethiopia, 14.7% [14] and Dale District 13.6% [19]. This difference might be arising in variations of the areas of studies. For instance, the studies in Bahir Dar, Adama town and jigjiga were small area and more of urban based unlike this study which was also conducted at large community level including rural based and the study period itself might be also have responsible for the source of variation as per studied [24-26] even though it needs more research.

The likelihood of the occurrence of diarrhea among children age under five were 2.99 times higher than children age under five who reside in urban. Commonly, children age under five located in a rural area



have poor access to protected water, nutrition, toilet facility, hand washing facility after latrine and postnatal care. Furthermore, methodological, socioeconomic and seasonal[24-26] variations may explain the differences in diarrhea in Ethiopia on one hand. Moreover, child feeding care have a great effect on prevalence of diarrheal disease actually unsafe water or contaminated food are commonly practiced in rural areas, such children are more likely to develop diarrhea outcomes than urban dwellers. This study agreed with the previous studies[20]. •

The results of this study, showed that have poor access to protected water, nutrition, not good toilet and no hand washing facility after latrine were highly contributing the likelihood occurrences of diarrheal disease in the study area. This finding consistent with the study[5, 9, 12, 21]. Children whose mothers/caregivers had not washing his or her hand after latrines were 7.91 times more likely to acquire acute diarrhea compared to their counterparts. This finding is supported by those of studies conducted in Rwanda[18], Kamashi district[5], Bahir Dar[29], Dale district[19] and Geze Gofa district [14]. Consequently, they had low chance of removing microorganisms that contaminant hands after latrine utilization than those who had such washing facilities.

Child age less than 1 year were at higher risk of encountering diarrheal disease than its counterpart[5, 7, 8, 16]. In this study, women age  $\geq 34$  years were at higher risk of encountering diarrheal disease for their child. This is supported by other findings in[15, 16, 20]. Perhaps because of the advanced maternal age result in diarrhea. This might be due to the unprotected nutritional status and socioeconomic burden which increases the sharing of food among family members. Mothers education and occupation also a responsible factors of the occurrence of diarrhea. this finding is supported by those of studies conducted by[3-6, 16, 19, 22, 23]. Likewise, child living with whom is one of the major factors for determining the prevalence of diarrhea disease under-five years. According to the results of this study, it was found that the odds of prevalence of diarrhea in child lives with others(non biological mothers) were 32.44 times higher than that of children live with his or her biological mother. This may be due to misconception, and the negative attitude of the caregivers toward the causes of diarrhea. A previous study conducted in Ethiopia and outside Ethiopia found that children living with non biological mother's were more probable to the prevalence of diarrhea as linked to broods living with the respondents[1, 2, 7, 10, 17, 29]. The other results of this study found that, children age of under five whose mother was current pregnant have higher odds of prevalence of diarrhea than children whose mother was not currently pregnant. This study also consistent with the study conducted by[11, 29] and For children who had no Measles vaccination were higher chance of developing diarrheal disease than its counterpart[13].

## **Conclusions**

This study revealed that the prevalence of the diarrhea in Jabitehnan District was 19.8%. Child age, residence, mother age 21-34, mother education, mother occupation, child lived with whom, current pregnant of mothers, source of drinking water, Type of toilet facility, washing hands after latrine and Measles vaccine were mainly associated with diarrhea. Addressing these factors will help to prevent future

morbidity and mortality of child and will assist in alleviating hygiene and refining their quality of life. Moreover, trend based sampling design might be considered for a better understanding.

## Acknowledgements

I am very grateful to Woldia University for the financial support to this study and all study participants for their commitment in responding to the questionnaire. Finally, the author would also thanks to data collectors for their effort.

**Contributor** HDM Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation, Visualization, Investigation, Supervision, Software, Validation, Writing- Reviewing and Editing, Manuscript preparation and writing revised manuscript.

**Funding** This work was supported by Woldia University for research and community service award/grant number is not applicable.

**Competing interests** The author declare that there is no competing interests.

**Patient consent for publication** Not applicable

**Ethics approval** Ethical clearance was obtained from institutional review board of Woldia University, Faculty of Natural and Computational Sciences(Ref# Wldu/15931/05/Rcs/2011). Official letter of permission was written to the respective Kebeles by Amhara health bureau to Jabitehnan district health offices.

**Provenance and peer review** Not commissioned, externally peer reviewed.

**Data availability statement** Data are available on reasonable request. The dataset of the study findings is available from the corresponding author on reasonable request.

## References

1. Organization., W.H., *Diarrhoeal disease*: . May 02, 2017.
2. Farthing M, S.M., Lindberg G, et al. , *Acute diarrhea in adults and children: a global perspective*. J Clin Gastroenterol. , 2013. **47**(1): p. 12-20.
3. Gidudu J, e.a., *Diarrhea:case definition and guidelines for collection,analysis, and presentation of immunization safety data*. Vaccine., 2011. **29**(5): p. 1053.
4. UNICEF/WHO., *Why children are still dying and what can be done?*. . 2009.
5. Fenta, A.A., Kassahun Angaw, Dessie Abebaw, *Prevalence and associated factors of acute diarrhea among under-five children in Kamashi district, western Ethiopia: community-based study*. BMC pediatrics, 2020. **20**(1): p. 236-236.
6. Mokomane, M., et al., *The global problem of childhood diarrhoeal diseases: emerging strategies in prevention and management*. Therapeutic advances in infectious disease, 2018. **5**(1): p. 29-43.
7. Tambe AB, N.L., Nicoline NA. , *Childhood diarrhea determinants in subSaharan Africa: a cross sectional study of Tiko-Cameroon.Challenges*. 2015. **6**(2): p. 229-43.
8. Module., C.D., *General Features of Faeco-Orally Transmitted Diseases*. . 2018.
9. Kasye DG, G.N., Kassa MA. , *Assessment of the prevalence of diarrheal disease under-five children Serbo town, Jimma Zone South West Ethiopia*. Clinics Mother Child Health., 2018. **15**(28): p. 2.

10. UNICEF., *One is too many: ending child deaths from pneumonia and diarrhoea*. In: Every breath count;, 2016.
11. Genet Gedamu, A.K., Desta Haftu, *Magnitude and Associated Factors of Diarrhea among Under Five Children in Farta Wereda, North West Ethiopia*. Quality in Primary Care 2017. **25**(4): p. 199-207.
12. Habtu, M., J. Nsabimana, and C. Mureithi, *Factors Contributing to Diarrheal Diseases among Children Less than Five Years in Nyarugenge District, Rwanda*. Journal of Tropical Disease, 2017. **5**: p. 3.
13. Kotloff, K.L., et al., *The incidence, aetiology, and adverse clinical consequences of less severe diarrhoeal episodes among infants and children residing in low-income and middle-income countries: a 12-month case-control study as a follow-on to the Global Enteric Multicenter Study (GEMS)*. The Lancet Global Health, 2019. **7**(5): p. e568-e584.
14. Central Statistical Agency (CSA) [Ethiopia] and ICF. Ethiopia Demographic and Health Survey 2016. Addis Ababa, E., and Rockville, Maryland, USA: CSA and ICF; , 2016.
15. Ferede, M.M., *Socio-demographic, environmental and behavioural risk factors of diarrhoea among under-five children in rural Ethiopia: further analysis of the 2016 Ethiopian demographic and health survey*. BMC pediatrics, 2020. **20**(1): p. 239-239.
16. Getachew, A., et al., *Diarrhea Prevalence and Sociodemographic Factors among Under-Five Children in Rural Areas of North Gondar Zone, Northwest Ethiopia*. International Journal of Pediatrics, 2018. **2018**: p. 6031594.
17. WHO, *Progress on sanitation and drinking water: 2015 update and MDG assessment.2015*. World Health Organization, Accessed October 2017.
18. Jean N, e.a., *Factors contributing to diarrheal diseases among children less than five years in Nyarugenge District, Rwanda*. J Trop Dis., Feburary 12/2018. **5**(3).
19. Melese, B., et al., *Prevalence of diarrheal diseases and associated factors among under-five children in Dale District, Sidama zone, Southern Ethiopia: a cross-sectional study*. BMC Public Health, 2019. **19**(1): p. 1235.
20. Girma, M., et al., *Determinants of childhood diarrhea in West Gojjam, Northwest Ethiopia: a case control study*. Pan Afr Med J, 2018. **30**: p. 234.
21. Gashaw D, W.K., Shewanew T, Yitbarek K. , *What Factors Aggravate Prevalence of Diarrhea among Infants of 7-12 Months in Southern Ethiopia?*. . Quality in Primary Care., 2017. **25**(5): p. 321-5.
22. Degebase MZ, W.D., Marama MT. , *Diarrheal status and associated factors in under five years old children in relation to implemented and unimplemented community-led total sanitation and hygiene in Yaya Gulele in 2017*. Pediatric Health Med Ther, 2018. **9**: p. 109-121.
23. D. Amare, B.D., B. Kassie et al., *"Maternal knowledge and practice towards diarrhoea management in under five children in fenote Selam town, West Gojjam Zone, Amhara regional State, Northwest Ethiopia,"* Journal of Infectious Diseases and Berapy, , 2014. **2**(6): p. 398-403.
24. Xu Zhiwei., e.a., *Exploration of diarrhoea seasonality and its drivers in China*. Scientific reports, 2015. **5**: p. 8241.

25. Gong, X.-H., et al., "*Epidemiology, aetiology and seasonality of infectious diarrhoea in adult outpatients through active surveillance in Shanghai, China, 2012–2016: a cross-sectional study*". *BMJ open*, 2018. **8**(9): p. e019699.
26. Giribabu Dandabathula, P.B., Mithilesh Burra, Peddineni VV Prasada Rao, Srinivasa S Rao, Sudhakar C Reddy, *Seasonal Variations of Acute Diarrheal Disease Outbreaks in India(2010-2018)*. 2019. **3**(7).
27. Bizuahu H, e.a., *Factors associated with diarrheal morbidity among underfive children in Jigjiga town, Somali Regional State, eastern Ethiopia*. . *BMC Pediatrics*., 2018. **17**: p. 182.
28. CSA, *Summary and statistical report of the 2007 population and housing census. Population size by age and sex 2008*: Addis Abeba, Ethiopia.
29. Dagnew, A.B., et al., *Prevalence of diarrhea and associated factors among under-five children in Bahir Dar city, Northwest Ethiopia, 2016: a cross-sectional study*. *BMC Infectious Diseases*, 2019. **19**(1): p. 417.