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Determinants of Diarrhea Among Under-Five Children-Visiting Government Health Facilities in Nekemte Town, Western Ethiopia: Unmatched Case Control Study

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Abstract:
Background: Diarrheal disease is the most common cause of illness and the second leading cause of child death next to pneumonia in the World. The aim of the study was to identify the determinants of diarrheal diseases among under five children visiting government health facilities in Nekemte Town, Western Ethiopia. Method: Facility based unmatched case-control study was conducted in Nekemte Town Government Health facilities. Four hundred seventy-seven (159 cases and 318 controls) under five children were selected using consecutive sampling method. Data were cleaned, coded and entered in to Epi data version 3.1 then exported to SPSS version 20 for statistical analysis. Association between dependent and independent variables were computed using multivariable logistic regression and significance of the associations were declared by p-values with their corresponding 95% confidence interval along with adjusted odds ratios. Result: A total of 447 (159 cases and 318 controls) were participated with equal response rate of 100%. In this study: diarrheal morbidity is significantly determined by family income [AOR: 0.435, 95% CI: (0.263-0.72)], supplementary feeding commenced time [AOR: 5.38, 95% CI: (3.23-8.94)] and Measles vaccination [AOR: 3.72, 95% CI: (1.6.9-8.63)] respectively. Conclusion and Recommendation: In this study family income, Supplementary feeding commenced time and measles vaccination status were determinants of diarrhea morbidity among under-five of age visiting public health facilities in Nekemte town. Health service providers should aware mother/caregiver on supplementary feeding commenced time and measles vaccination.

Keywords: Unmatched Case-control, Under Five Childhood Diarrhea Morbidity, Ethiopia

INTRODUCTION

Diarrhea is a major health problem and usually a symptom of an infection in the intestinal tract, which has a variety of causative agents including viruses, bacteria and parasites. The infection spreads through the ingestion of contaminated food or drinking-water, or person-to-person as a result of poor hygiene. There are three clinical types of diarrhea: Acute watery diarrhea which lasts several hours or days and includes cholera; acute bloody diarrhea (dysentery); and persistent diarrhea that lasts 14 days or longer [1-3].

Diarrhea is a leading cause of morbidity and mortality across all age groups and regions of the world. Though mortality rates among 9-12 years of children, adolescents, and adults are lower than those observed in children under five, diarrhea still poses a substantial burden accounting

for approximately 2.8 billion diarrhea episodes among older children, adolescents, and adults [4-6].

Diarrheal disease due to unsafe water and lack of sanitation is the greatest cause of morbidity and mortality in under-five children in the world, especially in poor countries. Diarrhea alone kills more children than AIDS, malaria, and measles combined [4-6].

It is estimated that 6,000 children die every day from diarrheal diseases alone and large proportion of diarrheal disease in the developing world are due to poor water-handling practices, sanitation and hygiene. A child dies every 15 seconds from diarrhea caused largely by poor sanitation and a contaminated water supply [7, 8].

As a child's immune system is progressively compromised with each attack of diarrhea, related illnesses kill millions or more indirectly. Almost 90%of diarrhea is attributed to unsafe drinking water, inadequate sanitation and poor hygiene [7, 8].

Many children in the developing world cannot access urgent medical care for severe illnesses, making prevention methods, including improved hygiene, sanitation, safe drinking water, exclusive breastfeeding, and also rotavirus vaccines which are a critical component of diarrheal disease prevention and control. When diarrhea occurs, it can be successfully treated with simple solutions, including oral rehydration therapy/oral rehydration solution (ORS), zinc and other micronutrients, and continued feeding [9, 10].

Diarrheal disease is the second leading cause of death in children under five years old, and is responsible for killing around 760,000 children every year. Diarrhea can last several days, and can leave the body without the water and salts that are necessary for survival. Globally diarrhea accounts for 17% of the deaths and 5% of health loss to disability among children under the age of five [11, 12].

Most people who die from diarrhea actually die from severe dehydration and fluid loss. Worldwide; there are 2.5 billion cases of diarrhea each year among under five children which is likely to result in death or other severe outcomes. More than half of these cases occur in Africa and South Asia. About 80% of deaths are still in Africa including Ethiopia and the average annual incidence rate of diarrhea in under-fives is estimated to be 2.6 episodes [11, 12].

Diarrheal diseases account for 1 in 9 child deaths worldwide. It kills 2,195 children every day more than AIDS, malaria, measles and 801 thousand Child deaths every year losing nearly 32 school buses full of children each day. Despite these sobering statistics, strides made over the last 20 years have shown that, in addition to rotavirus vaccination and breastfeeding, diarrhea prevention focused on safe water and improved hygiene and sanitation is not only possible, but cost effective: every $1 invested yields an average return of $25.50. A child dies every 15 seconds from diarrhea caused largely by poor sanitation and contaminated water supply [13, 14].

Water sources and sanitation facilities have an important influence on the health of household members, especially children. Water safety in a community at large and household levels depends on a range of factors to prevent childhood diarrhea, the quality of source water to storage, throwing away disposal of feces, point-of use household water treatment, washing of containers before transferring, duration of stored water, cover of container during transportation and

storage, unhygienic water drinking and handling in the domestic setting [15].

The consequences of diarrheal diseases on childhood are huge; leading to decreased food intake and nutrient absorption, malnutrition, reduced resistance to infection, and impaired physical growth and cognitive development [16, 17]. The cause of under five deaths in Ethiopia due to diarrhea are 23%. Under five mortality rates are 88 and 112 per 1000 lives birth in Ethiopia and Oromia respectively. [18, 19]

In Ethiopia, morbidity reports and community-based studies indicate that diarrheal diseases are public health problem that causes excess morbidity and mortality among under five children. However, various community-based studies conducted on different parts of Ethiopia indicated that the prevalence of diarrhea among under five years age vary for instance in Arba Minch district 30.5%, Nekemte town 28.9%, Mecha district 18% [20, 21].

According to Nekemte Town Health Office report diarrheal disease is one of the major public health problems in the area and it is among one of the top ten diseases causing morbidity and mortality in under-five children. There are few institution-based studies conducted on different parts of Ethiopia and significant number of patients coming to government Health Facilities in Nekemte town with diarrhea complaint. Therefore, the objective of this study was to identify potential determinants of acute childhood diarrhea among under five children.

METHODS

Study Design, Setting, and Population

The study was conducted in Nekemte town, East Wollega Zone, Oromia regional state, Western Ethiopia. Facility based Unmatched case control study was used.

Source Population:

The source populations were all under-five children visiting government health facilities of Nekemte town.

Study Population:

The study populations were selected children less than five years of age visiting government health facilities in Nekemte town who were included in the actual data collection.

Cases:

Under five children with diarrhea visiting government Health Facilities in NekemteTown come for treatment at outpatient department.

Controls:

Under-five children without diarrhea visiting government Health Facilities in Nekemte Town come for treatment of other cases at outpatient department.

Eligibility Criteria:

1. **Inclusion Criteria:** Children of under five age with mothers/ caregiver attending government health facilities in Nekemte town at under five outpatient department during the study period.
   Cases: were under five children with diarrhea visiting government Health Facilities in Nekemte Town come for treatment at outpatient department.
   Controls: wereunder-five children without diarrhea visiting government Health Facilities in

Nekemte Town come for treatment of other cases at outpatient department.

2. **Exclusion Criteria:** Mothers/caregivers of under five children unable to hear or speak, and those mothers or caregivers with under- five urgent referral cases, at outpatient department for both cases and controls.

Sample Size Determination and Sampling Techniques

Sample Size Determination:

The required sample size is calculated by double population proportion formula for unmatched case control study using Epi Info version 7 Stat Calc function. From similar study conducted in Kotebe sub city, Addis Ababa, hand washing practice taken as the main predictor of outcome (diarrhea). P1 = proportion of cases exposed to hand washing after cleaning child's buttock was 0.427, P2= proportion of control exposed to hand washing after cleaning child's buttock was 0.571[25].

Table 1. Associated variables for sample size determination.

Associated Variables	% of control exposed or p_2	% of Cases Exposed or P_1	Confidence interval	Power	Odds ratio	Sample size + 5% non-response rate				References
						Cases	Controls	controls to cases ratio	Total	
Maternal education	47.6	23.1	95%	80%	0.33	51	102	2:1	161	Aklilu T. & Zewdie A., 2014
Supplementary feeding commenced	43.2	29.1	95%	80%	0.3	148	296	2:1	452	
Hand Washing after cleaning child's buttock	57.1	42.7	95%	80%	0.59	159	318	2:1	477	

Then the largest sample size was selected for this study as follows
Case = **152**
Control = **303**
Total = **455**
Non response rate = **5%**
Total Cases = **159**
Total Controls = **318**
Final Sample size = **477**

Sampling Techniques:

One hospital and two health facilities are included in this study. Then the calculated sample size was distributed to the health facilities using proportional to size based on total under five visited at OPD in previous year to assure representativeness. In this allocation, total number of under five visited at OPD in each government Health facilities during the previous year from July 8, 2015 to July 7, 2016 which are 14068 Nekemte Hospital, 2173 Nekemte health center and 645 Chalelike Health center were used. Accordingly, 83% (396), 13% (63) and 4% (18) of the sample were allocated for Nekemte Hospital, Nekemte Health center and Chalilake Health center respectively. The survey was conducted in under five oPD to identify, register cases and controls. Cases and controls were selected by consecutive sampling from each facility based on fulfillment of case definition criteria.

Study Variables

Dependent Variables:

Childhood Diarrhea morbidity status.

Independent Variables:

1. **Socioeconomic & Demographic Status:** family income, place of residence, maternal age, education, ethnicity, number of children, occupation, marital status, religion.
2. **Behavioral Factors**: hand-washing, method of water drawing and storage, infant and young child feeding practices, duration of breast-feeding, time of introducing supplementary feeding, child immunization.
3. **Environmental Factors:** type of water source, distance to the water source, amount of daily water consumption availability of latrine, number of rooms, livestock in house, and refuse disposal.

Operational Definitions

Diarrhea: is defined as having three or more loose or watery stools per twenty-four hours in two weeks period preceding the data collection, as reported by the mother/care taker of the child.

Index Child: refers to a child that was included in the study from a household to have information on the demographic and health characteristics.

Improved Water Source: Water from protected springs and/or wells, from pipe and from distribution post unless considered as unimproved

Number of Rooms: are defined as any partition of a house that is intended to separate the rooms for different purposes.

Refuse: includes such solid wastes as ash, cow dung, home-sweepings; but not human excreta.

Exclusively Breast-Fed: A child who was receiving no food, solid or liquid, other than breast milk at the time of the survey.

Mixed Feeding: a child who was receiving food, solid or liquid, in addition to breast milk at the time of the survey.

Data Collection Procedure

Data Collection Instrument:

Data collection tool were adapted from various similar studies in different parts of the world and modified according to local context. Data collection tool is translated from English to local language, "Afan Oromo" then, back translated to English to check for consistency by different person.

Data Collection Techniques:

Data were collected by interview using interviewer administered structured questionnaire. Data collectors were college nursing students and supervisors were nurses who work in that health facility. There were 6 data collectors, 2 supervisors and the overall activities were supervised by principal investigator.

Data Quality Control:

To assure the quality of data, the following measures were undertaken pre-testing of the questionnaire, the final version of the questionnaire was translated into the local language of the respondents (Afan Oromo), and data collector and supervisors were trained for two days by the principal investigator on the objective of the study, the methods of data collection, how to recruit cases and controls, and data collectors were familiarized with data collection tools with respect to the study with practical exercises.

Pretest was conducted in neighboring Sibu Sire health centers which is 50km from the study area. By taking 5% of the sample size that were not included in the actual study population for three days before the actual data collection takes place. The collected data were checked for its completeness at the end of interview and at the end of the day by principal investigator. Missing values and outlier were checked before analysis by running descriptive analysis.

Data Processing and Analysis

Data completeness were checked manually, then entered into Epi-data software and exported to SPPS Version 20 for analysis. Descriptive statistics was used to describe frequency and percentage of diarrhea morbidity among under five children. Bivariate analyses were performed to nominate candidate variables for multivariable analysis with p-value less than 0.25. Multivariable logistic regression was used to identify independent factors associated with diarrhea morbidity. The assumption fitness was test by Hosmer Lemeshow goodness fit test. Independent factors associated with diarrhea morbidity were declared with P-value less than 0.05 at 95% CI as cut of point.

RESULTS

Socio-Demographic and Economic Characteristics

A total of 159 cases and 318 controls were included in the study and in both group the response rate was 100%. Among cases 82 (51.6%) and 177 (55.7%) controls were males respectively. Concerning the age groups 55 (34.6%) of cases and 130 (40.9%) controls were in the age groups of 24-59 months. Of total cases 85 (53.5%) and 170 (53.5%) controls were had 3-5 family size. From total cases 72 (45.3%) and controls 161 (50.6%) were protestant. Regarding ethnicity 142 (89.3%) and controls 286 (89.9%) were Oromo.

Out of total 41 (25.5%) cases and controls 83 (26.1%) mothers/caregivers and 71 (44.7%) cases and controls 139 (43.7%) fathers had Higher Education. From total cases 105 (66.1%) and 201 (63.2%) controls mothers/caregivers and 76 (47.8%) cases and control 144 (48.3%) fathers were housewives and government employers respectively. Of total cases 148 (93.1%) and controls 291 (91.5%) were married. Regarding monthly income 81 (50.9%) cases and 195 (61.3%) controls earn greater than 1000 ETB.

In Bivariate analysis from all socio demographic factors only Age of child and family income were nominated with p-value ≤ 0.25 for multivariable logistic regression of under-five age childhood diarrhea morbidity.

Table 2. Bivariate analysis socio-demographic and economic characteristics of mothers/care givers children under 5 years of age in Nekemte town

Variables	Category	Cases (n=159) No. (%)	Controls (n=318) No. (%)	COR (95% CI)	P-values
Age of child (months)	<6	16 (10.1)	40 (12.6)	1.05 (0.54-2)	0.868
	6-11	33 (20.8)	73 (23.0)	0.93 (0.5-1.57)	0.802
	12-23	55 (34.6)	75 (23.6)	0.57 (0.3-0.92)	0.22
	24-59	55 (34.6)	130 (40.9)	1	
Sex of child	Male	82 (51.6)	177 (55.7)	1	
	Female	77 (48.4)	141 (44.3)	2.15 (0.57-1.2)	0.398
Family size	1-2	6 (3.8)	12 (3.8)	1.00 (0.36-2.7)	1.000
	3-5	85 (53.5)	170 (53.5)	1.00 (0.67-1.4)	1.000
	>5	68 (42.8)	136 (42.8)	1	
Religion	Orthodox	67 (42.1)	117 (36.8)	0.89 (0.4-1.63)	0.717
	Muslim	20 (12.6)	40 (12.6)	0.78 (0.5-1.17)	0.236
	Protestant	72 (45.3)	161 (50.6)	1	
Ethnicity	Oromo	142 (89.3)	286 (89.9)	1	
	Amhara	13 (8.2)	25 (7.9)	0.95 (0.47-1.92)	0.897
	Others	4 (2.5)	7 (2.2)	0.86 (0.25-3.0)	0.825
Maternal education	Illiterate	40 (25.2)	70 (22.0)	0.86 (0.5-1.48)	0.597
	Able to read and write	21 (13.2)	50 (15.7)	1.76 (0.65-2.2)	0.615
	Primary (1-8)	27 (17.0)	52 (16.4)	0.95 (0.52-1.7)	0.87
	Secondary (9-12)	30 (18.9)	63 (19.8)	1.03 (0.58-1.8)	0.9
	Higher Education	41 (25.5)	83 (26.1)	1	
Occupation of Mother	House wife	105 (66.1)	201 (63.2)	1	
	Government Employee	42 (26.4)	70 (22.0)	0.87 (0.55-1.3)	0.546
	Merchant	8 (5.0)	30 (9.4)	1.95 (0.86-4.4)	0.106
	Daily labourer	4 (2.5)	17 (5.3)	2.22 (0.72-6.7)	0.161
Occupation of Father	Government Employee	76 (47.8)	144 (48.3)	1	
	Merchant	28 (17.6)	60 (18.9)	1.18 (0.6-2.03)	0.535
	Farmers	36 (22.6)	73 (23.0)	1.04 (0.6-1.69)	0.869
	Daily labourer	19 (11.9)	41 (12.9)	0.91 (0.51-1.6)	0.768
Parental education	Illiterate	22 (13.8)	40 (12.6)	0.92 (0.5-1.68)	0.807
	Able to read and write	27 (17.0)	52 (16.4)	0.98 (0.57-1.6)	0.953
	Primary (1-8)	15 (9.4)	39 (12.3)	0.98 (0.57-1.6)	0.400
	Secondary (9-12)	24 (15.7)	48 (15.1)	1.02 (0.57-1.8)	0.941
	Higher Education	71 (44.7)	139 (43.7)	1	
Marital status	Married	148 (93.1)	291 (91.5)	1	
	Single	2 (0.6)	7 (2.2)	0.71 (0.2-2.28)	0.568
	Others	6 (3.8%)	20 (6.3%)	1.69 (0.6-4.31)	0.268
Monthly income	Less than 500	44 (27.7%)	51 (16%)	1	0.001
	501-1000	34 (21.4%)	72 (22.6%)	0.46 (0.29-0.7)	0.954
	>1000	81 (50.9%)	195 (61.3%)	1.01 (0.6-1.70)	

Environmental Exposure Characteristics

From total cases 387 (81.1%) and controls 263 (68%) in the area were used pipe as main source of water. of total cases 121 (79.6%) and controls 241 (76.8%) had privately owned latrine. Out of total 152 (95.6%) cases and 314 (98.7) controls had hand washing availability within the Latrine. Of total cases 97 (61%) and controls 163 (51.3%) daily water consumption were <=20 Liters/day. Concerning household solid wastes disposal method from total 74 (46.1%) cases and 165 (69.6%) controls used burning as main disposal of refuse

In Bivariate analysis from all environmental factors only daily water consumption and hand washing availability within the Latrine nominated with p-value ≤ 0.25 for multivariable logistic regression of under-five age childhood diarrhea morbidity.

Table 3. Bivariate analysis of environmental characteristics of mothers/care givers children under 5 years of age in Nekemte town

Variables	Category		Cases (n=159) No. (%)	Controls (n=318) No. (%)	COR (95% CI)	P-values
Water source	Spring		35 (22%)	55 (17.3%)	0.74 (0.4-1.2)	0.215
	Piped water		124 (78%)	263 (68%)	1	
Latrine Owned	No		38 (20.4%)	73 (23.2%)	1.18 (0.7-1.8)	0.48
	Yes		121 (79.6%)	241 (76.8%)	1	
Latrine Availability	Yes		152 (95.6%)	314 (98.7%)	1	
	No		7 (4.4%)	4 (1.3%)	0.2 (0.08-0.9)	0.043
Daily water consumption	<=20 Liters		97 (61%)	62 (39%)	0.6 (0.45-0.9)	0.044
	>20 Liters		163 (51.3%)	155 (48.7%)	1	
Hand Washing Availability within the Latrine	No		7 (4.4%)	4 (1.3%)	0.2 (0.08-0.9)	0.043
	Yes		152 (95.6%)	314 (98.7)	1	
Household solid wastes disposal method	Open field	Yes	73 (45.9%)	146 (45.9)	1.0 (0.68-1.4)	1.00
		No	86 (54.1%)	172 (54.1%)	1	
	Pit	Yes	42 (26%)	97 (30.5%)	1	
		No	117 (73.6%)	221 (69.5%)	0.8 (0.53-1.2)	0.355
	Burning	Yes	74 (46.1%)	165 (69.6%)	1	
		No	87 (53.9%)	153 (48.1%)	0.7 (0.5-2.03)	0.174
	Garbage can	Yes	43 (27%)	70 (22%)	1.3 (0.84-2.0)	
		No	116 (73%)	248 (78%)	1	

Behavioral Characteristics

From total cases 78 (49.1%) and controls 78 (49.1%) were those mothers/caretakers who started supplementary feeding for their children before the child reached 6 months and on 6 months respectively. Of total case 105 (72.4%) and controls 214 (77.5%) mothers/cares breast feed their greater than two years.

Out of total cases 136 (85.5%) and controls 292 (91.8%) had Separate can taking drinking water from storage. Of total cases 141 (90%) and 259 (81.5%) had complete vaccination. Only 58 (36.5%) cases and controls 93 (29.2%) used Pouring as method of drawing of water from storage container. And also, only 58 (38.4%) cases and controls 101 (29.2%) used dipping as method of drawing of water from storage container.

Of total only 14 (8.8%) cases and 13 (4.1%) controls had mother / caretaker diarrhea history. All most all cases 154 (96.9%) and 296 (93.1%) controls mother / caretaker were cut their child's finger nail well as their finger nail when it grows. From total cases 77 (48.8%) and controls 174 (69.3%) mother / caretaker were used both water and soap for hand washing.

From total cases 131 (82.4%) and 256 (80.5%) controls mother / caretaker were used cup and spoon for feeding their child. Only 40 (25.2%) cases and 55 (17.3%) controls mother / caretaker were used bottle for feeding their child. Of total cases majority of cases 97 (61%) mother / caretaker wash their hand after visiting latrine, whereas the majority of controls mother / caretaker wash their hand before food preparation and eating.

In bivariate analysis from all behavioral characteristics factors Supplementary feeding commenced time, Presence of Separate can take drinking water from storage, Measles vaccination, Pouring, Mother/caretaker diarrhea history and bottle feeding were nominated with nominated with p-value ≤ 0.25 for multivariable logistic regression of under-five age childhood diarrhea morbidity.

Table 4. Bivariate analysis behavioral characteristics of mothers/care givers children under 5 years of age in Nekemte town

Variables	Category		Cases (n=159) No. (%)	Controls (n=318) No. (%)	COR (95% CI)	P-values
Supplementary feeding commenced time	On 6 months		62 (39%)	189 (59.4%)	1	
	Before 6 months		78 (49.1%)	43 (13.5%)	5.5 (3.4-8.84)	0.000
	After 6 months		15 (9.4%)	53 (16.7%)	6.4 (3.2-12.6)	0.000
	Not started		4 (2.5%)	33 (10.4%)	14.9 (4.9-45)	0.000
Breast feeding status	<24 month		40 (27.6%)	62 (22.5%)	0.76 (0.4-1.2)	0.244
	>=24 month		105 (72.4%)	214 (77.5%)	1	
Presence of Separate can take drinking water from storage	Yes		136 (85.5%)	292 (91.8%)	1	
	No		23 (14.5%)	26 (8.2%)	0.5 (0.29-0.9)	0.035
Measles Vaccination	Yes		141 (90%)	259 (81.5%)	1	
	No		18 (11%)	59 (18.6%)	2.17 (1.2-3.6)	0.004
Method of drawing of water from storage container	Pouring	Yes	58 (36.5%)	93 (29.2%)	2.07 (1.1-3.8)	0.019
		No	101 (63.5%)	225 (70.8%)	1	
	Dipping	Yes	58 (38.4%)	101 (29.2%)	0.72 (0.4-1.0)	0.11
		No	93 (61.6%)	225 (70.8%)	1	
Mother / caretaker diarrhea history	Yes		14 (8.8%)	13 (4.1%)	1	
	No		145 (91.2%)	305 (95.9%)	0.4 (0.2-0.96)	0.040
Mother / caretaker finger nail cutting	Yes		154 (96.9%)	296 (93.1%)	1	
	No		5 (3.1%)	22 (6.9%)	2.28 (0.8-6.1)	0.101
Finger nail cutting for child	Yes		153 (96.2%)	296 (93.1%)	1	
	No		6 (3.8%)	22 (6.9%)	1.8 (0.75-4.7)	0.175
Hand washing material	Soap & water		77 (48.8%)	174 (69.3%)	1	
	Only water		73 (45.9%)	103 (31.2%)	0.6 (0.4-1.0)	0.075
	Ash & water		9 (5.7%)	29 (9.1%)	1.4 (0.64-3.1)	0.381
Methods of child feeding	Hand	Yes	88 (55.3%)	172 (54.1%)	1	
		No	71 (44.7)	146 (45.9%)	1.05 (0.7-1.5)	0.79
	Cup & spoon	Yes	131 (82.4%)	256 (80.5%)	1	
		No	28 (17.6%)	62 (19.5%)	1.13 (0.6-1.8)	0.620
	Bottle	Yes	40 (25.2%)	55 (17.3%)	0.62 (0.3-0.9)	0.044
		No	119 (74.8%)	263 (82.7%)	1	
Hand washing Time	Before food preparation & eating	Yes	135 (85%)	271 (85.2%)	1	
		No	24 (15%)	47 (14.8%)	0.9 (0.57-1.6)	0.928
	After eating	Yes	71 (44.7%)	152 (68.2%)	1	
		No	88 (34.6%)	166 (52.2%)	0.8 (0.60-1.2)	0.517
	After visiting latrine	Yes	97 (61%)	214 (65.3%)	1	
		No	62 (39%)	104 (32.7%)	0.76 (0.5-1.1)	0.175
	After cleaning of child bottom	Yes	70 (44%)	166 (52.2%)	1	
		No	89 (56%)	152 (47.8%)	0.72 (0.4-1.0)	0.93

In Bivariate analysis Age of child, family income, Latrine availability, Daily water consumption, Bottle feeding, Separate can take drinking water from storage, Method of drawing of water from the storage container (pouring), Mother / caretaker diarrhea history supplementary feeding commenced time, Measles vaccination were nominated with p-value ≤ 0.25 for multivariable logistic regression of under-five age childhood diarrhea morbidity.

Determinants of Child Hood Diarrhea Morbidity

The Odds of childhood diarrhea morbidity among children who started supplementary feeding before six months was about five times higher when compared with their counterpart [AOR=5.38 95% CI (3.23-8.94)]. Similarly, the Odds of childhood diarrhea morbidity among children who started supplementary feeding after six months was about six times higher when compared with those stared on 6 months. [AOR= 6.19 95% CI (2.96-12.93)] Table 5.

The Odds of childhood diarrhea morbidity among children who have no Measles vaccination was higher when compared with those who receive Measles vaccination with odds of [AOR=3.7295% CI (1.609-8.63)].

Table 5. Multivariate Analysis of Factors Associated with Children Under 5 Years of Age Diarrhea morbidity In Nekemte Town, Western Ethiopia

Variables	Category	Diarrhea status		AOR (95% CI)
		Cases (%)	Control (%)	
Monthly income	Less than 500	51 (32.1%)	57 (17.9%)	1
	501-1000	27 (17%)	66 (20.8%)	0.863 (0.491-1.51)
	>1000	81 (50.9%)	195 (61.3%)	0.435 (0.263-0.72)
Supplementary feeding commenced time	On 6 months	62 (39%)	189 (59.4%)	1
	Before 6 months	78 (49.1%)	43 (13.5%)	5.38 (3.23-8.94)
	After 6 months	15 (9.4%)	53 (16.7%)	6.19 (2.96-12.93)
Measles vaccination	Yes	141 (90%)	259 (81.5%)	1
	No	18 (11%)	59 (18.6%)	3.72 (1.6-8.63)

DISCUSSION

The major predictors of diarrhea morbidity in Nekemte town were family income, Supplementary feeding commenced time and Measles vaccination.

According to this study factors remained independently significant to the risk of diarrhea, were family income [AOR: 0.435, 95% CI: (0.263-0.72)], Supplementary feeding commenced time [AOR: 5.38, 95% CI: (3.23-8.94)] and Measles vaccination [AOR: 3.72, 95% CI: (1.6.9-8.63)].

From all socio-demographic factors tested only family income remained, significant after controlling other variables. This findings in line with other study conducted in Northern Ethiopia and Enderta Woreda, Tigray [22, 24].

From behavioral factors only supplementary feeding commenced time and measles vaccination were significant after controlling others variables. It was found that there was significant association between starting supplementary food lately after 6 months and childhood diarrhea morbidity which constitute with the study conducted in Haramiya and Kenya [23, 25].

The reason is that breast feeding and starting supplementary feeding on 6th months provides protective factors that may help reduce infections such as diarrhea, malnutrition and other infection for under five children. In addition, initiations of complementary feeding on 6 months may strengthened the immunity of children which indirectly reduces diarrhea causative organism accidentally introduced into supplementary foods during feeding practices and due to unhygienic procedures in the preparation of foods, materials and types of water used.

In this study, Children who were receive the measles vaccine had a lower risk of childhood diarrhea morbidity than those who did not receive measles vaccine with odds of 3.72 (1.609-8.63). This study is in line with the study conducted in India, in which Children who were given the measles vaccine had

a lower risk of diarrhea than their counterparts who had not been given the vaccine. Compared to unvaccinated children, measles vaccination was associated in reducing diarrhea in vaccinated children by 22% Democratic Republic of Congo, 12% in India, 21%t in Nigeria and 19 5 in Pakistan [26].

Limitation of the Study

The limitation of this study was recalling bias, interviewer bias. It was difficult to measure some variable like income.

CONCLUSION

In this study factors namely family income, Supplementary feeding commenced time and measles vaccination status were determinants of diarrhea morbidity among under five of age visiting in Nekemte town public health facilities. Thus, Nekemte town health office should aware mother/caregiver on supplementary feeding commenced time and measles vaccination. Further studies to identify the possible factor of childhood diarrhea.

ACRONOMY/ABBREVIATION

AIDS	Acquired Immune Deficiency Syndrome
ARI	Acute Respiratory Infection
CI	Confidence Interval
DHS	Demographic Health Survey
EDHS	Ethiopian Demographic Health Survey
FMOH	Federal Ministry of Health
HC	Health Center
HEW	Health Extension Worker
HIV	Human Immune Deficiency Virus
NDDI	National Digestive Diseases Information Clearing house
ORS	Oral Rehydration Solution
UNICEF	United Nations Children's Fund
WHO	World Health Organization

DECLARATIONS

Ethics Approval and Consent to Participate

The research project was reviewed by an Institutional Review Board of Jimma University. Permission to conduct the research was obtained from the authorities in the study settings and written informed consents were secured from each participant.

Availability of Data and Materials

Datasets used and /or analyzed during the current study available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

MG, TT, EA and YG participated from the inception of the research idea to proposal development, data collection, analysis and preparation & revision of the manuscript for publication. The authors read and approved the final version of the manuscript.

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APPENDIX

Questionnaires (English Version) Study Participants

1. Cases
2. Controls

Name of Health facility _____Code number of the child (patient) ---------

Name and signature of data collector: _____

Code of questions	QUESTIONS	Responses	Skip to
	PART I. SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERISTICS		
101	family`s dwelling areas	1. Urban 2. Rural	
102	Relation of the respondent to the child	1. Mother 2. Caretaker	
103	Age of the mother/caretaker	Years	
104	Marital status of the mother/caretaker	1. Currently Married 2. Divorced 3. Single 4. Widowed 5. Separated	
105	Family size of the household	1. < 3 2. 3-5 3. 6-8 4. 9-11 5. >=12	
106	Number of U5 children	1. 1 2. 2 3. 3 4. >3	
107	Ethnic group of parents/caretakers	1. Oromo 2. Amhara 3. Others (Specify):	
108	Educational level of mother/caretaker	1. Formal education (A. Primary, B. Secondary, C. Higher) 2. Read and write 3. Read only 4. Neither write nor read	
109	Occupation of mother/caretaker	1. House wife 2. Government employee 3. Merchant 4. Farmer 5. Other (specify):	
110	Age of the child's father	Years	
111	Educational level of the father	1. Formal education (last grade completed) 2. Read and write 3. Read only 4. Neither	
112	Occupation of the father	1. Government employee 2. Merchant 3. Farmer 4. No job 5. Other (specify	
113	Religion	Muslim Orthodox Christian Others (specify): ____	
114	Monthly income	1. < 500 birr 2. 501-1000 birr 3. > 1000 birr 4. Do not know (unspecified)	
	PART II. HOUSEHOLD ENVIRONMENTAL HEALTH CONDITIONS		
201	Do have latrine facility?	1. Yes 2. No ⟶	205
202	Ownership of the latrine	1. Privately owned 2. Shared with neighbors	
203	Type of latrine facility (observation)	1. Traditional pit latrine 2. VIP latrine 3. Public latrine	

Code of questions	QUESTIONS	Responses	Skip to
		4. Communal latrine 5. Other (specify):	
204	Does the latrine currently functioning?	1. Yes 2. No	
205	If the family has no latrine, where do you dispose human waste (Adult member open defecation)	1. Open field 2. Other (specify	
206	How do you dispose refuse? (Multiple response is possible)	A. Pit B. Open field C. Burning D. Garbage can E. Other (specify):	
207	Is feces seen around the house (or in the compound)?	1. Yes 2. No	
208	Where you dispose infant feces/excreta?	1. Not in latrine 2. In latrine	
209	Status of drinking water source	1. Improved 2. Unimproved	
210	Daily water consumption (Per capita water consumption)	1. ≤ 20 Liters 2. > 20 Liters	
211	Distance from the house to the water source	Minutes	
212	Number of rooms in the house	1. 1 2. 2 3. 3 and above	
213	Are there domestic animals living in the same house with the members of the family?	1. Yes 2. No	
	PART III: BEHAVIORAL ASPECTS		
301	Did you wash your hands yesterday?	1. Yes 2. No → 304	
302	At what point/time?	1. Before food preparation and eating 2. After eating 3. After visiting latrine 4. After cleaning of child bottom 5. Other (specify):	
303	By using what did you wash hands yesterday?	1. Soap & water 2. Ash & water 3. Only water 4. Other (specify):	
304	Do you separately prepare food for the child, using a Separate material?	1. Yes 2. No	
305	Do you cut your child nail when grown?	1. Always 2. Sometimes 3. Never	
306	What do you use to feed the child?	1. Hand 2. Cup and spoon 3. Cup 4. Bottle 5. Other (specify):	
307	Does the drinking-water storage container have a cover? Ask the respondent to show you the storage container	1. Yes 2. No	
308	Is there a separate can for taking drinking water from the storage container? Ask the respondent to show you the Can	1. Yes 2. No	
309	Type of collection container	1. Pot 2. Plastic bucket 3. Iron bucket 4. Jerry can 5. Other (specify):	
310	Method of drawing of water from the storage container Dipping Pouring	1. Yes 2. No 1. Yes	

Code of questions	QUESTIONS	Responses	Skip to
		2. No	
	Others (specify)….		
311	Covering material is used during transportation	1. Yes 2. No	
312	Frequency of washing collection containers and others per week	1. Not washed 2. Once 3. Twice 4. ≥ Three	
	When is strict care while handling water?		
313	Fetching	1. Yes 2. No	
	Transporting	1. Yes 2. No	
	Storing	1. Yes 2. No	
	Drinking	1. Yes 2. No	
	Others		
314	Do you treat your water in any way to make it safer to drink?	1. Yes 2. No	
315	What do you usually do to the water to make it safer to drink?	1. Boil 2. Chlorine 3. Strain through cloth (Filtering) 4. Other (specify): _____	
	PART IV: INFORMATION OF THE INDEX CHILD		
401	Age of the index child (in Months)	1. 0-5 Months 2. 6-11 3. 12-23 4. 24-35 5. 36-47 6. 48-59	
402	Sex of the index child	1. Male 2. Female	
403	Birth order of the child	1. First 2. Second 3. Third 4. Fourth & above	
404	Do you (the mother/caretaker) have a history of diarrhea in the past two weeks?	1. Yes 2. No	
405	Have you ever breast-fed your child?	1. Yes 2. No ⟶	407
406	For how long did you breastfed your child?	1. <1 Year 2. ≥ 1 Years	
407	What is his/her current breastfeeding status?	1. Exclusive breastfeeding 2. Partial breastfeeding 3. Not breastfeeding	
408	At what age the child started supplementary /weaning food?	1. Before 6 Months 2. At 6 Months 3. After 6 Months	
409	Did the child receive measles vaccination? Ask for children of age greater than nine months	1. Yes (response of the respondent) 2. Yes, (by checking the card) 3. No	
410	Do your child have diarrhea today? (Only for Cases)	1. Yes 2. No ⟶	End
411	For how long the diarrhea last?	1. Less than 14 days 2. Greater than 14 days	
412	If the child has diarrhea today, how many times a day he/she passes stool?	1. Three times 2. Less than three times 3. More than three times 4. Don't know	
413	The type of diarrhea that the child had	1. Watery 2. Blood and mucus	