A CASE-CONTROL STUDY OF BLOODY DIARRHOEA TRANSMISSION IN THE MORIFI, HOLY CROSS, MOHALINYANE AND LIPHIRING HEALTH CENTERS CATCHMENT AREAS IN LESOTHO, 2003.

BY

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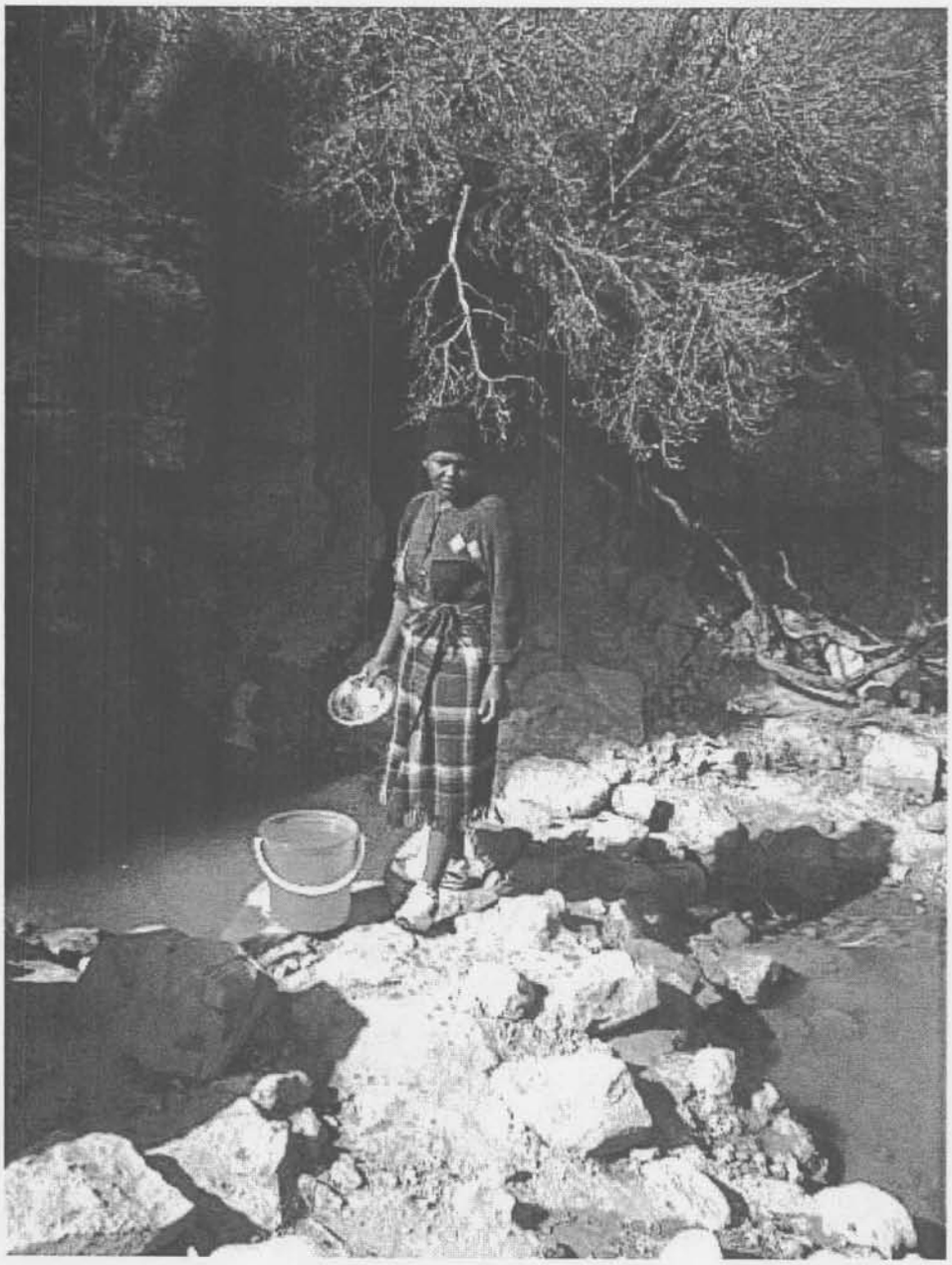

Water source at Tlokotsing in Mohalinyane HC

EXECUTIVE SUMMARY

Lesotho is experiencing a problem of seasonal bloody diarrhoea outbreaks that occur in the southern districts of the country. Usually large proportions of the meagre resources are used to combat such outbreaks. Measures have been taken to provide water and improve sanitation for the commonly affected communities. However, the problem has continued unabated. There was therefore, a need to isolate factors that are associated with the transmission of bloody diarrhoea among the communities in the Morifi, Holy Cross, Liphiring and Mohalinyane health centres where bloody diarrhoea is prevalent.

In this study, 145 cases of bloody diarrhoea and 269 controls were selected from the four health centres. Cases and controls were selected from subjects who were seen in the health centres during the period of December 2002 to February 2003. All available cases were selected whereas controls were selected by systematic sampling.

The study examined environmental factors such as water source, waste and refuse disposal and hygiene practices.

Binary logistic regression was used to estimate the effects of several exposures on bloody diarrhoea. The model showed maintenance of the boreholes to be the most important variable. The Odds ratio among people who experienced unavailability of water was 3.88 greater, among children who do not wash hands the odds ratio was 4.66 higher. Among subjects who ate bread in January the Odds ratio was 1.45 more and among subjects who had someone with bloody diarrhoea in the household the Odds ratio was 2.60 greater.

DISCUSSION

An association was shown between unavailability of water and bloody diarrhoea through binary logistic regression.

Access to water is still difficult because 77% of the people were still more than 100m from the water source. In some villages during the dry seasons, the water sources dry up. Scarcity of water poses vulnerability for these communities because they find themselves in a situation where they have to share the traditional water sources with animals. The prevailing situation of water shortage may be a possible vehicle to the association found in the results of this study.

There was an association between a household that had someone with bloody diarrhoea and the current bloody diarrhoea in the study. Most diarrhoeal infections are acquired by faecal-oral transmission via contaminated food or water. The epidemic curves in these outbreaks from Mohale's Hoek, show slow rise of successive waves. This does not depict a common source of contamination but it may suggest a person-to-person transmission. It is therefore, possible to deduce from this study that the resulting association may be due to compromised hygienic conditions.

An association was also found between lack of maintenance of the water boreholes and bloody diarrhoea. Boreholes are placed strategically to serve scattered villages. This study showed that 1/3 of the subjects had a borehole out of order which means several of the scattered villages are affected by water shortage. It was found out in this study that 93% of the boreholes were never maintained. From this study in Mohale's Hoek, HSA an important fact of lack of maintenance of the boreholes surfaced, and this needs to be investigated in depth to guide policy on community managed borehole water supply system in Lesotho.

In this study the fact that children do not wash their hands before handling food was associated with bloody diarrhoea. Hands are a recognised vehicle for the transmission of contamination, especially in children.

There was an association between eating bread and bloody diarrhoea. Bread is a type of food that can be kept for a long time, as result it may be vulnerable to frequent handling resulting in possible contamination.

CONCLUSION

It was deduced from the study that although the Government through its agencies has done so much to combat frequent outbreaks, bloody diarrhoea still poses a public health problem in these catchment areas. There is need to improve water availability, particularly during dry seasons.

Maintenance of the borehole seems to be an outstanding problem that needs to be investigated further. A policy guideline is required towards the establishment and management of the community fund for maintenance of the boreholes.

Scarcity of water facilitates transmission of diseases such as bloody diarrhoea.

The fact that children do not wash their hands, calls for the emphasis of basic public health principle of personal hygiene.

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted in partial fulfilment of the Degree Master of Science in Epidemiology at the University of Pretoria. It has not been submitted before for any other degree or examination at any other Technikon or University

_____

John Nkonyana

Signed on _____day of _____in _____

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ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
BOS	Bureau of Statistic
CHAL	Christian Health Association of Lesotho
HC	Health Centre
HIV	Human Immune Deficiency Virus
HSA	Health Service Area
MOHSW	Ministry of Health Social Welfare
NGO	Non Government Organization
WHO	World Health Organization

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

1.1. Country Profile

Lesotho is a mountainous country in Southern Africa that is completely surrounded by the Republic of South Africa. She has a population of 2 200000. She lies between 28° and 30° east and between 270 and 300 latitude. Lesotho covers an area of 30 355km^2. She is divided into 10 administrative districts and 18 health districts called Health Service Areas (HSA) as shown in figure 1 below. The people belong to one ethnic group (Basotho). They speak the same language.

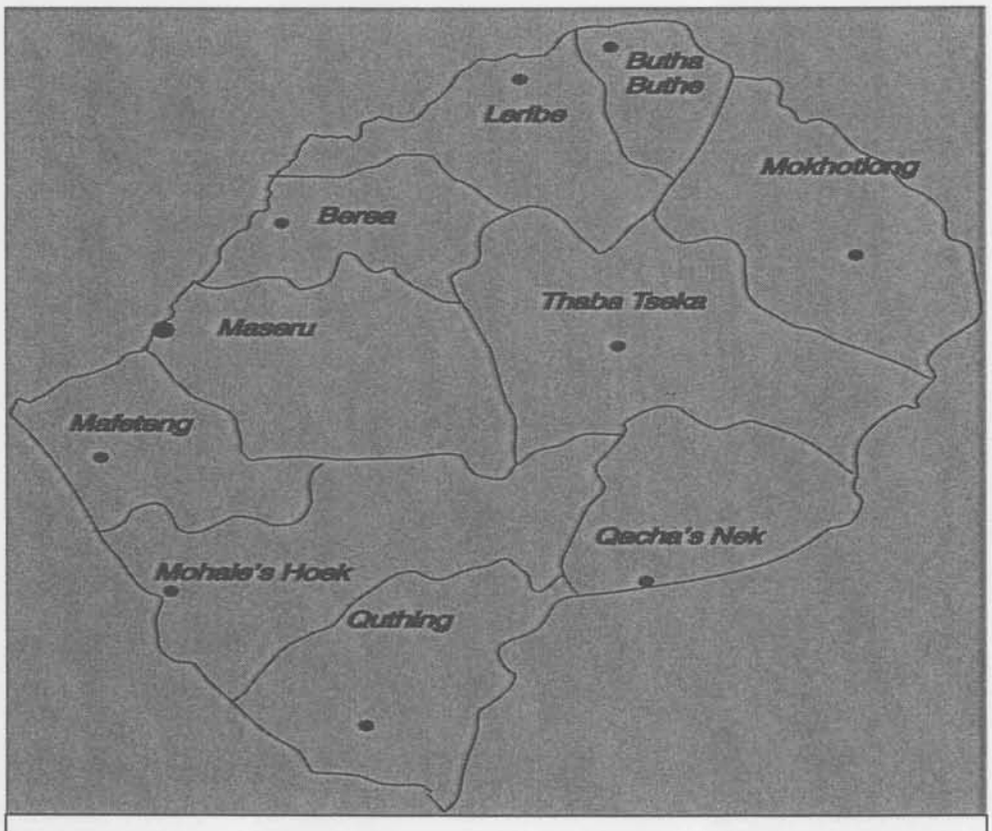

Figure 1: Map of Lesotho according to Administrative districts

Table 1: Some health and economic indicators

Name	Indicator
Infant mortality rate	80 per 1000 live births[1]
Maternal mortality rate	419 per 100000 live births (using sisterhood method) [1]
Life expectancy at birth in 2001	Males 45.1 and females 54.2 years [2]
Gross National Income per Purchasing Power Parity (GNI PPP per capita 2000 US$)	2590 (US$) [2]

1.2. Rationale

According to the Lesotho Health Reform Baseline report, diarrhoea is one of the ten major health problems in Lesotho. The report shows that diarrhoea and gastroenteritis with dehydration accounted for 5.11% of all outpatient conditions in 1998.[3] Mohale's Hoek is one of the 18 Health Service Areas (HSAs) of Lesotho known as Ntsekhe HSA. The Health Service Area is divided into four ecological regions of lowlands, foothills, highlands, and Senqu valley. Bloody diarrhoea outbreaks are common among communities in the Morifi, Holy Cross, Liphiring and Mohalinyane Health Centres catchment areas of Ntsekhe HSA Fig as shown in figure 2 below.

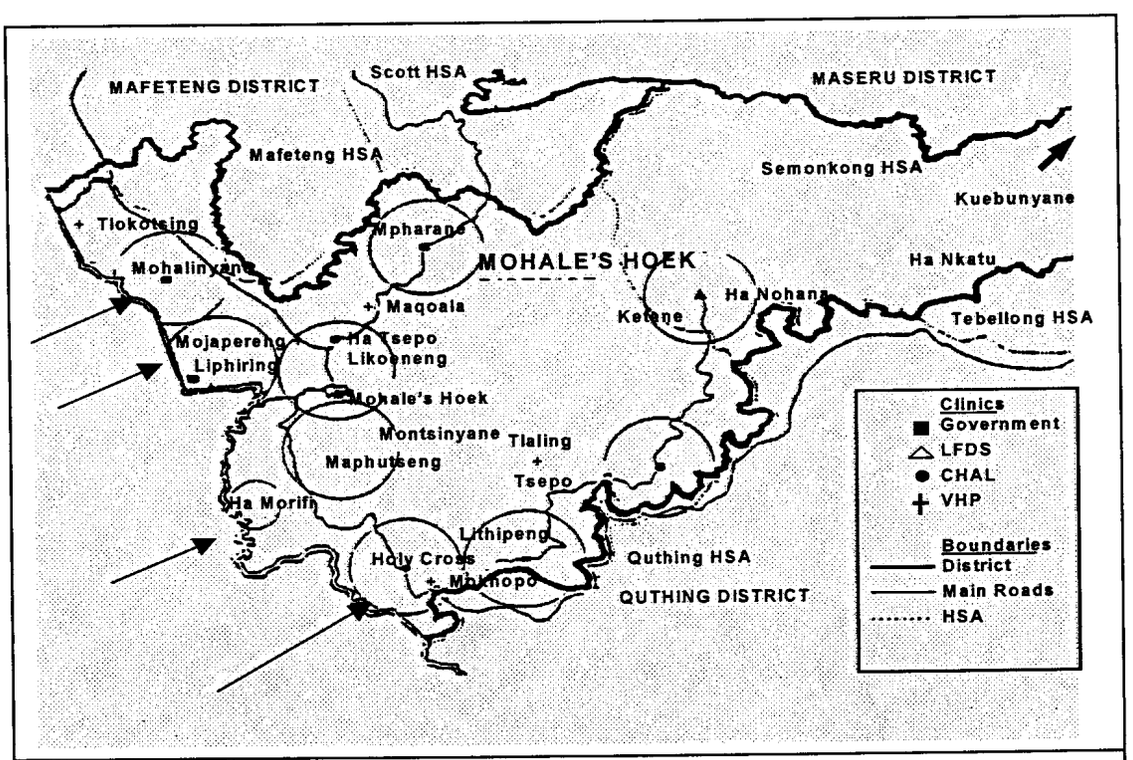

Figure 2: Mohale's Hoek District Health Facilities and rural sanitation sites

Diarrhoea outbreaks are seasonal, most occurring in the months of November, December and January. This outbreak usually affects people in the rural areas, who are disadvantaged and live in difficult to reach places with poor water supply facilities and poor sanitary conditions. The outbreaks have varied in intensity over the years with the most severe episode occurring in 1999 and 2000. These outbreaks have often been accompanied by loss of lives, although this is not well documented because of poor vital statistics registration in Lesotho.

Investigations have been conducted following these outbreaks, which were followed by intervention which were meant to combat the outbreak.

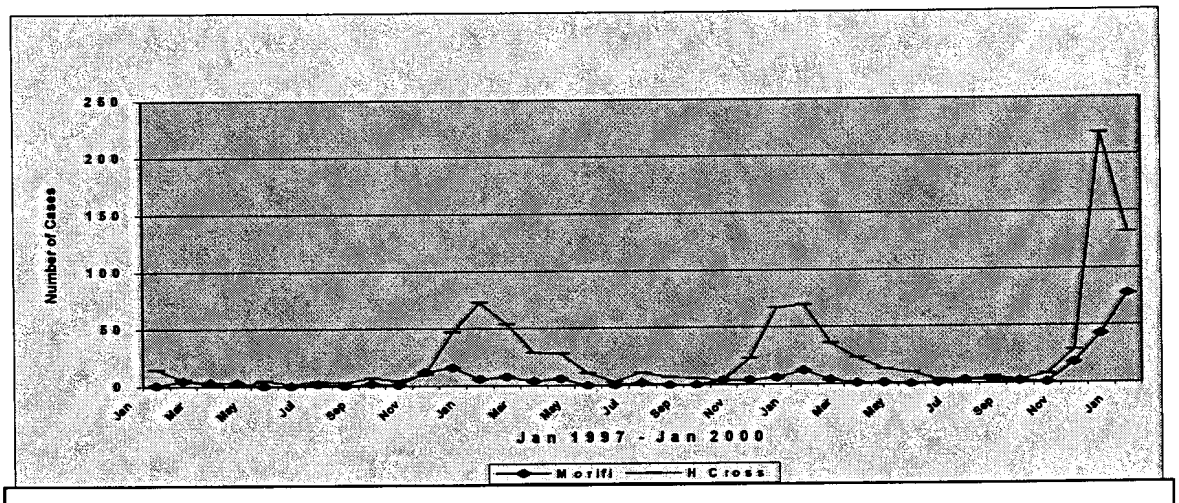

Figure 3: Trend of Bloody Diarrhoea in Morifi and Holy Cross Health Centres. Mohale's Hoek, Jan1997-Jan 2000[4]. Source: DCU

According to the investigation conducted in 2000, Holy Cross has always seen more cases than Morifi during the seasonal outbreaks as shown in figure 3 above[4]. Even if one would speculate that the utilization of health services might be better in Holy Cross and that Holy Cross is more accessible than Morifi, this does not fully explain why Holy Cross had five times more cases of bloody diarrhoea than Morifi at every annual outbreak.

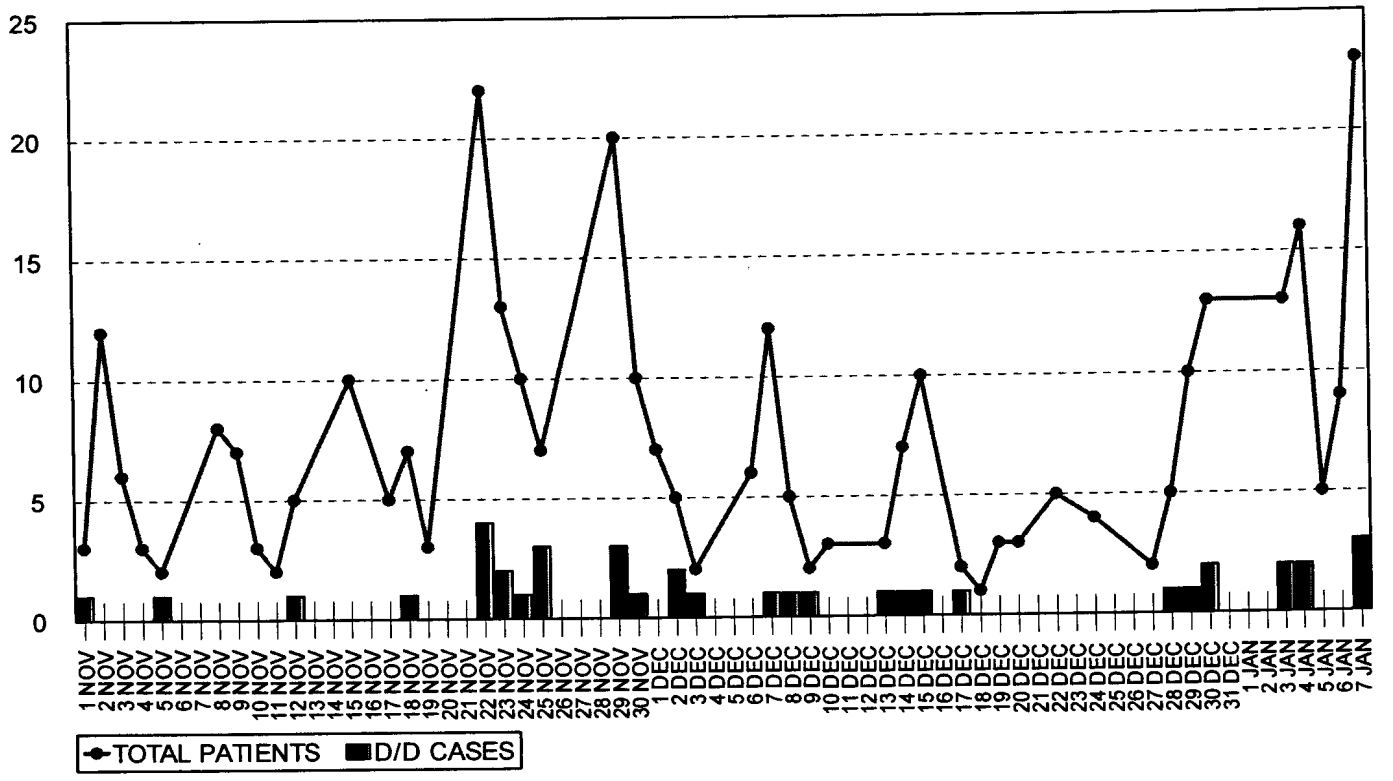

Figure 4: Trends of Bloody Diarrhoea in Liphiring HC, Nov 1999 - Jan 2000. Source: Disease Control

The number of cases in Liphiring also show diarrhoea occurrence but a fewer cases than Holy-Cross. [4]

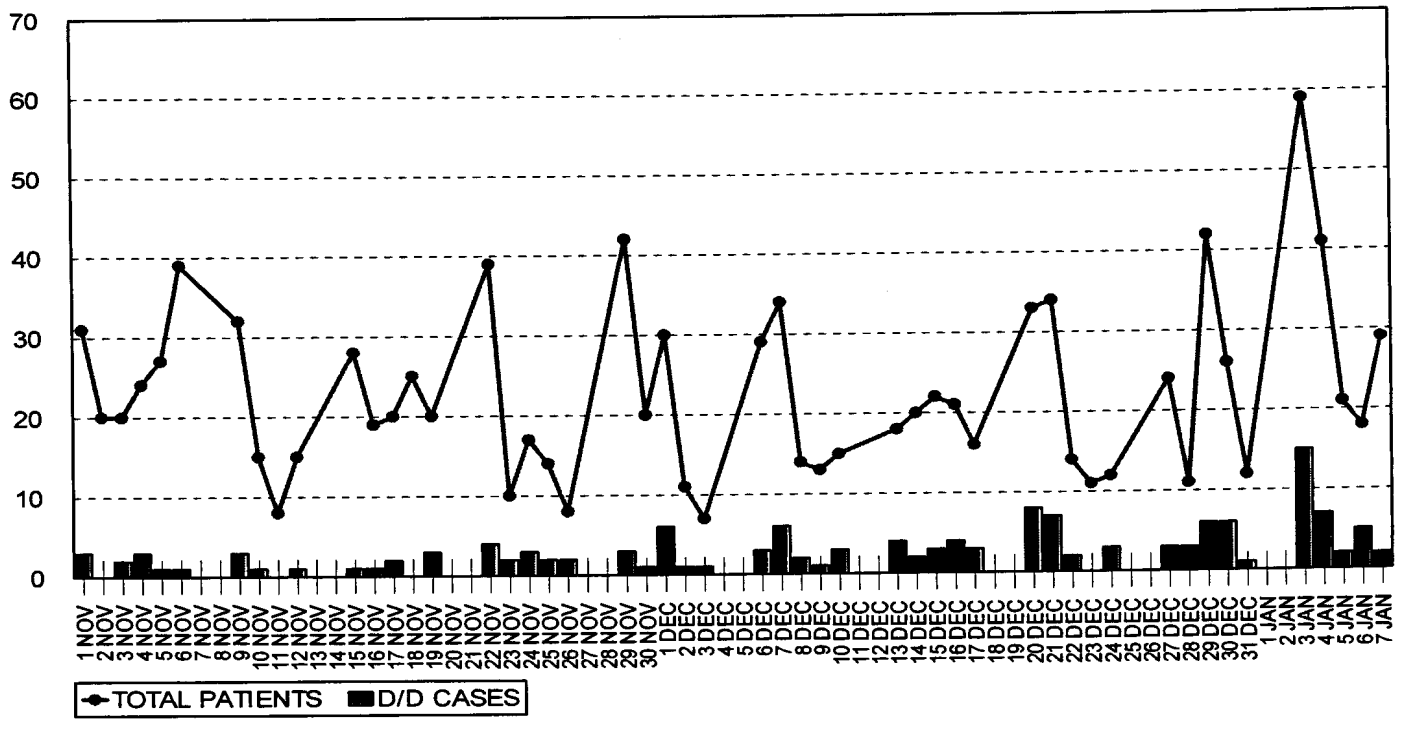

Figure 5: Trends in Bloody Diarrhoea in Mohalinyane HC, Nov 1999 - Jan 2000. Source: Disease

In Mohalinyane Health Centre (HC) the number of cases of diarrhoea were different from their neighbouring Liphiring Health Centre, however a lot more cases were seen here and there was an increased number of cases in January 2000 which denotes a possible out break [4].

The causative germ of the bloody diarrhoea outbreak in 2000 at Mohale's Hoek was identified. Shigella dysenteriae type 1 (SD1) was isolated in four out of the eleven stool specimens which were available. Stools were, however, collected after antibiotics had been widely distributed in the communities. On the other hand, the sensitivity of the isolated organisms to antibiotics was not uniformly assessed among all antibiotics through laboratory investigations.

Blood specimens were also collected on 28 patients and analysed [4]. Nine of them were positive for Widal with significant titers, as an indication of Salmonella typhi infection. The Widal test, however, does not necessarily reflect an acute infection but that a person has been infected. On the other hand, the epidemiology of this outbreak is not typical of typhoid fever, which is more common in children below fifteen.

The investigation of the water sources which was done during the out-break in the affected communities was inadequate to base any concrete conclusions on.

The Ministry of Health and Social Welfare in Lesotho is committed to the improvement of water provision and sanitation around the catchment areas. Example of this commitment is shown by assisting the communities to build latrines, some communities were provided with running water whereas others were assisted to protect their wells. The communities were also given health education through many different mediums of communication. Despite all the effort, this catchment area still experiences bloody diarrhoea. It would therefore be

necessary to isolate factors that are associated with the transmission of bloody diarrhoea among these communities in order to direct prevention activities and to facilitate effective utilization of meagre resources.

1.3. Research Question

What factors are associated with the transmission of bloody diarrhoea among the communities in the Morifi, Holy Cross, Liphiring and Mohalinyane Health Centres catchment areas?

1.4. Objectives

1. To obtain baseline data for Environmental Health Sanitation Program in Lesotho.
2. To determine environmental, living conditions, socio-economic status, lifestyle and personal hygiene factors underlying the seasonal high frequency cases of bloody diarrhoea in Morifi, Holy Cross, Mohalinyane and Liphiring health centres catchment areas.

1.5. Null Hypothesis

There is no association between environmental and/or social factors and the transmission of bloody diarrhoea.

1.6. Literature Review

Acute bloody diarrhoea may be defined as the passage of stools that are both loose or watery with visible red blood. Most episodes of acute diarrhoea are less than 5-7 days long.

In the developing countries, it is estimated that each year there are over 1 billion episodes of diarrhoea in children. There are 3.3 million deaths from diarrhoea, 80% occurring in the first 2 years of life[5].

The most important causes of acute bloody diarrhoea (dysentery) are shigella, campylobacterjejuni, non typhoid salmonella, entero-invasive E coli and entamoeba histolytica, although the latter three are said to be less important.

In dysentery due to invasive bacteria, that is, shigella and campylobacter, the bacteria infects the epithelial cells of the mucosal cells and spread between cells, killing them and extensive inflammatory damage is caused to the mucosa. [6]

In children, a history of bloody stools reported by the mother is sufficient for diagnosis. The most common mode of transmission is the faecal-oral route through contamination of hands, cloths, food, water and person to person.[7]

Diarrhoea is associated with failure to breast feed, impaired immunity, malnutrition, lack of food hygiene, poor weaning practice, lack of sufficient clean water, inadequate sanitation and poor personal and domestic hygiene.[7]

A case-control study of maternal behavioural risk factors for severe diarrhoea in young children in Kinshasa, Democratic Republic of the Congo was done. The study compared hospitalised patients less than three years old with acute diarrhoea requiring re-hydration to the residential neighbours as controls. In this study although there was a trend towards lower maternal educational status among cases, all other socio-economic and demographic characteristics were similar in the study group. The study showed that the households had inferior hygiene practices including improper disposal of children's faeces, absence of toilet

paper, and there was solid or liquid waste disposal within the living compound. Improper refuse disposal was found to be associated with prevalence of diarrhoea.[8]

Ponds and sources of drinking water have been significantly associated with an increased risk of diarrhoea. It has been shown that if drinking water is not purified through filtering, boiling or the addition of alum, it is a risk factor for acute diarrhoea in the dry season. Ponds, rivers and unprotected springs tend to be more heavily contaminated than protected springs[9,10].

The Ministry of Health in Lesotho, reported that 9.5% of children under five years of age who were hospitalised for diarrhoea in 1984 died. Of 104 children under five years of age who died during hospitalisation for diarrhoea, 85% were aged 24 months or younger and had non-bloody diarrhoea during the warm season. Two retrospective case-control studies conducted among children aged 24 months or younger admitted for diarrhoea at two hospitals in 1983 and 1984, compared 44 children who died with 89 who survived death from bloody diarrhoea. In these studies eight factors which were significantly associated with death at one or both hospitals were isolated as follows: diagnosis of a major infection, age under six months, illness for seven days or more before admission, thrush or stomatitis on admission, severe dehydration, history of vomiting, dehydration that had not improved after 12 hours of admission in hospital, and fever or subnormal temperature. Multivariate analysis of data from one hospital showed the first three factors to be significantly associated with death. Cases and controls were similar in sex and in degree of malnutrition. [11]

This investigation followed after case-control study on bloody diarrhoea was last conducted in 1984 as mentioned above.

The bloody diarrhoea investigation in Mohale's Hoek was an undertaking that sought to fill the information deficit by isolating factors that are associated with the transmission of bloody diarrhoea among the identified communities.

CHAPTER 2: METHODS

2.1. Study design

This is a retrospective case-control study design which involved 145 cases of bloody diarrhoea selected from 4 rural sites and 269 controls selected from the same rural sites in Lesotho. The total number of cases, which were listed from patient registers in the respective facilities, was 154. The researcher found out that in this period the number of cases that occurred were fewer than expected as a result all the available cases were selected. Two controls were selected for each case therefore, 308 controls were selected. It was decided that two controls would provide adequate comparison and would assist the researcher to avoid unnecessary cost from a large sample size. In this study there was about 10% non-response resulting in 145 cases and 269 controls who participated in the study.

Cases and controls were similar with regard to environmental and social factors such as water sources, except for the effect of bloody diarrhoea.
The health centres studied were Morifi, Holy-Cross, Mohalinyane and Liphiring.

2.2. Definition of cases and controls

Case definition

A person of any age who presented at the local Health Centre with bloody diarrhoea, in the period between December 2002 and February 2003(this is a time at which cases were identified, it is a high frequency period), who had been resident in the community for at least three months. Diarrhoea is noted to be bloody by the patient, parent or caretaker and or health care provider.

Control definition

An individual of the same age group, who is from the community who did not have bloody diarrhoea but presented at the local health centre for any other condition and has been resident in the community for at least three months prior to the diagnosis of the case.

2.3. Statistical methods

Sample size determination

All population of cases was selected and this constituted 154.

Thus, the number of controls became twice as much, or 308.

Sample selection

The sampling frame (the list of all reported cases of bloody diarrhoea) was prepared from a list of all bloody diarrhoea cases that had been reported at the respective health centres where all case were selected. For controls, in each of the 4 sites, sampling interval was determined: k=N/n where N was the total number of controls listed from the health centre register, n was the sample of controls required and k was therefore resulting figure used systematic selection. The first control was selected using a table of random numbers. The"k^{th}" control on the list was selected. The process continued until *n* controls were selected out of the population (N), at each of the four sites of the study. The tow controls for each case were deemed to be adequate for providing comparison; the researcher also found out that the predecessors in similar studies used as many controls[11]. However, more controls would be desirable if the budget permitted it. Controls were similar with regard to environmental and social factors such as source of water supply except for the effect of bloody diarrhoea. Individual matching was used, specifically for age and sex to ensure that effect modification due to these factors does not occur. Age group matching was done within 5 years age groups. However, matching was not too elaborate where many factors would be used, so that the research would not be undermined by the problem of securing the needed controls, leading to unnecessary expenses and delays.

Each case and its controls were assigned unique identification numbers to facilitate the analysis.

2.4. Preparation of the questionnaire

A pre-quoted questionnaire (Appendix F) was prepared which covers all the variables to be measured in the study. Adequate space was provided in the questionnaire for the interviewer to indicate the responses and no names were recorded on the questionnaire. The questionnaire was translated to Sesotho which is the local language spoken by all the communities in the study area. It was translated back to English to ensure congruency.

2.5. Training

Data collectors, supervisors and data clerks were trained for three days to ensure an understanding of the procedures (see the training guidelines: Annex A) that were used in data collection and entry, their individual roles and the roles of others in the team. The questionnaire was discussed, and any ambiguities and inconsistencies that were found in the questionnaire during training session were rectified.

2.6. Monitoring

The supervisors consistently monitored data collection to ensure the proper and complete recording of information. The supervisors collected the questionnaires from the data collectors at the end of every working day and they also checked the questionnaires for any errors and rectified them. If necessary, the person interviewed was contacted to verify information collected.

2.7. *Limitations*

This study may not be generalized beyond the study population.

The study focused only on those cases that were diagnosed in the local health centre, therefore, leaving the other community members who were treated elsewhere.

2.8. *List of variables of study and their levels*

Variable	Level	Meaning	Comments
Number			Unique number assigned to the subject
Bloody Diarrhoea	1	Yes	
	2	No	
Subject's HC	1	Morifi	
	2	Holy Cross	
	3	Mohalinyane	
	4	Liphiring	
	5	Mootsinyane	
Village			Names of villages of subjects
Sex	1	Male	Gender of the subject
	2	Female	
Age			Age shown in years, if the child's age was less than 10 years the parent/guardian became the respondent.
Education	1	Illiterate	Denoted those who did not attend school
	2	Literate	Denoted those who attended school to at least primary level completing standard 7.
Religion	1	Roman Catholic	
	2	Anglican	
	3	Seventh Day Adventist	
	4	Jehovah's witness	
	5	Zionist	
	6	Lesotho Evangelical Church	
	7	Methodist	
	8	Pentecostal	
	9	Other	
Employment	1	Employed	
	2	Unemployed	
Monthly income per household	1	No income	
	2	Some income	

Variable	Level	Meaning	Comments
Sheep			Interval variable showing number of sheep in the household
Goats			Interval variable showing number of goats the subject has
Cattle			Interval variable showing number of cattle the subject has
Where the animals are watered	1	Risky	A variable showing possibility of water contamination because people and animal share water sources.
	2	Not risky	Sourced not shared with animals
Availability of safe water	1	No	A variable showing that water is found with difficulty
	2	Yes	Water is not found with difficulty
Protected water sources at home	1	No	
	2	Yes	
Protected water sources at school	1	No	
	2	Yes	
Protected water sources at work	1	No	
	2	Yes	
Is the borehole maintained	1	No	
	2	Yes	
If the borehole breaks down	1	No	
	2	Yes	
Availability of community fund	1	No	
	2	Yes	
If boreholes are repaired on time	1	No	
	2	Yes	
Water storage	1	Unsafe	Variable showing that water is stored in a large mouth container uncovered
	2	Safe	Water is either covered in a large mouth container or is stored in a small mouth container.
Frequency of food handling	1	Unsafe	
	2	Safe	
Adult's hand washing practice	1	Unsafe	
	2	Safe	
Children dish up food	1	Yes	
	2	No	
Children's hand washing practice	1	Unsafe	
	2	Safe	
Subjects use soap for hand washing	1	No	
	2	Yes	
Subjects eat pap	1	Yes	
	2	No	
Subjects ate porridge	1	Yes	
	2	No	
Subjects drank milk	1	Yes	

Variable	Level	Meaning	Comments
	2	No	
Subjects ate bread	1	Yes	
	2	No	
Subjects ate meat	1	Yes	
	2	No	
Subjects at rice	1	Yes	
	2	No	
Subjects ate stamp	1	Yes	
	2	No	
Subjects ate salads	1	Yes	
	2	No	
Subjects ate vegetables	1	Yes	
	2	No	
Availability of toilet	1	No	
	2	Yes	
All members of household use the toilet	1	No	
	2	Yes	
Why toilet was used by adults only	1	Fear that children will fall inside	
	2	Fear that children will spoil it	
	3	To keep it clean	
	4	Unspecified	
Someone had bloody diarrhoea	1	Yes	
	2	No	
Safety in wiping	1	Unsafe	
	2	Safe	
Perception on causes of bloody diarrhoea	1	Unprotected water sources	
	2	Lack of toilets	
	3	Poor refuse disposal	
	4	Poverty	
	5	Unspecified causes	
Observed safety of the place used for refuse disposal	1	Unsafe	
	2	Safe	
Distance of the water source in meters from the household			
Availability of protected water source	1	No	
	2	Yes	
Observed availability of a toilet facility	1	No	
	2	Yes	
Observed availability of a safe toilet facility	1	No	
	2	Yes	
Hygienic conditions of the toilet facility	1	Unsafe	
	2	Safe	
Observed safety of waste disposal	1	Unsafe	
	2	Safe	
Status of presence of flies	1	Hazardous	
	2	Safe	
Presence of soap	1	No	

Variable	Level	Meaning	Comments
	2	Yes	

2.9. Data analysis

Data analysis was performed through a series of deliberate procedures explained below. The statistical package used was STATA version 7.

Frequency tables

Frequency tables were arrayed for each variable. The purpose of this procedure was to determine the response to each of the variables.

Pearson's chi-square test of association

The purpose of this procedure was to select 10 or less variable that are strongly associated with the variable bloody diarrhoea. Association was determined at 10% level of significance.

Binary Logistic regression

The purpose of binary logistic regression was to produce a mathematical equation that relates to the probability having bloody diarrhoea to the particular value of risk factor variable. The model was to measure association between bloody diarrhoea and a given variable. In the initial design of the study, conditional logistic regression analysis was proposed. This was based on the assumption that occurrence of diarrhoea could be influenced by sex, age categories and educational status of the respondent, however, this was not supported by the data.

CHAPTER 3 RESULTS

3.1. Frequency Tables

The data set was subjected to analysis using various tests as specified in chapter 2.

The first procedure was to tabulate all variables.

Table 1: Bloody Diarrhoea

	Meaning	Frequency	Percentage	Cumulative
1	Yes	145	35.02	35.02
2	No	269	64.98	100.00
Total		**414**	**100.00**	

Table 2: Frequency according to Health Centre

	Meaning	Frequency	Percentage	Cumulative
1	Morifi	102	24.64	24.64
2	Holy Cross	22	5.31	29.95
3	Mohalinyane	124	29.95	59.9
4	Liphiring	73	17.63	77.54
5	Mootsinyana	93	22.46	100.00
Total		**414**	**100.00**	

The subjects who were interviewed were 414 and they indicated that they were in the jurisdiction of the following Health Centres; Morifi 25% Holy Cross 5%, and Mootsinyana 22%. These health centres almost share the catchment area around the Maphutseng river. Mohalinyane was 30% and Liphiring 18% . The cases that were investigated were 145 and the controls were 269.

Table 3: List of Villages and number of subjects investigated

HEALTH CENTRE	VILLAGE	TOTAL
Morifi Health Centre	Brekfanteng	13
	Ha Maphakela	3
	Mpharane	6
	Thetso	10
	Chopho	4
	Sebetleng	6

	Moiloa	5
	Ha Khosi	6
	Makhabane	3
	Morie	3
	Makunyanpane	4
	Morifi	4
	Makoetlane	3
	Bereng Matsoho	2
	Khoaba lea Bua	3
	Qooane	3
	Liphokoaneng	2
	Thaba Bosiu	3
	Jobo	4
	Mekaling	7
	Masekhonyana	3
	Mokotso	5
	Sub-total	**102**
Mohalinyane Health Centre	Tlokotsing	16
	Ramonate	15
	Linareng	17
	Majapereng	6
	Majakaneng	5
	Raubi	11
	Mahlehle	7
	Matsie	14
	Leribe	6
	Seliba	3
	Pii	9
	Moletsane	8
	Monyake	3
	Sub-total	**124**
Liphiring Health Centre	Makhineng	8
	Ramoitoi	9
	Lekhooe	8
	Liphiring	9
	Makalepentseng	3
	Mokhatla	7
	Raboko	6
	Lipeleng	4
	Khitsane	3
	Mokhethi	7
	Qhalasi	3
	Makhosi	3
	Mokhesi	3
	Sub-total	**73**
Mootsinyana Health Centre	Poqa	11
	Salang	9
	Makilanyaneng	10
	Mootsinyana	5
	Makhube	8
	Khatampi	7
	Setanteng	2
	Mafethe	9

	Matale	3
	Ntseno	8
	Makhosi	18
	Makhetha	3
	Sub-total	**93**
Holy Cross	Makoili	7
	Sethaleng	6
	Theko	9
	Sub-total	**22**
TOTAL		**414**

Table 4: Distribution of respondents by gender

	Meaning	Frequency	Percentage	Cumulative
1	Male	168	40.58	40.58
2	Female	246	59.42	100.00
Total		**414**	**100.00**	

In this study 41% were males while 59% were females.

Table 5: Distribution of respondents by age

Age	Frequency	Percentage	Cumulative
1	9	2.17	2.17
2	31	7.47	9.64
3	18	4.34	13.98
4	22	5.30	19.28
5	11	2.65	21.93
6	9	2.17	24.10
7	8	1.93	26.02
8	6	1.45	27.47
9	11	2.65	30.12
10	16	3.86	33.98
11	12	2.89	36.87
12	4	0.96	37.83
13	11	2.65	40.48
14	19	4.58	45.06
15	12	2.89	47.95
16	16	3.86	51.81
17	8	1.93	53.73
18	18	4.34	58.07
19	12	2.89	60.96
20	8	1.93	62.89
21	6	1.45	64.34
22	6	1.45	65.78
23	13	3.13	68.92
24	6	1.45	70.36
25	5	1.20	71.57
26	1	0.24	71.81

27	5	1.20	73.01
28	3	0.72	73.73
29	5	1.20	74.94
30	8	1.93	76.87
31	7	1.69	78.55
32	3	0.72	79.28
33	2	0.48	79.76
34	3	0.72	80.48
35	5	1.20	81.69
37	1	0.24	81.93
38	3	0.72	82.65
39	3	0.72	83.37
40	6	1.45	84.82
41	7	1.69	86.51
42	2	0.48	86.99
43	3	0.72	87.71
44	3	0.72	88.43
45	2	0.48	88.92
47	2	0.48	89.40
49	1	0.24	89.64
50	4	0.96	90.60
51	1	0.24	90.84
52	1	0.24	91.08
53	3	0.72	91.81
54	1	0.24	92.05
56	6	1.45	93.49
58	3	0.72	94.22
59	3	0.72	94.94
60	4	0.96	95.90
62	3	0.72	96.63
64	3	0.72	97.35
65	1	0.24	97.59
66	1	0.24	97.83
67	2	0.48	98.31
68	2	0.48	98.80
71	1	0.24	99.04
74	2	0.48	99.52
76	1	0.24	99.76
78	1	0.24	100.00
Total	**414**	**100.00**	

This was a variable showing age in years.

Table 6: Distribution of respondents by education status

	Meaning	Frequency	Percentage	Cumulative
1	Illiterate	73	27.04	27.04
2	Literate	197	72.96	100.00
Total		**270**	**100.00**	

Majority (73%) of the people interviewed were literate which means they have completed primary school while 27% were illiterate.

Table 7: Distribution of respondents by religion

	Meaning	Frequency	Percentage	Cumulative
1	Roman Catholic	148	35.66	35.66
2	Anglican	31	7.47	43.13
3	Seventh Day Adventist	0	0.00	43.13
4	Jehovah's witness	5	1.20	44.34
5	Zionist	44	10.60	54.94
6	Lesotho Evangelical	122	29.40	84.34
7	Methodist	34	8.19	92.53
8	Pentecostal	5	1.20	93.73
9	Other	26	6.27	100.00
Total		**415**	**100.00**	

Many (36%) people who were interviewed belonged to the Roman Catholic Church, from Lesotho Evangelical church were 29%, Jehovah's Witnesses showed 10% and Methodist formed 8%, while the rest of the other denominations were represented in small percentages.

Table 8: Distribution of respondents by employment status

	Meaning	Frequency	Percentage	Cumulative
1	Unemployed	94	86.24	86.24
2	Employed	15	13.76	100.00
Total		**109**	**100.00**	

The people who did not respond may have been either unemployed or children. Among subjects (109) who responded on the variable of employment the unemployed formed the majority (86%) and14% were employed.

Table 9: Distribution of respondents by income

	Meaning	Frequency	Percentage	Cumulative
1	No income	154	37.56	37.56
2	Some income	256	62.44	100.00
Total		**410**	**100.00**	

Subjects who indicated their income per month were 410 and 38% had income =< 15USD/month and 62% had income > 15UD/month.

Table 10: Distribution of respondents by number of sheep owned

Sheep	Frequency	Percent	Cumulative
1	11	9.17	9.17
2	17	14.17	23.33
3	17	14.17	37.50
4	14	11.67	49.17
5	11	9.17	58.33
6	5	4.17	62.50
7	6	5.00	67.50
8	6	5.00	72.50
9	2	1.67	74.17
10	7	5.83	80.00
11	3	2.50	82.50
12	3	2.50	85.00
13	3	2.50	87.50
14	2	1.67	89.17
16	1	0.83	90.00
18	1	0.83	90.83
20	4	3.33	94.17
23	2	1.67	95.83
25	1	0.83	96.67
30	2	1.67	98.33
31	2	1.67	100.00
Total	**120**	**100.00**	

This was a variable showing the number of sheep the household had. There were 120 subjects who responded on the question enquiring for the number of sheep they had; 70% had 5 to15 sheep, 30% had 4 sheep or less.

Table 11: Distribution of respondents by number of goats owned

Goats	Frequency	Percent	Cumulative
1	12	11.76	11.76
2	18	17.65	29.41
3	6	5.88	35.29
4	12	11.76	47.06
5	13	12.75	59.80
6	10	9.80	69.61
7	4	3.92	73.53
8	5	4.90	78.43
9	3	2.94	81.37
10	2	1.96	83.33
11	4	3.92	87.25
12	2	1.96	89.22

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13	4	3.92	93.14
14	3	2.94	96.08
17	1	0.98	97.06
19	1	0.98	98.04
20	1	0.98	99.02
27	1	0.98	100.00
Total	102	100.00	

This was a variable showing the number of goats the household had. Of the 102 subjects who responded for the number goats they had in the household, 60% had 5-18 goats, whereas, 40% had 4 goats or less.

Table 12: Distribution of respondents by number of cattle owned

Cattle	Frequency	Percent	Cumulative
1	33	17.46	17.46
2	43	22.75	40.21
3	37	19.58	59.79
4	20	10.58	70.37
5	11	5.82	76.19
6	16	8.47	84.66
7	5	2.65	87.30
8	8	4.23	91.53
9	5	2.65	94.18
10	8	4.23	98.41
11	1	0.53	98.94
19	1	0.53	99.47
20	1	0.53	100.00
Total	**189**	**100.00**	

This was a variable showing the number of cattle a household had. Of 189 subjects who provided information on cattle, 76% had 6 or more cattle and 24% had 5 or less cattle.

Table 13: Distribution of respondents by place where animals are watered

	Meaning	Frequency	Percentage	Cumulative
1	Risky	9	2.17	2.17
2	Not risky	405	97.83	100.00
Total		**414**	**100.00**	

On enquiring on the place where animals were watered, many (98%) indicated that they were watered at the river and dams whereas 2% were watered at wells.

Table 14: Distribution of respondents by availability of water

	Meaning	Frequency	Percentage	Cumulative
1	No	265	64.01	64.01
2	Yes	149	35.99	100.00
Total		**414**	**100.00**	

The subjects (414) who responded to the variable determining the availability of water 64% showed that safe water was not easily available whereas 36% said it was readily available.

Table 15: Distribution of respondents by source of water in the home

	Meaning	Frequency	Percentage	Cumulative
1	No	152	36.80	36.80
2	Yes	261	63.20	100.00
Total		**413**	**100.00**	

At home, 63% of the subjects drank from protected water sources whereas 37% drank from unprotected sources.

Table 16: Distribution of respondents by source of water at school

	Meaning	Frequency	Percentage	Cumulative
1	No	19	23.75	23.75
2	Yes	61	76.25	100.00
Total		**80**	**100.00**	

At school, 76% of the subjects drank from protected water sources whereas 24% drank from unprotected sources.

Table 17: Distribution of respondents by source of water at work

	Meaning	Frequency	Percentage	Cumulative
1	No	6	31.58	31.58
2	Yes	13	68.42	100.00
Total		**19**	**100.00**	

At work, 68% drank from protected water sources whereas 32% drank from unprotected sources.

Table 18: Distribution of respondents by maintenance of the boreholes

	Meaning	Frequency	Percentage	Cumulative
1	No	123	93.18	93.18
2	Yes	9	6.82	100.00
Total		**132**	**100.00**	

This variable measures if the boreholes were maintained. Among the people (132) who drank from boreholes 93% showed that their boreholes system is never maintained. Only 7% said they were maintained.

Table 19: Distribution of respondents by how often the water source breaks down

	Meaning	Frequency	Percentage	Cumulative
1	Yes	92	69.70	69.70
2	No	40	30.30	100.00
Total		**132**	**100.00**	

Of the people (132) who drank from the boreholes 70% indicated that the borehole did not breakdown, while 35% said that it had been out of order.

Table 20: Distribution of respondents by presence of the community fund

	Meaning	Frequency	Percentage	Cumulative
1	Yes	46	36.51	36.51
2	No	80	63.49	100.00
Total		**126**	**100.00**	

Many (63%) research subjects who drank from the borehole showed that the boreholes did not have community maintenance fund, while 37% said they had.

Table 21: Distribution of respondents by repairs of boreholes

	Meaning	Frequency	Percentage	Cumulative
1	No	35	34.31	34.31
2	Yes	67	65.69	100.00
Total		**102**	**100.00**	

This variable enquired whether boreholes were repaired on time. Of the 102 who responded to the variable determining how long it takes to repair a borehole when it is broken; 66% said they were repaired on time (1 to 4 months) while 34% said they were not repaired on time(5 months or more).

Table 22: Distribution of respondents according to how water is stored

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	81	19.57	19.57
2	Safe	333	80.43	100.00
Total		**414**	**100.00**	

An investigation was done to find out how water is stored in the home 100% of the subjects responded and 80% showed that it is stored in a safe way while 20% indicated un-safe storage. Most people (85%) showed that they used soap and water to wash their hands while 15% showed that they did not.

Table 23: Distribution of respondents by how often and how safe food was handled

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	40	9.76	9.76
2	Safe	370	90.24	100.00
Total		**410**	**100.00**	

There was a response rate of 99% to the variable determining how often subjects handled food, 90% handled food in safe frequencies whereas 10% handled food at un-safe frequencies.

Table 24: Distribution of respondents by adult hand washing practices

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	25	6.05	6.05
2	Safe	388	93.95	100.00
Total		**413**	**100.00**	

On finding out whether subjects washed their hands before handling food 94% said they had safe practice of hand washing while 6% said they did not.

Table 25: Distribution of respondents by child food serving practices

	Meaning	Frequency	Percentage	Cumulative
1	Yes	105	26.92	26.92
2	No	285	73.08	100.00
Total		**390**	**100.00**	

On finding out children's practices towards serving food, 73% indicated that children never served food while 27% said they did.

Table 26: Distribution of respondents by child hand washing practices

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	43	41.75	41.75
2	Safe	60	58.25	100.00
Total		**103**	**100.00**	

Many (58%) of the people indicated that children had unsafe practice of not washing hands before handling food, whereas 42% said they washed their hands.

Table 27: Distribution of respondents by material used to wash hands

	Meaning	Frequency	Percentage	Cumulative
1	No	61	14.81	14.81
2	Yes	351	85.19	100.00
Total		**412**	**100.00**	

Most people (85%) showed that they used soap and water to wash their hands while 15% showed that they did not.

Table 28: Distribution of respondents by who ate pap

	Meaning	Frequency	Percentage	Cumulative
1	Yes	349	84.30	84.30
2	No	65	15.70	100.00
Total		**414**	**100.00**	

Most people (84%) ate pap while 16% did not eat it.

Table 29: Distribution of respondents by who ate porridge

	Meaning	Frequency	Percentage	Cumulative
1	Yes	142	34.30	34.30
2	No	272	65.70	100.00
Total		**414**	**100.00**	

Those who did not eat porridge formed 66% and those who ate it 34%

Table 30: Distribution of respondents by who drank milk

	Meaning	Frequency	Percentage	Cumulative
1	Yes	138	33.33	33.33
2	No	276	66.67	100.00
Total		**414**	**100.00**	

There were 67% who did not drink milk while 33% drank it

Table 31: Distribution of respondents by who ate bread

	Meaning	Frequency	Percentage	Cumulative
1	Yes	115	27.71	27.71
2	No	300	72.29	100.00
Total		**415**	**100.00**	

There were 72% who did not eat bread and 28% did.

Table 32: Distribution of respondents by who ate meat

	Meaning	Frequency	Percentage	Cumulative
1	Yes	126	30.36	30.36
2	No	289	69.64	100.00
Total		**415**	**100.00**	

Those who did not eat meat were 70% and 30% ate it

Table 33: Distribution of respondents who ate rice

	Meaning	Frequency	Percentage	Cumulative
1	Yes	45	10.84	10.84
2	No	370	89.16	100.00
Total		**415**	**100.00**	

Rice was eaten by only 11% whereas 89% did not eat it.

Table 34: Distribution of respondents who ate stamp

	Meaning	Frequency	Percentage	Cumulative
1	Yes	36	8.67	8.67
2	No	379	91.33	100.00
Total		**415**	**100.00**	

There was 91% who did not eat stamp and only 9% ate it.

Table 35: Distribution of respondents who ate salads

	Meaning	Frequency	Percentage	Cumulative
1	Yes	64	15.42	15.42
2	No	351	84.58	100.00
Total		**415**	**100.00**	

Those who did not eat salads formed 85% and 15% ate them.

Table 36: Distribution of respondents by who ate vegetables

	Meaning	Frequency	Percentage	Cumulative
1	Yes	136	32.77	32.77
2	No	279	67.23	100.00
Total		**415**	**100.00**	

Table 37: Distribution of respondents by whether they have a toilet

	Meaning	Frequency	Percentage	Cumulative
1	No	194	47.20	47.20
2	Yes	217	52.80	100.00
Total		**411**	**100.00**	

There were 95% who responded to the question determining the presence of a toilet facility in the home state and 53% showed that they had toilets whereas 47% did not have.

Table 38: Distribution of respondents who use a toilet

	Meaning	Frequency	Percentage	Cumulative
1	No	85	40.48	40.48
2	Yes	125	59.52	100.00
Total		**210**	**100.00**	

Of the 51% who responded to the variable enquiring on who used the toilet, 60% said it was used by all members of the family while 40% said it was use by adults only.

Table 39: Distribution of respondents by reasons why the toilet is used by adults only

	Meaning	Frequency	Percentage	Cumulative
1	Fear that children will fall inside.	86	88.30	88.30
2	Children will spoil it	6	6.38	94.68
3	To keep it clean	1	1.06	95.74
4	Others	4	4.26	100.00
Total		**97**	**100.00**	

Other subjects may have not responded because they did not have toilets. The variable determining why the toilet was used by adults only: 1 represented, fear that children will fall inside, 2 fear that children will spoil it, 3 to keep it clean, and 4 unspecified others reasons.

Some of the reasons provided by those who said the toilet is used by adult members of the house hold only showed (88%) fear that children would fall inside, 6% stated fear that children would spoil it, whereas 1% felt they wanted to keep the toilet clean.

Table 40: Distribution of respondents by whether someone in the household has bloody diarrhoea

	Meaning	Frequency	Percentage	Cumulative
1	Yes	182	43.95	43.95
2	No	232	56.04	100.00
Total		**414**	**100.00**	

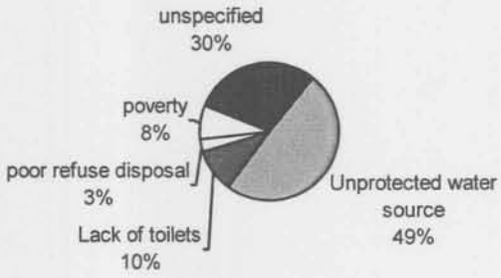
Among 414 subjects interviewed 44% had someone in the household who had bloody diarrhoea, whereas 56% showed that they did not have it.

Table 41: Distribution of respondents by what they use to wipe after defecation

	Meaning	Frequency	Percentage	Cumulative
1	Safe	43	20.67	20.67
2	Unsafe	165	79.33	100.00
Total		**208**	**100.00**	

There was 79% of the subjects who did not use safe material for wiping after defecating, whereas 21% did.

A pie chart showing the perception of subjects on causes of bloody diarrhea



This variable determined the subjects' perception on causes of bloody diarrhoea 1. Unprotected water sources, 2. Lack of toilets, 3. Poor refuse disposal, 4. Poverty and 5. Unspecified causes.

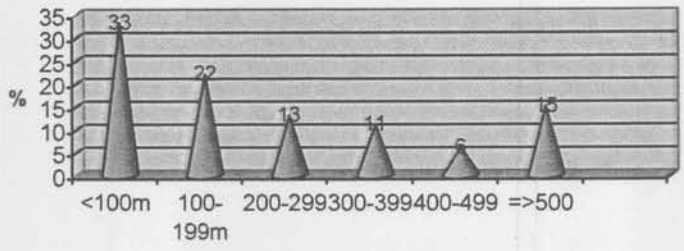
The variable which determined what people perceive as the cause of bloody diarrhoea had 99% response rate, 49% said it is cause by unprotected water sources, 30% mentioned other unspecified causes, 10% said lack of toilets, whereas 3% pointed at poor refuse disposal, and 8% pointed at poverty.

Table 42: Distribution of respondents by observed status of waste disposal

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	395	95.42	95.42
2	Safe	19	4.58	100.00
Total		**414**	**100.00**	

Most (95%) people disposed refuse in unsafe ways and only 5% use safe ways.

Bar chart showing distance from the water source



Distance of the household from the water source in meters.

33% was <100 m away from the water source, 22% was 100-199m away, 15% was 500m < away 13% are 200-299m away, 11% was 300-399m away and 6% was 400-499 m away.

Table 43: Distribution of respondents by observed protection of the water source in the household

	Meaning	Frequency	Percentage	Cumulative
1	No	141	34.56	34.56
2	Yes	267	65.44	100.00
Total		**408**	**100.00**	

408 water sources were inspected for protection in which 65% were protected and 35% were not protected

Table 44: Distribution of respondents by observed presence of toilet

	Meaning	Frequency	Percentage	Cumulative
1	No	190	47.26	47.26
2	Yes	212	52.74	100.00
Total		**402**	**100.00**	

402 households were inspected for the presence of a toilet facility and 53% had a toilet facility whereas 47% did not have.

Table 45: Distribution of respondents by observed toilet type

	Meaning	Frequency	Percentage	Cumulative
1	No	59	31.05	31.05
2	Yes	131	68.95	100.00
Total		**190**	**100.00**	

Of the households which had a toilet facility, 69% had safe toilet facility and 31% had unsafe ones.

Table 46: Distribution of respondents by the observed hygienic conditions of toilet

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	188	88.26	88.26
2	Safe	25	11.74	100.00
Total		**213**	**100.00**	

The toilets were also inspected for hygienic condition, 88% were found to be unhygienic (unsafe) and 12% were safe

Table 47: Distribution of respondents by observed safety of waste disposal

	Meaning	Frequency	Percentage	Cumulative
1	Unsafe	398	97.07	97.07
2	Safe	12	2.93	100.00
Total		**410**	**100.00**	

Waste disposal safety was inspected for in 410 house holds and 97% were found to be hazardous and 3% were safe.

Table 48: Distribution of respondents by observed presence of flies

	Meaning	Frequency	Percentage	Cumulative
1	Hazardous	62	14.98	14.98
2	Safe	352	85.02	100.00
Total		**414**	**100.00**	

Flies population was inspected for in 414 households. In 85% of the households flies were not seen and in15% unsafe population of flies was noted.

Table 49: Distribution of respondents by observed presence of soap

	Meaning	Frequency	Percentage	Cumulative
1	No	20	4.83	4.83
2	Yes	394	95.17	100.00
Total		**414**	**100.00**	

In 414 households inspected for the presence of soap 95% had soap while 5% did not.

3.2 Findings from Test of Association

The second procedure was to perform Pearson's Chi-square test of association between variable diarrhoea (which was depicting cases and controls) against all other variable. The purpose of this procedure was to screen the variables in order to select 10 or less variables that are strongly associated with the variable bloody diarrhoea. The variables were tested at 10% level of significance.

Table 50: Cross tabulation of bloody diarrhoea and educational status

Type	1	2	Total
0	50	130	180
1	23	66	89
Total	**73**	**196**	**269**

Pearson chi2(1) = 0.1128 Pr=0.737

At 10% level of significance, no association was found between bloody diarrhoea and education level. (p0.737)

Table 51: Cross tabulation of bloody diarrhoea and employment status

Type	1	2	Total
0	59	12	71
1	35	3	38
Total	**94**	**15**	**109**

Pearson chi2(1) = 1.6919 Pr = 0.193

At 10% level of significance, no association was found between bloody diarrhoea and employment status (p0.193).

Table 52: Cross tabulation of bloody diarrhoea and place where animals are watered

Type	1	2	Total
0	8	261	269
1	1	143	144
Total	**9**	**404**	**413**

Pearson chi2(1) = 2.2863 Pr = 0.131

At 10% level of significance, no association was found between bloody diarrhoea and a place for watering animals (p0.131).

Table 53: Cross tabulation of bloody diarrhoea and availability of water

Type	1	2	Total
0	105	163	268
1	44	101	145
Total	**149**	**264**	**413**

Pearson chi2(1) = 3.1842 Pr = 0.074

At 10% level of significance an association was found between diarrhoea and availability of water (p0.074).

Table 54: Cross tabulation of bloody diarrhoea and source of water at home

Type	1	2	Total
0	96	172	268
1	55	89	144
Total	**151**	**261**	**412**

Pearson chi2(1) = 0.2273 Pr = 0.634

At 10% level of significance, no association was found between bloody diarrhoea and a place for source of water at home (p0.634).

Table 55: Cross tabulation of bloody diarrhoea and source of water at school

Type	1	2	Total
0	13	39	52
1	6	21	27
Total	**19**	**60**	**79**

Pearson chi2(1) = 0.0751 Pr = 0.784

At 10% level of significance, no association was found between bloody diarrhoea and source of drinking water at school (p0.784).

Table 56: Cross tabulation of bloody diarrhoea and source of water at work

Type	1	2	Total
0	5	10	15
1	1	3	4
Total	**6**	**13**	**19**

Pearson chi2(1) = 0.1015 Pr = 0.750

At 10% level of significance, no association was found between bloody diarrhoea and source of water at work (p0.750).

Table 57: Cross tabulation of bloody diarrhoea and maintenance borehole

Type	1	2	Total
0	9	76	85
1	0	47	47
Total	**9**	**123**	**132**

Pearson chi2(1) = 5.3406 Pr = 0.021

At 10% level of significance an association was found between diarrhoea and maintenance of boreholes (p0.021).

Table 58: Cross tabulation of bloody diarrhoea and breakdown of boreholes

Type	1	2	Total
0	60	25	85
1	32	15	47
Total	**92**	**40**	**132**

Pearson chi2(1) = 0.0898 Pr = 0.764

At 10% level of significance, no association was found between bloody diarrhoea and breakdown of the boreholes (p0.764).

Table 59: Cross tabulation of bloody diarrhoea and community fund

Type	1	2	Total
0	30	51	81
1	16	29	45
Total	**46**	**80**	**126**

Pearson chi2(1) = 0.0274 Pr = 0.869

At 10% level of significance, no association was found between bloody diarrhoea and availability of a community fund for repair of the borehole (p0.869).

Table 60: Cross tabulation of bloody diarrhoea and source of water at home

Type	1	2	Total
0	22	43	65
1	13	24	37
Total	**35**	**67**	**102**

Pearson chi2(1) = 0.0174 Pr = 0.895

At 10% level of significance there was no association found between bloody diarrhoea and the time it takes to repair a broken borehole (p0.895).

Table 61: Cross tabulation of bloody diarrhoea and storage of water

Type	1	2	Total
0	53	216	269
1	28	116	144
Total	**81**	**332**	**413**

Pearson chi2(1) = 0.0040 Pr = 0.950

At 10% level of significance there was no association found between bloody diarrhoea and the way water is stored in the home (0.950).

Table 62: Cross tabulation of bloody diarrhoea and how often food is handled

Type	1	2	Total
0	24	240	264
1	16	129	145
Total	**40**	**369**	**409**

Pearson chi2(1) = 0.4007 Pr = 0.527

At 10% level of significance there was no association found between bloody diarrhoea and how often food is handled (0.527).

Table 63: Cross tabulation of bloody diarrhoea and adult hand washing practices

Type	1	2	Total
0	13	254	267
1	12	133	145
Total	**25**	**387**	**412**

Pearson chi2(1) = 1.9136 Pr = 0.167

At 10% level of significance there was no association found between bloody diarrhoea and how often one remembers to wash hands before handling food (0.167).

Table 64: Cross tabulation of bloody diarrhoea and child serving food

Type	1	2	Total
0	70	178	248
1	35	106	141
Total	**105**	**284**	**389**

Pearson chi2(1) = 0.5283 Pr = 0.467

At 10% level of significance there was no association found between bloody diarrhoea and how often children served food for themselves (0.467).

Table 65: Cross tabulation of bloody diarrhoea and child hand washing practice

Type	1	2	Total
0	46	22	68
1	14	21	35
Total	**60**	**43**	**103**

Pearson chi2(1) = 7.2626 Pr = 0.007

The respondents may be fewer(103) because other households did not have children. At 10% level of significance an association was found between diarrhoea and how often children wash their hands before handling food (p0.007).

Table 66: Cross tabulation of bloody diarrhoea and material used to wash hands

Type	1	2	Total
0	37	231	268
1	24	119	143
Total	**61**	**350**	**411**

Pearson chi2(1) = 0.6539 Pr = 0.419

At 10% level of significance there was no association found between bloody diarrhoea and what subjects used to wash their hands. (p0.419).

Table 67: Cross tabulation of bloody diarrhoea and eating pap

Type	1	2	Total
0	224	44	268
1	124	21	145
Total	**348**	**65**	**413**

Pearson chi2(1) = 0.2657 Pr = 0.606

At 10% level of significance there was no association found between bloody diarrhoea and eating pap (0.606).

Table 68: Cross tabulation of bloody diarrhoea and eating porridge

Type	1	2	Total
0	92	176	268
1	50	95	145
Total	**142**	**271**	**413**

Pearson chi2(1) = 0.0010 Pr = 0.975

At 10% level of significance there was no association found between bloody diarrhoea and eating pap (0.975).

Table 69: Cross tabulation of bloody diarrhoea and drinking milk

Type	1	2	Total
0	85	183	268
1	52	93	145
Total	**137**	**276**	**413**

Pearson chi2(1) = 0.7295 Pr = 0.393

At 10% level of significance there was no association found between bloody diarrhoea and drinking milk (p0.393).

Table 70: Cross tabulation of bloody diarrhoea and eating bread

Type	1	2	Total
0	184	85	269
1	115	30	145
Total	**299**	**115**	**414**

Pearson chi2(1) = 5.5887 Pr = 0.018

At 10% level of significance there was an association found between bloody diarrhoea and eating bread (p0.018)

Table 71: Cross tabulation of bloody diarrhoea and eating meat

Type	1	2	Total
0	77	192	269
1	48	97	145
Total	**125**	**289**	**414**

Pearson chi2(1) = 0.8967 Pr = 0.344

At 10% level of significance there was no association found between bloody diarrhoea and eating meat (p0.344).

Table 72: Cross tabulation of bloody diarrhoea and eating rice

Type	1	2	Total
0	33	236	269
1	12	133	145
Total	**45**	**369**	**414**

Pearson chi2(1) = 1.5496 Pr = 0.213

At 10% level of significance there was no association found between bloody diarrhoea and eating rice (p0.213).

Table 73: Cross tabulation of bloody diarrhoea and eating stamp

Type	1	2	Total
0	25	244	269
1	11	134	145
Total	**36**	**378**	**414**

Pearson chi2(1) = 0.3460 Pr = 0.556

At 10% level of significance there was no association found between bloody diarrhoea and eating stamp (p0.556).

Table 74: Cross tabulation of bloody diarrhoea and eating salads

Type	1	2	Total
0	44	225	269
1	20	125	145
Total	**64**	**350**	**414**

Pearson chi2(1) = 0.4738 Pr = 0.491

At 10% level of significance there was no association found between bloody diarrhoea and eating salads (p0.491).

Table 75: Cross tabulation of bloody diarrhoea and eating vegetables

Type	1	2	Total
0	96	173	269
1	40	105	145
Total	**136**	**278**	**414**

Pearson chi2(1) = 2.8033 Pr = 0.094

At 10% level of significance there was an association between bloody diarrhoea and eating vegetables (p0.094).

Table 76: Cross tabulation of bloody diarrhoea and having a toilet

Type	1	2	Total
0	123	145	268
1	71	71	142
Total	**194**	**216**	**410**

Pearson chi2(1) = 0.6273 Pr = 0.428

At 10% level of significance there was an association found between bloody diarrhoea and having a toilet facility in the household (p0.428).

Table 77: Cross tabulation of bloody diarrhoea and those using the toilet

Type	1	2	Total
0	57	84	141
1	27	41	68
Total	**84**	**125**	**209**

Pearson chi2(1) = 0.0099 Pr = 0.921

At 10% level of significance there was an association found between bloody diarrhoea and how toilet facility was used by the household (p0.428).

Table 78: Cross tabulation of bloody diarrhoea and having someone with bloody diarrhoea in the house

Type	1	2	Total
0	177	92	269
1	54	90	144
Total	**231**	**182**	**413**

Pearson chi2(1) = 30.4741 Pr = 0.000

At 10% level of significance there was an association found between bloody diarrhoea and having some one with bloody diarrhoea in the household (p0.000).

Table 79: Cross tabulation of bloody diarrhoea and materials used after defecation

Type	1	2	Total
0	28	111	139
1	14	54	68
Total	**42**	**165**	**207**

Pearson chi2(1) = 0.0056 Pr = 0.940

At 10% level of significance there was no association found between bloody diarrhoea and how subjects clean themselves after defecating (p0.940).

Table 80: Cross tabulation of bloody diarrhoea and refuse disposal

Type	1	2	Total
0	254	15	269
1	141	4	145
Total	**395**	**19**	**414**

Pearson chi2(1) = 1.7081 Pr = 0.191

At 10% level of significance there was no association found between bloody diarrhoea and where subjects disposed their refuse (p0.940).

Table 81: Cross tabulation of bloody diarrhoea and observed protection of the water source

Type	1	2	Total
0	88	176	264
1	52	91	143
Total	**140**	**267**	**407**

Pearson chi2(1) = 0.3775 Pr = 0.539

At 10% level of significance there was no association found between bloody diarrhoea and protection of the water sources (p0.539).

Table 82: Cross tabulation of bloody diarrhoea and observed availability of toilet

Type	1	2	Total
0	123	142	265
1	67	69	136
Total	**190**	**2111**	**401**

Pearson chi2(1) = 0.2927 Pr = 0.588

At 10% level of significance there was no association found between bloody diarrhoea and non availability of a toilet facility (p0.588).

Table 83: Cross tabulation of bloody diarrhoea and toilet type

Type	1	2	Total
0	82	45	127
1	48	14	62
Total	**130**	**59**	**189**

Pearson chi2(1) = 3.2050 Pr = 0.073

At 10% level of significance there was an association found between bloody diarrhoea and a type of toilet facility that the subjects had (p0.073).

Table 84: Cross tabulation of bloody diarrhoea and hygienic conditions of toilet

Type	1	2	Total
0	124	19	143
1	63	6	25
Total	**187**	**25**	**212**

Pearson chi2(1) = 0.9431 Pr = 0.331

At 10% level of significance there was no association found between bloody diarrhoea and the hygienic conditions of a toilet facility (p0.331).

Table 85: Cross tabulation of bloody diarrhoea and waste disposal

Type	1	2	Total
0	255	9	264
1	142	3	145
Total	**397**	**12**	**442**

Pearson chi2(1) = 0.5902 Pr = 0.442

At 10% level of significance there was no association found between bloody diarrhoea and the waste disposal in the household (p0.441).

Table 86: Cross tabulation of bloody diarrhoea and presence of flies

Type	1	2	Total
0	44	224	268
1	18	127	145
Total	**62**	**351**	**413**

Pearson chi2(1) = 1.1824 Pr = 0.277

At 10% level of significance there was no association found between bloody diarrhoea and the presence of flies in the household (p0.277).

Table 87: Cross tabulation of bloody diarrhoea carriers

Type	1	2	Total
0	12	257	269
1	8	136	413
Total	**20**	**393**	**413**

Pearson chi2(1) = 0.2439 Pr = 0.621

At 10% level of significance there was no association found between bloody diarrhoea and the presence of soap in the household (p0.627).

3.3 Binary logistic regression analysis

logistic diarrhoea AVAILWAT MAINTAIN CHILDWAS BREAD VEGETAB HADBLDIA TOILETT

note: MAINTAIN~=1 predicts failure perfectly

MAINTAIN dropped and 1 obs not used

Logit estimates

Number of obs = 14

LR chi2(6) = 4.11

Prob > chi2 = 0.0120

Log likelihood = -7.5064478

Pseudo R2 = 0.7249

Diarrhoea	Odds Ratio	Std Err	Z	P>|Z|	[95% Conf. Interval]
AVAILWAT	3.885363	8.351025	2.63	0.008	.0575304 - 262.4014
CHILDWAS	4.668381	7.788394	3.92	0.006	.1774526 - 122.8147
BREAD	1.459113	3.410247	2.16	0.072	.0149505 – 142.4038
VEGETAB	.4595504	1.036471	-2.34	0.030	.0055275 – 38.20623
HADBLDIA	2.605275	4.241294	2.59	0.015	.1071836 – 63.32552
TOILET	.4195766	.942773	-1.99	0.099	.0051309 – 34.31068

Interpretations of odds ratios:

Odds ratio = exp($\hat{\beta}$).

(1) If the odds ratio is greater than 1, the likelihood of bloody diarrhoea is increased.

(2) If the odds ratio is smaller than 1, the likelihood of bloody diarrhoea is decreased.

(3) If the odds ratio is equal to 1, the likelihood of bloody diarrhoea is not affected at all.

The odds ratio for the variable AVAILWAT is 3.88. When the value of AVAILWAT changes from low level to high level (when there is no clean drinking water available), the likelihood of bloody diarrhoea is increased by a factor of 3.88.

The odd ratio for the variable CHILDWAS is 4.66. When children's hand washing practice is unsafe, CHILDWAS changes from low to high level the likelihood of bloody diarrhoea is increased by factor of 4.66.

The odds ratio for the variable BREAD is 1.45. Eating bread changed BREAD from low to high level the likelihood of bloody diarrhoea is increased by factor of 1.45.

The odds ratio for the variable HADBLDIA is 2.61. Having someone in the household with bloody diarrhoea changed HADBLDIA from low to high level the likelihood of bloody diarrhoea is increased by factor of 2.6.

Thus, on the basis of estimated odds ratios, the 6 important predictor variables in the study can be listed down in a decreasing order of their strength as follows:

Variable	Odds ratio	p-value	Order of strength
CHILDWAS	4.67	0.006	1
AVAILWAT	3.89	0.008	2
HADBDIA	2.61	0.015	3
BREAD	1.46	0.072	4
VEGETAB	0.46	0.030	5
TOILETT	0.42	0.099	6

The regression coefficients in the estimated logistic regression model were obtained as follows:

logit

note: MAINTAIN~=1 predicts failure perfectly

MAINTAIN dropped and 1 obs not used

Logit estimates Number of obs = 14

LR chi2(6) = 4.11

Prob > chi2 = 0.6620

Log likelihood = -7.5064478 Pseudo R2 = 0.2149

Diarrhoea	Coefficients	Std Err	Z	P>|Z|	[95% Conf. Interval]
AVAILWAT	1.357216	2.149355	0.63	0.528	-2.855443 – 5.569875
CHILDWAS	1.540812	1.668329	0.92	0.356	-1.729052 – 4.810676
BREAD	.3778288	2.337205	0.16	0.872	-4.203009 – 4.958667
VEGETAB	-.7775067	2.255401	-0.34	0.730	-5.198012 – 3.642999
HADBLDIA	.9575384	1.627964	0.59	0.556	-2.233212 – 4.148288
TOILET	-.8685091	2.246963	-0.39	0.699	-5.272475 – 3.535457
Constant	-1.493529	2.340282	-0.64	0.523	-6.080397 – 3.093339

The above table shows estimated regression coefficients. The estimated binary logistic regression model is written as follows:

$$\Pr(Y=1)=\frac{1}{1+\exp(-Z)} \quad \text{where}$$

$$Z=-1.49+1.36*AVAILWATER+1.54*CHILDWAS+0.38*BREAD-0.78*VEGETAB$$
$$+0.96*HADBLDIA-0.87*TOILETT$$

Using the above relationship, the probability of bloody diarrhoea can be worked out for a randomly identified person in the study.

Assessing the fitted model

Diagnostic procedures were used to assess the adequacy of the fitted logistic regression model.

. lstat

Logistic model for diarrhoea

------- True -------

Classified	D	~D	Total
+	4	1	5
-	2	7	9
Total	6	8	14

classified + if predicted Pr(D) >= .5

True D defined as diarrhoea ~= 0

Sensitivity	Pr(+|D)	66.67%
Specificity	Pr(-|~D)	87.50%
Positive Predictive value	Pr(D|+)	80.00%
Negative Predictive value	Pr(~D|-)	77.78%

False + rate for true ~D	Pr(+|D)	12.50%
False – rate for true D	Pr(-|D)	33.33%
False + rate for classified	Pr(~D|+)	20.00%
False – rate for classified	Pr(~D|-)	22.22%
Correctly classified		78%

The above table shows that the percentage of correctly classified cases is 78.57%. As this percentage is over 75%, it can be assumed that the estimated model is fairly reliable.

The ability of the model to detect bloody diarrhoea is 66.66% which is sensitivity. Its negative rate is 33.33% which means it may falsely give negative results in 33.33%.

The ability of the model to identify the subjects who do not have bloody diarrhoea is 87.75% which is the specificity. The false positive rate is 12.50% and it may give positive results only in few cases.

The estimated model is moderately sensitive to detecting bloody diarrhoea when it is used within the given study setting. The model has high specificity for identifying subjects without bloody diarrhoea.

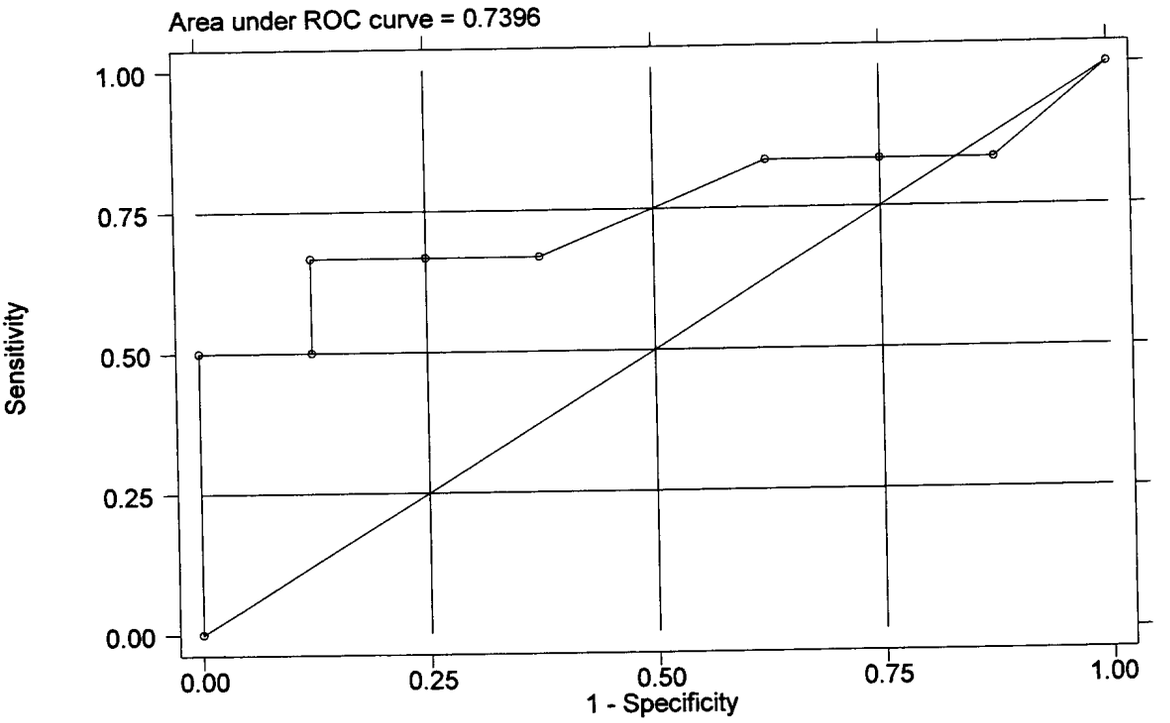
Measure of correct classification

. lroc

Logistic model for diarrhoea

number of observations = 14

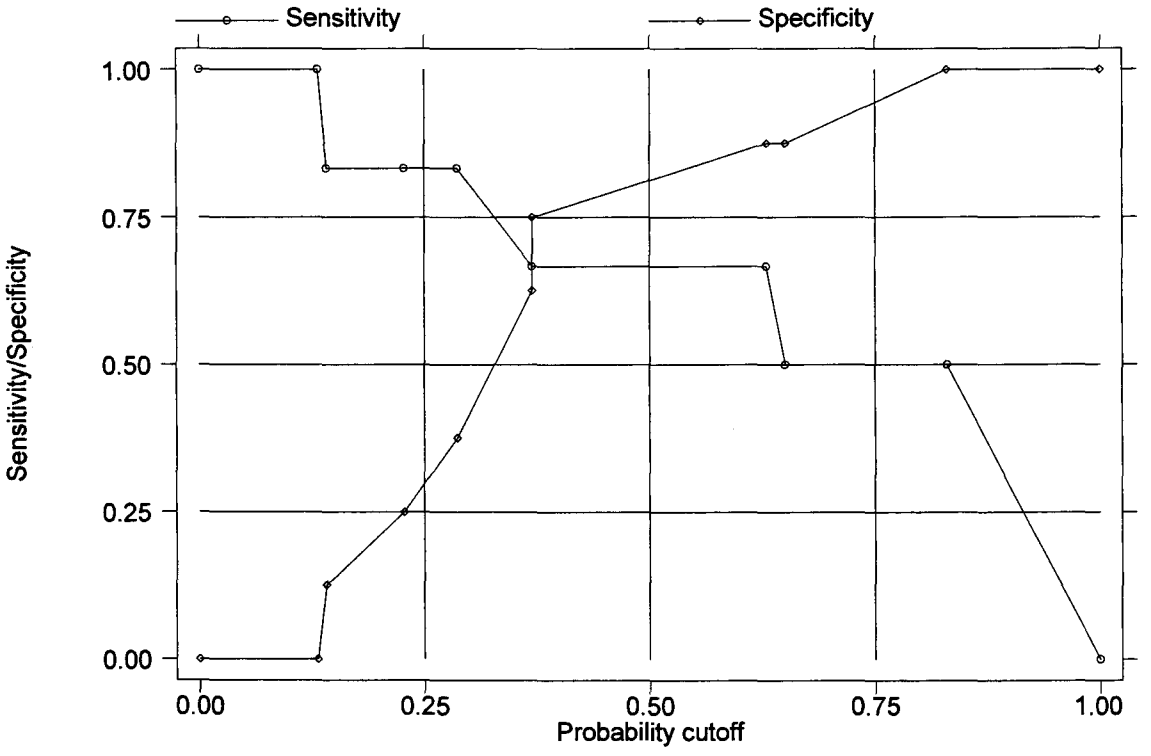
area under ROC curve = 0.7396



The area that lies under the ROC (receiver of characteristic) curve is 73.96%. The ROC curve is also a measure of correct classification. As the area that lies under the ROC curve is almost 75%, it shows that the estimated model is good.

Sensitivity and specificity of the model

. lsens



The above plot gives a plot of sensitivity/specificity versus probability cut-off point. For a good model, the probability cut-off point that lies vertically below the point of intersection of the two curves should be fairly close to 0. For this model the probability cut-off point is well above 0.25. The above graph shows that the estimated model is not so good with regards to sensitivity and specificity. When used in this study for sensitivity and specificity the results may not be reliable.

Goodness of fit

. lfit

Logistic model for diarrhoea, goodness-of-fit test

number of observations = 14

number of covariate patterns = 9

Pearson chi2(2) = 7.13

Prob > chi2 = 0.0783

The Hosmer and Lemeshow goodness of fit statistic is used to assess the adequacy of the estimated model. The null hypothesis states that we have no reason to doubt the adequacy of the fitted model. The alternative hypothesis states that we have enough reason to doubt the adequacy of the fitted model. The null hypothesis is rejected if the p-value is less than $\alpha = 0.05$.

Decision rule:

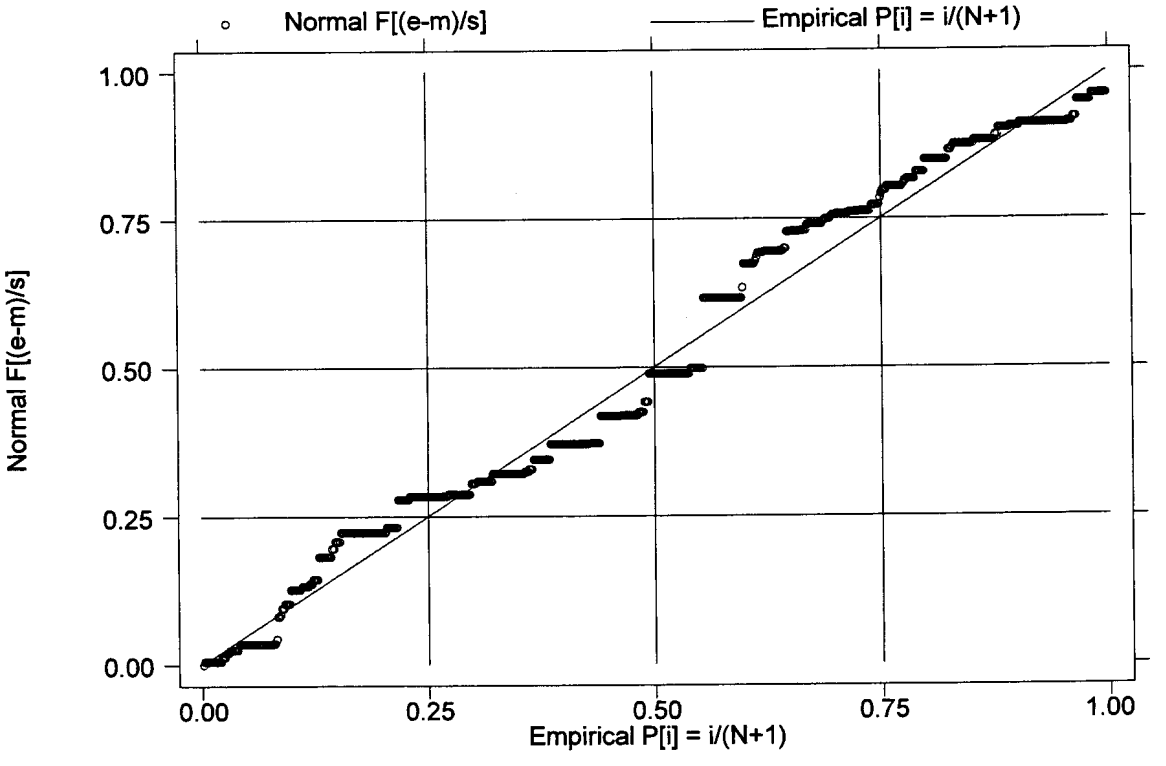
1. Reject the null hypothesis if $p < \alpha$
2. Accept the null hypothesis if $p \geq \alpha$

Now, since $p \geq \alpha$ (p=0.0783) (α=0.05), the null hypothesis is accepted at the 5% level of significance. We thus conclude that the fitted model is good.

predict e if e(sample), resid

(401 missing values generated)

pnorm e, grid



The above normal probability plot is fairly S-shaped. This shows that the residuals are fairly normally distributed with mean 0 and constant variance. Hence, we can assume that the fitted model is reliable.

Measure of correct classification

.lroc

Logistic model for diarrhoea

number of observations = 14

area under ROC curve = 0.7396

CHAPTER 4: DISCUSSION

4.1. Introduction

The cyclical epidemics in this Health Service Area occur in the rural communities, which are difficult to access because of poor roads. Some villages can only be accessed by four-wheel-drive vehicles, yet some can be accessed on horseback only. These are disadvantaged communities which survive through nonviable subsistence farming. In these communities the sanitation system is weak. There are a few latrines, most of which are ordinary pit latrines. Many households use dongas, bush and hills as toilets. Most villages do not have running water. However, there are boreholes, which are dug in many villages by governmental and non-governmental organizations.

In most households both liquid and solid waste are disposed of on an ash heap (thothobolo), which is also used by children as toilet. The heaps are normally placed near the households, and during windy and rainy seasons, the waste gets into the house. The heap is also used as a graveyard for stillbirths and infants. The families have cultural and emotional ties to the heap.

The communities in these villages experience high migration because of changing patterns of source of household income in Lesotho. Many mineworkers have been retrenched from the South African mines. The new sources of employment are the fabric industries that are found in the urban areas; they are mostly suitable for female employees. This has brought about migration of women and as a result, men bear responsibilities for the care of the households, the role that may be new to most men. This can lead to the compromised hygienic conditions because unlike men, women always receive health education on hygienic care of the family during pre-natal and anti-natal clinic, which men do not normally attend.

4.2. Discussion

In the initial design of the study, conditional logistic regression analysis was proposed. This was based on the assumption that the prevalence of diarrhoea could be influenced by sex and age categories; as is the case in diarrhoeal studies. For example, in study done in Pakistan to evaluate Water and Sanitation extension programme, it was found out that after the other variables had been adjusted for, boys had 25% lower Odds of having diarrhoea than females while the mothers' age was inversely proportional to diarrhoeal disease [12] However, that assumption was not supported by the data set in this study. The frequencies tables showed that diarrhoea was insensitive to among others sex, age categories, occupation and the level of education. As a result the main method of analysis used was the binary logistic regression. Analysis was based on logistic regression as a mathematical modeling approach. It was aimed to describe the relationship between independent factors and the dichotomous variable to the dependent variable, which in this case was bloody diarrhoea. Binary logistic regression analysis for potential risk factors for bloody diarrhoea revealed that: non-availability of water, children's unsafe practice of not washing hands, eating bread in January, eating vegetables in January, someone having bloody diarrhoea in the house and unsafe toilet facilities in the household were associated with bloody diarrhoea

Association between availability of water and bloody diarrhoea

An association was shown between unavailability of water and bloody diarrhoea through binary logistic regression.

The catchment areas under study usually experience drought in the months of December to February. In some villages during the dry season water sources dry up. Scarcity of water poses vulnerability for these communities because they find themselves in a situation where

they have to share the traditional water sources with animals. Cattle, for instance, are a major reservoir of E. coli and shed the organism frequently when stressed[10].

The Government of Lesotho through relevant Ministries and Non Governmental organization has undertaken to provide water supply in many villages in these catchment areas through water gravity systems and boreholes. However, access to water is still difficult because 77% of the people in this study were still more than 100m from the water source. Although this distance might seem within acceptable range, the terrain is mountainous and it is difficult to move around in the area. Therefore, for this area, water sources that are more than 100m away from the homes could be difficult to reach.

Prospective community studies indicate that incidence of rotavirus infections increase in the dry season[13]. In this study no water testing was done from the water sources however, bacteriological studies in rural Nigeria have shown consistent contamination of traditional water sources with faecal coliform and streptococci, albeit varying with patterns of rain fall. Ponds, rivers and unprotected springs tend to be more heavily contaminated than protected springs. The sources of drinking water have been significantly associated with increased risk of diarrhoea[14].

In the results, the Pearson's Chi square test showed that there was an association with the maintenance of boreholes. However, when refining the association, the variable MAINTAIN was rejected by the binary logistic regression model. It was dropped because nearly all answers were positive for it.

The boreholes in this study area frequently get broken and also run dry during the dry season. It is at this time that communities resort to unprotected water sources such as springs and nearby rivers. They have to walk long distances to find water. Where the boreholes have been dug by governmental or nongovernmental organizations, communities are charged with the responsibility to develop a community fund for maintenance and repair

of such boreholes. The fund is generated and run by the communities themselves. They elect a committee to take care of such a fund. This fund is not properly managed because the communities are not adequately trained for management to do so. There is no policy or studies that have been done to guide the management of such fund in Lesotho, however, in Uganda community based management of water supply was frustrated by expensive maintenance[15]. However, in some communities in this study, such fund is available whereas in others it is not.

Boreholes are placed strategically to serve the scattered villages; in this study 1/3 of the subjects had boreholes out of order and this means that several of the scattered villages were affected by water shortage. It was found out in this study that 93% of the boreholes were never maintained. It was also observed that in two of the communities studied boreholes were placed in sloppy areas below graveyards and toilets and water from boreholes had a foul odour, as a result, people were not using it.

Community participation and empowerment, skills training, cost recovery, transparency, setting-up of proper spares for the borehole system, capacity building of the community in borehole management as well as an integrated monitoring of the system to ensure efficiency and preventive maintenance, are paramount in ensuring the success of an investment such as community managed boreholes systems. In studies that were done in Uganda to determine how well community based borehole systems were maintained, some of the problems identified were that some boreholes were not a community preferred water source, there was corrosion of the pipes resulting in low yield, the water pipes were imported and as a result, it became expensive to secure parts for maintenance[15]. In South Africa some of the reasons noted in for inefficiency borehole water supply system in the communities included, poor borehole development which resulted in boreholes drying out, inadequate pump design, poor pump selection and installation, inadequate monitoring and maintenance[16]. From this study in Mohale's Hoek HSA an important factor of lack of maintenance of the boreholes

surfaced and needs to be investigated in depth to guide policy on community managed borehole water supply system in Lesotho.

The prevailing situation of shortage of water may be a possible vehicle to the association as found in the results of this study.

Association between having someone with bloody diarrhoea in the household and bloody diarrhoea

There was an association between a household that has had someone with bloody diarrhoea and the current bloody diarrhoea study.

The epidemic curves in these outbreaks from Mohale's Hoek, show slow rise of successive waves. This does not depict a common source of contamination but it suggests a person-to-person transmission. It is therefore, possible to deduce from this study that the resulting association may be due to compromised hygienic status.

Having someone with bloody diarrhoea calls for stringent hygiene practices by the family members to prevent contamination. In most cases of diarrhoeal infection the culprits are viral or bacterial. Most infections are acquired by faecal-oral transmission via contaminated food or water. If appropriate hygienic measures are not taken, bloody diarrhoea can be easily transmitted[9].

A study conducted in Guanza Sul-Angola concluded that diarrhoea is a major problem however; it was found that people did not understand the faecal oral transmission of diarrhoea[17]. In this Lesotho study, no knowledge of bloody diarrhoea transmission was measured however; people's perception show that they think only unprotected water sources cause bloody diarrhoea. This perception could be linked to the increase in bloody diarrhoea during the dry season when water is scarce.

Association between the children's hand washing practices and bloody diarrhoea.

In this study the fact, that children do not wash their hands before handling food was associated with bloody diarrhoea.

Hands are recognized as a vehicle for the transmission of contamination, especially in children, although the number who responded to this question was low it could showing some important finding. The HIV/AIDS pandemic exaggerates the situation because children find themselves liable to frequent food handling because they either become nurses to their sick relatives or they are orphans who need to fend for themselves. If children are not habitually educated to wash their hands at home and at schools, transmission of bloody diarrhoea and other diseases will ensue. A study that was conducted among 305 Detroit school children found that young children who washed their hands four times a day, had 24% fewer sick days due to respiratory illnesses and 51% fewer days are lost because of stomach upsets[7]. In Ghana studies found that hand washing at school was made difficult by lack of hand washing materials in the researched school, however, when observed, children showed appropriate hand washing skills[18]. A similar situation is found in Lesotho, there are no materials available for hand washing in schools. In Kenya it was revealed that plentiful availability of water was not necessarily associated with frequent hand washing [19,20]. In Burkina Faso children showed behaviours change after implementation of hand washing program[21]. Such health promotion programs are not available in the schools in Lesotho despite common outbreaks experienced in this rural area.

The study highlights the need for behaviour change among children, perhaps there is need to integrate hand washing in school hygiene curriculum and to provide materials for hand washing practices with a hope of inculcating hand washing practice among children from young age. The results were not stratified by age to look at adults and children separately may be more age variation could have been found.

Association between whether one ate bread and bloody diarrhoea

Food poisoning arises from the ingestion of food that is contaminated with micro organisms, microbial toxins or chemicals. When two or more people experience similar illness after ingesting a common food an investigation is required that may implicate that food as a source of illness.

It has been shown that the health economics of food contamination often differ among countries and regions of the world, among other determining factors is social and economic development. This may disadvantage communities of the education in the principles of food handling[22]. As has been mentioned the communities under study are disadvantaged and may be lacking the vital knowledge of hygienic ways of food handling.

The people's staple food in this study area is Mealie-pap. This food was not associated with bloody diarrhoea, perhaps the reasons are that most of the time it is prepared and eaten immediately, it is not kept for long time. Unlike bread many people prefer to eat mealie-pap warm.

There was an association between eating bread and bloody diarrhoea. Bread is a type of food that can be kept for a long time, as a result, it may be vulnerable to frequent handling ending in possible contamination. Most of these communities are found in remote areas where the bread that is eaten is prepared from home. Bread can be kept for three days or more while still being handled all the time when food is prepared resulting in exposure to contamination.

Health promotion programmes that will have a food-handling component need to be developed and the community educated on the safety of food handling.

Association between whether one ate vegetables and bloody diarrhoea

The threat of contamination of vegetables in food preparation is well established particularly in freshly served food such as salads. The common vegetables that are eaten in this study area are served cooked.

In this study although Chi Square test showed association between eating vegetables and bloody diarrhoea, on further applying regression the association appeared to be untrue. However, this shows the need to subject data to several tests before a decision for association can be drawn.

Association between the type of toilet one had and bloody diarrhoea

As mentioned earlier in this paper the most common mode of transmission of organisms that cause bloody diarrhoea is faecal-oral route[7]. It mainly results from compromised hygiene. The MOHSW and WHO in Lesotho promote the use of Improved Ventilated Pit Latrines. This facility is recommended for rural communities for faeces disposal. In this study 31% of the subjects were found to have such toilets. Having such a toilet, through binary logistic regression model, was found to be protective against bloody diarrhoea. However, this study also showed that most of the toilets found were not of the recommended type.

The fact that 88% of the subjects who responded showed that they could not allow their children to use the toilets for fear that they would fall inside and 88% were unhygienic, shows that the recommended structure for pit latrine is not suitable for children. A design of a toilet that would suite the children while meeting the WHO and MOHSW guidelines should be investigated. This design once approved should be promoted in the villages especially in schools.

CHAPTER 5 Conclusion

The study has identified the variables strongly associated with bloody diarrhoea. The findings could be used to inform policy on what to target in order to address the outbreaks in this study area. This reduces the trial and error associated with uninformed decisions.

Bloody diarrhoea outbreaks in these catchment areas have been common over a long period of time. These outbreaks have a bearing on the resources allocated to ensure good health of the people of Lesotho. Although financial implications due to control of this outbreaks are not well documented, it is generally accepted that the cost implications are enormous usually occurring unexpectedly in magnitude that vary all the time.

In these outbreaks unnecessary loss of lives ensue. It is also known that some food borne diseases can cause serious and chronic sequelae on the cardiovascular, renal, articular, respiratory or immune system. Some examples of such complications are reactive arthritis, rheumatoid syndrome, meningitis, or many other opportunistic infections if a person is HIV positive [22].

It is noted that ever since hand washing was recognized as an important simple measure for prevention of disease, its importance has been recognized by all categories of health professionals. Recent systematic review showing that simple act of washing hands with soap and water can reduce the risk of diarrhoea by nearly half and life threatening diarrhoea by nearly half, in both developed and developing countries [23].

It was deduced from the study that although the Government through its agencies has done much to combat frequent outbreaks, bloody diarrhoea still poses a public health problem in these catchment areas. There is need to improve water availability particularly during dry

seasons. There may be need to identify reliable boreholes and establish reservoirs from them, that can supply the nearby communities by gravity instead of digging many boreholes, some of which get dry during the dry season.

Maintenance of the borehole seems an outstanding problem that needs to be investigated further. The best way through which the meagre resources from communities can be put to the best use to benefit the same communities has to be established. There is need to use appropriate and low-cost water and sanitation technologies to promote the construction of safe latrines recommended by World Health Organization and the Ministry of Health. A policy guideline is required towards the establishment and management of this community fund for the maintenance of the boreholes.

45% of the people lived outside the recommended 200m distance from the water source. This may result in scarcity of water and compromised hygiene status. Scarcity of water facilitates the transmission of diseases such as bloody diarrhoea. Diseases could affect communities which otherwise have adequate water supply because visitors from diarrhoea affected area arrive. The Basotho still maintain a strong bond of extended family structures; the families interact all the time by visiting distant relatives.

Although, many people did not respond to this question. The factor that children do not wash their hands, calls for the emphasis of basic public health principle for personal hygiene. This can be addressed through health education in the communities and in schools with special focus on children who have become orphans or have to manage the household because their parents are sick. It is recommended that schools in these areas that are prone to bloody diarrhoea outbreaks will be provided with equipment that will be used for hand washing practice at school.

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Annex A Training Guidelines

CASE CONTROL STUDY OF BLODY DIARRHOEA IN MORIFI, HOLLY CROSS, MOHALINYANE AND LIPHIRING HEALTH CENTERS-LESOTHO

TRAINING GUIDELINES FOR DATA COLLECTORS, SUPERVISORS AND DATA CLERKS

Description of study

- The study will be conducted among selected people in the villages surrounding Morifi, Holy Cross, Mohalinyane and Liphiring Centres.
- An interview schedule will be used to collect data; where a data collector will use a questionnaire to collect data.
- There will also be inspections of the premises of the persons interviewed that will be conducted.
- Two groups of people will be investigated the ones affected by bloody diarrhoea and those who are not. One person from the affected group will be selected and paired with two from the group made up of people who are not affected.
- All the people will be selected prior to the study and will be allocated numbers accordingly.
- If the selected person is not available he/she may not be replaced with anybody else.

Role of Researcher

- Organizes for the training.
- Conducts training.
- Secures and distributes resources.
- Prepares lists for selected persons and villages from which they are found.
- Prepares the data screen.
- Check that all records and questionnaire are correctly done.
- Ensures remunerations.
- Takes responsibility of the whole process of data collection and entry.

The role of the data collector

1. To provide information on the objectives of the research study to the selected persons.
2. To secure the informed consent and fill in the provided forms.

3. To correctly and legibly fill the questionnaires according to individual's response.
4. To interview the selected persons from their homes.

Where ever the interviewer gets more than plausible answers such as the water sources the data collector will take the most frequently used in the past three weeks.

The data collector will be encouraged to leave a person in a good attitude whether they accepted to participate in the study or not. The purpose is to avoid spoiling ground for the next research or any other public health activity.

Data collectors will be briefed that they should not make any promises beyond the purposes of the research study.

The data collectors will be instructed on going back to find the interviewee who was not available on first visit. Enough time will be available to attempt at least 3 times to find the subject before he/she is declared a non-respondent. Only the supervisor will be authorized to declare non-respondents.

Tools to be provided for data collection

1. Questionnaires, Pens, Pencils, Pencil Erasers and Clip boards
2. List of names of the selected persons and villages from which they will be found.

Role of the supervisor

- Reports to the village chief/headman and introduces the team.
- Explains the purpose of research to the chief/headman and requests the informed consent.
- Attend to any problems that may be found during data collection.
- Checks that all forms are properly filled.
- Supervises all data collection activities.
- Collects all the filled forms from the data collectors and keeps them.
- Keeps reserve stationary.
- Keeps record of all received questionnaires endorsed with both signatures of data collector and supervisor.
- Delivers questionnaires, records and any other relevant information to the researcher.

The role of the Data clerk

- Receives the questionnaires from the researcher.
- Enter data from the questionnaire to the prepared data screen.
- Enquires from the research for any problems related data entry.

NOTE

1. Teams will be organized before data collection. Transport will be allocated. The plan of work will be clearly spelled out, which include hours of daily activity and the number of days that will be taken to complete the exercise.
2. During training practice will be done and participants will be observed for correct execution roles set.

Annex B Servingram

Ref No:.....

To: **Chief**_____

From: Director General Health Services

Name: Dr T. Ramatlapeng

Signature: _____

Subject: Study on bloody diarrhoea in Morifi HC catchment area

Date: _____

Ministry of Health and Social Welfare invites you and your community to participate in a study on diarrhoea in your area.

Description of the study

The study seeks to find out factors that facilitate the transmission of diarrhoea in your area. Two groups of people will be involved; those who have diarrhoea and those who do not have it.

Study procedure

This study involves interview by someone new to your community. The person will ask the study participants questions that are related to personal daily practice and family practices in handling of food, gathering of water and examination of the general cleanliness of the home environment. Whenever more or verification of information is required, the interviewer his/her and supervisor may come back to you for confirmatory information.

Risks involved

This study involves allowing someone foreign to your community to enquire about matters of family practices and inspecting the family premises of some members of your community.

Confidentiality and right to withdraw

Information that is gathered from the individual household will be put together with the information from the rest of the selected households. The information will be reported collectively; no individual names will be attached to the information provided in order to ensure individual privacy.

The participation of the individual will be voluntary. If the individual concerned changes his/her mind at any stage, he/she will be free to discontinue without any consequences for their care.

Benefits of the study

The study may not benefit individuals. The participant will not receive any payment. However, the study will provide important information about your community that will assist the Ministry of Health and Social Welfare to plan specific activities to prevent diarrhoeal outbreaks in your community.

Many communities who participate in such research activities find it rewarding. Your community will grow to understand the problem of diarrhoea even better.

Should any problems or questions arise in relation to this, please enquire from our local office in Morifi Health Centre (phone number to be provided here).

By signing below, you state that you have read the explanation of the study, you have had chance to ask questions about it, and you give consent for your people to participate.

_____ _____

Signature of the Chief Date

_____ _____

Signature of Witness Date

_____ _____

Signature of Investigator Date

Annex C Authorization by the Ministry of Health and Social Welfare

LESOTHO

Ref: H/Proj/40

Ministry of Health and Social Welfare
P.O Box 514
Maseru 100
Lesotho

03rd January 2003

To whom it may concern

This serves to authorize Mr. John Nkonyana to conduct a case control study on bloody diarrhea among clients and patients who seek services in Morifi. Holy Cross, Mohalinyane and Liphiring Health Centres during the months of December 2002 to March 2003.

The study is a requirement for him to complete Msc. Epidemiology in the University of Pretoria in South Africa. However this is an important study to MOHSW in these areas which regularly experience outbreaks of bloody diarrhea.

The ministry will accord him necessary support and expect reports.

Yours Sincerely

DR Ramatlapeng
Director General MOHSW

Annex D Authorization by Ethics Committee of the University of Pretoria

University of Pretoria

Faculty of Health Sciences Research Ethics Committee
University of Pretoria
Tel (012) 339 8619 Fax (012) 339 8587
E Mail dbehari@med.up.ac.za
Soutpansberg Road Private Bag x 385
MRC-Building Pretoria
Level 2, Room 20 0001

Date: 5/05/2003

Number : S83/2003

Title : A case control study on bloody diarrhea transmission in Morifi, Holy Cross, Mohalinyane and Liphiring Health Centres catchment areas in Lesotho - 2003

Investigator : J P Nkonyane, School of Health Systems and Public Health, Univ. of Pretoria (SUPERVISOR: PROF K VOYI)

Sponsor : None

This Student Protocol has been considered by the Faculty of Health Sciences Research Ethics Committee, University of Pretoria on 29/04/2003 and found to be acceptable.

Prof P Carstens	BLC LLB LLD (Pret) Faculty of Law
Prof S.V. Grey	(female) BSc (Hons); MSc; DSc: Deputy Dean
Prof C B Ijsselmuiden	MD; DTM & H; DPH ;FFCH (CM); MPH; School of Health Systems and Public Health
Prof V.O.L. Karusseit	MBChB; MFGP (SA); M.Med (Chir); FCS (SA): Surgeon
Dr M E Kenoshi	MB,CHB; DTM & H (Wits); C.E.O. of the Pretoria Academic Hospital
Prof M Kruger	(female) MB.ChB.(Pret); Mmed.Paed.(Pret); PhDd. (Leuven)
Dr N K Likibi	MB.BCh.; Med.Adviser (Gauteng Dept.of Health)
Miss B Mullins	(female) BscHons; Teachers Diploma;
Snr Sr J. Phatoli	(female) BCur (Et.Al) Senior Nursing-Sister
Prof H.W. Pretorius	MBChB; M.Med (Psych) MD: Psychiatrist
Prof P. Rheeder	MBChB; M.Med (Int); LKI (SA); MSc (CLIN.EPI): Specialist Physician
Reverend P Richards	B.Th. (UNISA), M.Sc. (Applied Biology) (Knights), M.Sc (Med) (Wits), TechRMS, DipRMS
Dr L Schoeman	(female) Bpharm, BA Hons (Psy), PhD
Dr C F Slabber	BSc (Med) MB BCh, FCP (SA) Acting Head; Dept Medical Oncology
Prof J.R. Snyman	MBChB, M.Pharm.Med: MD: Pharmacologist
Prof De K.Sommers	BChB; HDD; MBChB; MD: Pharmacologist
Dr R Sommers	(female) MBChB; M.Med (Int); MPhar.Med
Dr TJP Swart	BChD, MSc (Odont), MChD (Oral Path) Senior Specialist; Oral Pathology
Dr S.J.C.Christa v/d Walt	(female) D. Cur, M.Ed, Department of Nursing
	Student Ethics Sub-Committee
Mrs E Ahrens	(female)B.Cur
Prof S Meij	(female) DScTHED;MSc
Prof P. Rheeder	MBChB;M.Med(Int);LKI(SA);MSc (CLIN.EPI): Specialist Physician
Dr R Sommers	SECRETARIAT (female)MBChB; M.Med (Int); MPharMed
Dr S.J.C.Christa v/d Walt	(female) D. Cur, M.Ed, Department of Nursing
Mrs N Lizamore	(female) BSc(Stell), BSc (Hons) (Pret),MSc (Pret) DHETP (Pret)
Prof R S K Apalu	MBChB(Legon); PhD(Cambridge)
Prof P Carstens	BLC LLB LLD (Pret) Faculty of Law
Dr S I Cronje	DD (UP) – Old Testament Theology
Dr M M (Mimi) Geyser	(female) BSc; MBChB; BSc HONS (Pharm); Dip PEC; MPraxMed

PROF J.R SNYMAN
MBChB, M.Pharm.Med; MD: Pharmacologist
CHAIRPERSON of the Faculty of Health Sciences Research
Main Ethics Committee - University of Pretoria

PROF P. RHEEDER
MBChB, M.Med (Int); LKI (SA); MSc (CLIN.EPI): Specialist Physician
CHAIRPERSON of the Faculty of Health Sciences Research
Students Ethics Committee – University of Pretoria

Annex E Informed Consent

Title of study: A case-control study of bloody diarrhoea transmission in the Morifi, Holy Cross, Mohalinyane and Liphiring Health Centres catchment areas in Lesotho, 2003.

Introduction

You are invited to volunteer as a participant in this research study. This information leaflet is to help you to decide if you would like to participate. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained in this leaflet, do not hesitate to ask the researcher. You should not agree to take part unless you are completely happy about what is expected of you.

The purpose of this part of the study is to find out factors that facilitate transmission of diarrhoea in your area. Two groups of people will be involved, those who have diarrhoea and those who do not have it.

You are requested to participate in a study on diarrhoea in your area.

This study protocol was submitted to the Research Ethics Committee of the University of Pretoria, Faculty of Health Sciences. The committee has granted written approval (Annex D).

Your participation in this study is entirely voluntary and you can refuse to participate or stop at any time without stating any reason. Your withdrawal will not be held against you.

All information obtained during the course of the focus group interview is strictly confidential. Data that may be reported in scientific journals will not include any information that identifies you as a participant in this study.

INFORMED CONSENT

I hereby confirm that the researcher, ..., has informed me about the nature and conduct of the study. I have also received, read and understood the above written information (Participant Information Leaflet and Informed Consent) regarding the study.

I am aware that the results of the study, including personal details will be anonymously processed into the study report.

I may, at any stage, without prejudice, withdraw my consent and participation in the study. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

Participant's name _____ (Please print)

Participant's signature _____ Date _____

I, ... herewith confirm that the above participant has been informed fully about the nature, conduct and risks of the above study.

Researcher's name _____ (Pease print)

Researcher's signature _____ Date _____

Annex F Questionnaire

A case-control study of bloody diarrhea in the Four rural HCs Catchment areas in Lesotho, 2003

1 Number	

2 Type		
	Case	1
	Control	2

3 Village of residence	

4 Health center		
	Morifi	1
	Holy Cross	2
	Mohalinyane	3
	Liphiring	4

5 Sex		
	Male	1
	Female	2

6 How long have you stayed in this village?	

7 Age in		
	Months	
	Years	

8 What level of education did you reach?		
	Did not attend school	1
	Primary	2
	Secondary	3
	High school	4
	Tertiary	5
	Other	6

Circle () for response in the box provided on the extreme end.

9 To which religion do you belong?		
	RCC	1
	Anglican	2
	SDA	3

	Jehova's witness	4
	Zionist	5
	LEC	6
	Methodist	7
	Pentecostal	8
	Other	9

10 Are you presently

	Unemployed	1
	Employed fulltime	2
	Employed part-time	3
	Self Employed	4
	Other	5

11 What is the monthly income category of your household?

	<100	1
	100-499	2
	500-999	4
	1000+	4
	NONE	5

12 How many sheep, goats or cattle do you have in your household?

	Sheep	
	Goats	
	Cattle	
	None	

13 Where are the animals watered in this village?

	River	1
	Dam	2
	Borehole	3
	Well (specify)	

14 How would you categorize availability of water in this village?

	Readily available	1
	Available	2
	Scarce	3
	hard to get	4

15 What is your source of drinking water for the household?

	Spring	1
	Borehole	2
	Tap	3

	Other (specify)	

16 What is the source of drinking water for your school?		
	Spring	1
	Borehole	2
	Tap	3
	Other (specify)	

17 What is the source of drinking water for your workplace?		
	Spring	1
	Borehole	2
	Tap	3
	Other (specify)	

18 If borehole, how often does it get maintained?		
	Always	1
	Sometimes	2
	Occasionally	3
	Never	4

19 If borehole, how often does it break down?		
	Always	1
	Sometimes	2
	Occasionally	3
	Never	4

20 If borehole, does the community have fund to repair the borehole?		
	Yes	1
	No	2

21 How long does it take to get it repaired, when it breaks down?		
	1 to 4 months	1
	5 to 9 months	2
	10 to 14 months	3
	Years	4

22 How is water stored in your home?		
	Covered large mouth container	1
	Uncovered large mouth container	2
	Narrow mouth container	3
	Other (specify)_____	4

23 How often do you handle food in one day to prepare it?	
Once daily	1
Twice daily	2
Three time daily	3
More than three times daily	4
Never	5

24 How often do you remember to wash your hands before handling food?	
Always	1
Sometimes	2
Occasionally	3
Never	4

25 How often do your children dish food for themselves?	
Always	1
Sometimes	2
Occasionally	3
Never	4

26 How often do think your children wash their hands before handling food to dish/eat?	
Always	1
Sometimes	2
Occasionally	3
Never	4

27 What do you usually use to wash your hands?	
Usually water only	1
Usually soap and water	2
Sometimes soap and water	3
Other (specify)_____	4

28 Please list the food you ate 7 days before you had diarrhea. (for control ask" in the December month")

Pap	Yes	No
Porridge (fermented)	Yes	No
Milk	Yes	No
Bread	Yes	No
Meat	Yes	No
Rice	Yes	No
Stamp	Yes	No

	Salads	Yes	No
	Cooked vegetables	Yes	No
	Other (specify)_____		

29 Do you have a toilet facility for your home?

Yes	1
No	2

30 If yes who of the family members use the toilet ?

All members of the family	1
Important guests only	2
Adults only	3
No one	4

31 If adults only why?

Fear that children will fall inside	1
Fear that children will spoil it	2
To keep it clean	3
_____	
_____	
Other (specify) _____	4

32 Did someone have bloody diarrhea before in your household?

Yes	1
No	2

33 How do you usually clean yourselves after defecating?

Use toilet paper	1
Use bush	2
Use stones	3
Use bare hands	4
Other (specify)_____	

34 What do you think causes diarrhea in this village?

_____
_____
_____
_____

35 Where do you dispose off the refuse?

Hip	1
Pit	2
Donger	3

	Other (specify)_____

The following questions require inspection of the premises

36 How far is the water source from the home?	meters

37 Is the water source protected?		
	Yes	1
	No	2

38 Is there a toilet?		
	Yes	1
	No	2

39 What is type?		
	VIP	1
	Pit latrine	2
	Water closet	3
	Other (specify)	

40 If yes what is the hygienic condition of the toilet?		
	Good	1
	Fair	2
	Hazardous	3

41 How safe is the waste disposal?		
	Safe	1
	Fair	2
	Hazardous	3

42 How is the flies population in the surroundings?		
	Not seen	1
	Only a few	2
	Hazardous	3

43 Is soap present in the home?		
	Yes	1
	No	2

Annex G Paper presented at the 8th World Congress on Environmental Health

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A CASE-CONTROL STUDY OF BLOODY DIARRHOEA TRANSMISSION IN THE MORIFI, HOLY CROSS, MOHALINYANE AND LIPHIRING HEALTH CENTERS CATCHMENT AREAS IN LESOTHO, 2003.

John Nkonyana, Kuku Voyi

John Nkonyana student MSC Epidemiology, University of Pretoria
Professor Kuku Voyi, Environmental and Occupational Health, School of Health Systems and Public Health, University of Pretoria

Diarrhoea remains a worldwide health problem despite the world's advancement in technology today. It is estimated that in children alone there may be 3.5 to 18 million deaths per year from diarrhoeal disease[1]. Gastro-intestinal disease is the second most common cause of morbidity through-out the world after respiratory tract illness.[9]
World Health Organization reports that almost all (99%) of 10.5 million children under-five who died 36% were from Asia while 33% were from Africa; more than 50% of all child deaths were due to communicable disease that can be prevented and treated such as pneumonia, diarrhoea, measles, malaria and HIV/AIDS[3]. If governments are fortified with adequate information on how diseases such as diarrhoea are transmitted within populations and among all ages, this could facilitate focused and cost effective preventive and curative program implementation.

Lesotho a mountainous country in Southern Africa that is completely surrounded by the Republic of South Africa has population 2 200000 people[2]. Lesotho experiences seasonal diarrhoea outbreaks, most occurring in the period of November, December and January. This out-beak usually affects people in the rural areas, who are poor and live in difficult to reach places with poor water supply facilities and poor sanitary conditions. The outbreaks have varied in intensity over the years with the most sever episode occurring in 1999 and 2000. These outbreaks have often been accompanied by loss of lives, although this is not well documented because of poor vital registration in Lesotho

The study area is in Mohale's Hoek. Mohale's Hoek is one of the 18 Health Service Areas (HSAs) of Lesotho known as Ntsekhe HSA. This HSA is divided into four ecological regions of lowlands, foothills, highlands, and Senqu valley. These regions are serviced by the Morifi, Holy Cross, Liphiring and Mohalinyane Health Centers respectively. The HSA are shown in figure 1 below. Bloody diarrhea outbreaks are common among communities in these regions.

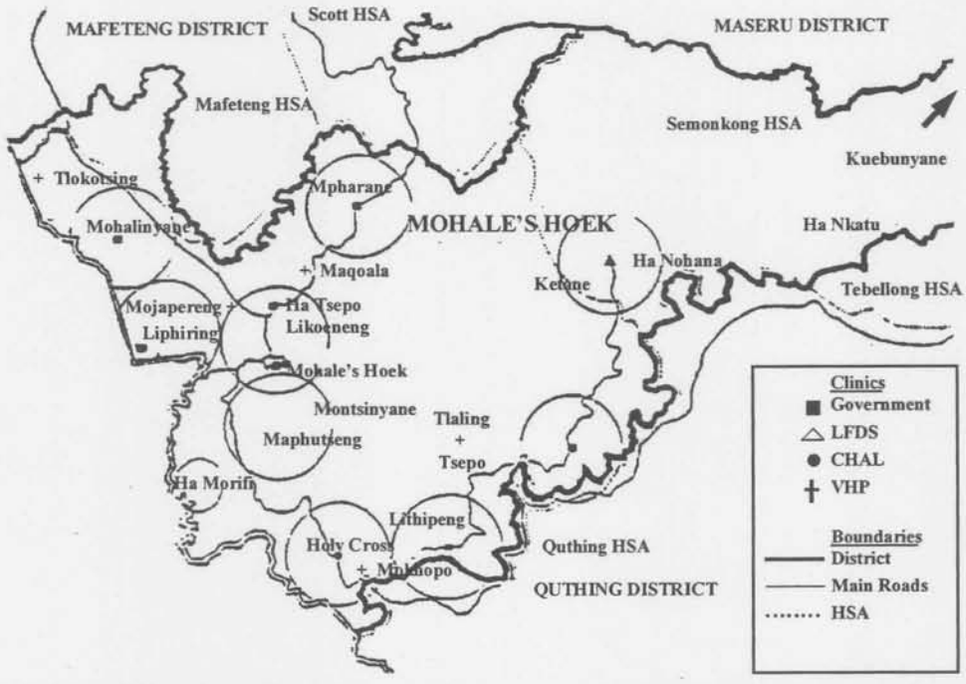

Figure 1. Shows encircled areas, which are commonly affected by bloody diarrhoea . (Mapatano Mala Ali and Oo Aug.Mynt 2000, Lesotho Health Ministry)

Investigations have been conducted following these outbreaks. According to the investigation conducted in 2000 Holy Cross has always seen more cases than Morifi during the seasonal outbreaks as shown in figure 2.

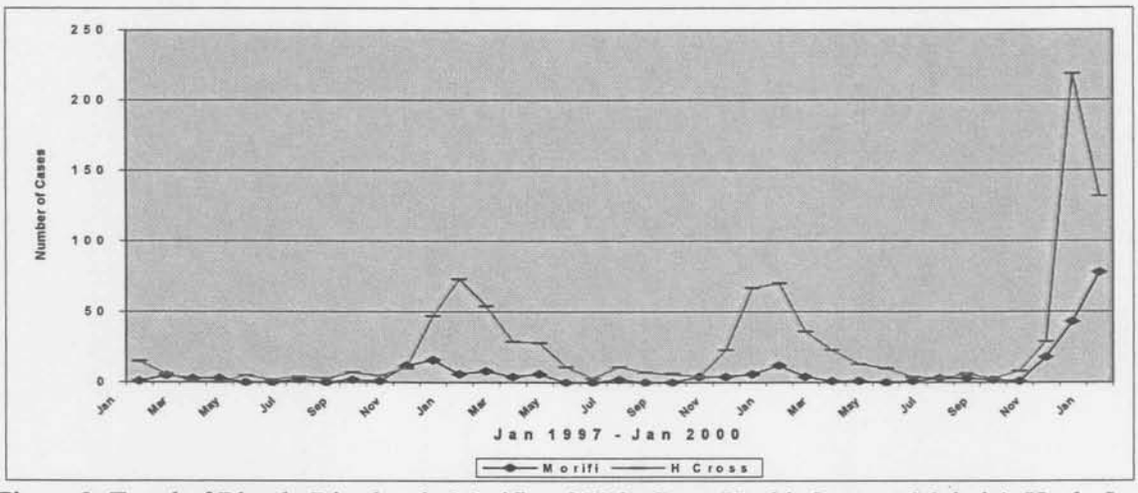

Figure 2. Trend of Bloody Diarrhea in Morifi and Holy Cross Health Centers. Mohale's Hoek, Jan 1997-Jan 2000 (Mapatano Mala Ali and Oo Aug.Mynt 2000, Lesotho Health Ministry)

In Mohalinyane Health Center (HC) the trend of diarrhea was not any different from their neighbouring Liphiring Health Center, however a lot more cases were seen, there was also an increased number of cases in January 2000 which denotes a possible outbreak. Despite all effort by the Ministry of Health and Social Welfare in Lesotho, this catchment area still experiences bloody diarrhoea

The objective of this study was to obtain baseline data for intervention program on bloody diarrhoea. This was done by determining the environmental and living conditions, socio-economic status, lifestyle and personal hygiene factors underlying the seasonal high frequency cases of bloody diarrhoea in Morifi, Holy Cross, Mohalinyane and Liphiring health centers catchment areas.

METHODOLOGY

Study design
This is a retrospective case-control study design involving 145 cases of bloody diarrhea selected from 4 rural sites and 269 controls selected from the same rural sites in Lesotho. Cases and controls were similar with regard to environmental and social factors except for effect of bloody diarrhoea.

Case definition

A person of any age who presented at the local Health Centre with bloody diarrhoea, in the period between December 2002 and February 2003(this is a time at which cases were identified, it is a high frequency period), who has been resident in the community over at least three months. Diarrhoea is noted to be bloody by the patient, parent/caretaker and/or health care provider.

Control definition

An individual of the age group from the community who does not have bloody diarrhoea but presented at the local health centre for any other condition and who has been resident in the community over at least three months prior to the diagnosis of the case.

Statistical methods

Sample selection
A sampling frame (the list of all reported cases of bloody diarrhoea) was prepared from a list of all bloody diarrhoea cases that had been reported at the respective health centres all case were selected. For controls, in each of the 4 sites, sampling intervals was determined: k=N/n. The first control was selected using a table of random numbers. The"k^{th}" control on the list was selected. The process continued until n control was selected out of the population (N), at each of the four sites of the study. Controls were similar with regard to environmental and social factors except for the effect of bloody diarrhoea. Individual matching was used, specifically for age and sex to ensure that effect modification due to these factors does not occur. Age group matching was done within 5 years age groups. However matching was not too strict, so that the research would not be undermined by the problem of securing the needed controls, leading to unnecessary expenses and delays.

Sample size determination
All population of cases was selected this constituted 154. Thus, the number of controls became twice as much, or 308. Each case and its controls were assigned unique identification numbers to facilitate the analysis.

Data analysis
A data screen was prepared in Epi-data programme, which was used for data entry. Data was cleaned in the same environment. Further analysis was done STATA version 7.

RESULTS

Demographic

In this study the sample size represented 414 subjects there was 10% overall non-response, the people who responde 41% were males while 59% were females. The majority (73%) of the people interviewed were literate 27% were illiterate.

Economical status

A proxy variable was used to estimate economical status. Majority (86%) were unemployed and only 14% were employed.

38% had household income of income ≤ 15USD/month and 62% had income > 15USD/month. The economical status was also measured according to the number of animals a household had. The results showed that 60% had 5-18 goats, whereas 40% had 4 goats or less. 189 subjects provide information on cattle 76% had 6 to 43 cattle and 24% had 5 or less cattle.

Availability and safety of water

On enquiring on the place where animals were watered, many (98%) indicated that they were watered at the river and dams whereas 2% were watered at well. 64% showed that safe water was not easily available whereas 36% said it was readily available. At home, 63% of the subjects drank from protected water sources whereas 37% drank from unprotected sources. At school, 76% of the subjects drank from protected water sources whereas 24% drank from unprotected. At work, 68% drank from protected water sources whereas 32% drank from unprotected. Among the people (132) who drank from boreholes 93% showed that their boreholes system is never maintained, only 7% said they were maintained. The people who drank from the boreholes 70% indicated that the borehole did not get broken while 35% said they had been out of order. Many (63%) research subjects who drank from the borehole showed that the boreholes did not have community maintenance fund, while 37% said they had.

102 who responded to the variable determining how long it takes to repair a borehole when it is broken; 66% said they were repaired on time (1 to 4 months) while 34% said they were not repaired on time (5 months or more).

An investigation was done to find out how water is stored in the home 100% of the subjects responded, 80% showed that it is stored in a safe way covered in large mouth container kept in a small mouth container while 20% indicated un-safe storage.

Safety towards food handling

Most people (85%) showed that they used soap and water to wash their hands while 15% showed that they did not.

90% handled food in safe number of times per day, which were three or less times per day whereas 10% handled food at un-safe frequencies. On finding out whether subjects washed their hands before handling food 94% said they had safe practice of hand washing and said 6% did not. On finding out children's practices towards dishing food, 73% indicated that children never dished food while 27% said they did. Many (58%) of the people indicated that children had unsafe practice of not washing hands before handling food, whereas 42% said they had.

Most people (85%) showed that they used soap and water to wash their hands while 15% showed that they did not.

Food the subject ate during the outbreak month of January

Those who did not eat porridge formed 66% and those who ate it 34%. There were 67% who did not eat milk while 33% ate it. There were 72% who did not eat bread and 28% did eat it. Those who did not eat meat were 70% and 30% ate it. Rice was eaten by only 11% whereas 89% did not eat it. There was 91% who did not eat samp and only 9% ate it. Those who did not eat salads formed 85% and 15% ate them. 67% ate vegetables whereas 33% did not.

Availability and use of a toilet facility

There were 95% who responded to the question determining the presence of a toilet facility in the home state 53% showed that they had toilets whereas 47% did not have. Of the 51% who responded to the variable enquiring on who uses the toilet 60% said it used by all members of the family while 40% said it is use by adults only.
Some of the reasons provided by those who said the toilet is used by adult members of the house hold only, showed (88%) fear that children will fall inside, 6% stated fear that children would spoil it, whereas 1% felt they wanted to keep the toilet clean.

Sanitation and hygiene practices

Among 414 subjects interviewed 44% had someone in the household who had bloody diarrhoea, whereas 56% showed that they did not have anyone. There were 79% of the subjects who used unsafe material such bush, stone and clothes to wipe after defecating, whereas 21% used unsafe material. 49% perceived that bloody diarrhea is caused by unprotected water sources, 30% mentioned other unspecified causes, 9% said lack of toilets, whereas 3% pointed at poor refuse disposal. Most (95%) people disposed refuse in unsafe ways only 5% used safe ways.

Inspection of the household premises and water sources

33% of the subjects were <100 m away from the water sources, 22% were 100-199m away, 15% were 500m < away 13% are 200-299m away, 11% were 300-399m away and 6% were 400-499 m away. 408 water source were inspected for protection which meant a water tap or well built on the side with tap outlet, 65% were protected 35% were not protected. 402 households were inspected for the presence of a toilet facility 53% had a toilet facility whereas 47% did not have. Of the households, which had a toilet facility, 69% had safe toilet facility and 31% had unsafe ones. The toilets were also inspected for hygienic condition 88% was found to be unhygienic (unsafe) and 12% were safe. Waste disposal safety was inspected for in 410 house holds in 97% were found to be hazardous and 3% were safe. Flies population was inspected for in 414 households, in 85% of the households flies were not seen; in 15% unsafe population of flies was noted. In 414 households inspected for the presence of soap 95% had soap while 5% did not have it.

Binary logistic regression analysis

Binary logistic regression was used to estimate the effects of several exposures on bloody diarrhea. The Odds ratio among people who experienced unavailability of water was 3.88 greater, among children who don not wash hands the Odds ratio was 4.66 higher, among subjects ate bread in January the Odds ratio was 1.45 more and among subjects who had someone with bloody diarrhea in the household the Odds ratio was 2.60 greater.

The mathematical model
The model that resulted from a logistic regression was as follows:
Z= -1.49+1.36*AVAILWATER+1.54*CHILWAS+0.38*BREAD-
0.78*VEGETAB+0.96*HADBLADIA-0.87*TOILETT
Using the above relationship, the probability of bloody diarrhoea can be worked out for a randomly identified person in the study.

DISCUSSION

The cyclical epidemic in this Health Service Area occurs in the rural communities, which are difficult to access because of poor roads. Some villages can only be accessed using four-wheel-drive vehicles, yet some can be accessed on horseback only. These are disadvantaged communities who survive through nonviable subsistence farming. In these communities the sanitation system is weak. There are a few latrines most of which are ordinary pit latrines. Many households use dongas, bush and hills as toilets. Most villages do not have running water. However, there are boreholes, which are dug in many villages by governmental and non-governmental organizations. These boreholes frequently get broken and also run dry during the dry season. It is at this time that communities resort to unprotected water sources such as springs and nearby rivers. They have to walk long distances to find water. In this crisis situation, both people and animals use the same water sources. Where the boreholes have been dug by governmental or nongovernmental organizations, communities are charged with the responsibility to develop a community fund for maintenance and repair of such boreholes. The fund is generated and run by the communities themselves. They elect a committee to take care of such a fund.

In most households both liquid and solid waste is disposed of on an ash heap (thothobolo), which is also used by children as toilet. The heaps are normally placed near the households, so that during windy and rainy seasons it possible for the waste to get into the house. The heap is also used as a graveyard for stillbirths and infants. The families have cultural and emotional ties to the heap.

The communities in this villages experience high migration because of changing patterns of source of household income in Lesotho. Many mineworkers have been retrenched from the South African mines. The new source of employment is the fabric industries that are found in the urban areas; they are mostly suitable for female employees. This has brought about migration of women; as result men bear responsibilities of care of the households, a role that may be new to most men. This can lead to compromised hygienic conditions because unlike men women always receive health education on hygiene care of the family during pre-natal and anti-natal clinic, which men do not normally attend.

In the initial design of the study, conditional logistic regression analysis was proposed. This was based on the assumption that the prevalence of diarrhoea disease could be dependent on sex and age categories. However that assumption was not supported by the data set. The frequencies tables showed that diarrhoea was insensitive to among others sex, age categories, occupation and the level of education. As a result the main method of analysis used was the binary logistic regression. Analysis was based on logistic regression as a mathematical modelling approach. It was aimed to describe the relationship between independent factors, the dichotomous variable to the dependent variable, which in this case was bloody diarrhoea. Binary logistic regression analysis for potential risk factors for bloody diarrhoea revealed that: non-availability of water, children 's unsafe practice of not washing hands, eating bread in January, eating vegetables in January, if someone had bloody diarrhoea in the house and unsafe toilet facilities in the household were associated with bloody diarrhoea

Association between availability of water and bloody diarrhoea

An association was shown between unavailability of water and bloody diarrhoea through binary logistic regression.

The Government of Lesotho through relevant ministries and Non Governmental organization has undertaken to provide water supply in many villages in these catchment areas through water gravity systems and boreholes. However, access to water is still difficult, 77% of the people were still more than 100m from the water source. In some villages during the dry seasons the water sources dry up. Scarcity of water poses vulnerability for these communities because they find themselves in situation where they have to share the traditional water sources with animals. Cattle, for instance, are a major reservoir of E. coli and shed the organism frequently when stressed (Griffin P M et al 1988, John A et al 2002). These catchment areas usually experience drought in the months of December to February.

Prospective community studies indicate that incidence of rotavirus infections increase in the dry season (Manun'Ebo et al 1994 Sitbon M et al 1985). In this study no water testing was done from the water sources however, bacteriological studies in rural Nigeria have shown consistent contamination of traditional water sources with faecal coliform and streptococci, albeit varying with patterns of rain fall. Ponds, rivers and unprotected springs tend to be more heavily contaminated than protected springs. The sources of drinking water have been significantly associated with increased risk of diarrhoea (Ekanem EE et al 1991, Georges MC et al 1984, Huttly SRA et al 1987, Mock NB et al 1995)
The prevailing situation of shortage of water may be a possible vehicle to the association as found in the results of this study.

Association between bloody diarrhoea in the household and the current study
There was an association between a household that has had someone with bloody diarrhoea and the current bloody diarrhoea study. Having someone with bloody diarrhoea calls for stringent hygiene practices by the family members to prevent contamination. In most cases of diarrhoeal infection the culprits are viral or bacterial. Most infections are acquired by faecal-oral transmission via contaminated food or water. If appropriate hygienic measures are not taken, bloody diarrhoea can be easily transmitted (Manun'Ebo et al 1994, Georges MC et al 1984). A study conducted in Guanza Sul-Angola concluded that diarrhoea is a major problem however; it was found that people did not understand the faecal oral transmission of diarrhoea[18]. The epidemic curves in these outbreaks from Mohale's Hoek, show slow rise of successive waves. This does not depict a common source of contamination, it may suggest a person-to-person transmission. It is therefore, possible to deduce from this study that the resulting association may be due to compromised hygienic status.

Association between maintenance of boreholes and bloody diarrhoea

An association was also found between lack of maintenance of the water boreholes and bloody diarrhoea. The communities are tasked with generating funds for maintenance of the water sources constructed for them by Government or non-Governmental Organizations. In some communities such fund is available whereas in other it is not. Boreholes are placed strategically to serve scattered villages; in this study 1/3 of the subjects had boreholes out of order these means several of the scattered villages are affected by water shortage. It was found out in this study that 93% of the boreholes were never maintained. It was also observed that in two of the communities studied boreholes were placed in sloppy areas below graveyards and toilets, water the from boreholes had a foul odour as result people were not using it.

Community participation and empowerment, skills training, cost recovery, transparency, setting-up of proper spares for the borehole system, capacity building of the community in borehole management as well as an integrated monitoring of the system to ensure efficiency and preventive maintenance, are paramount in ensuring the success of an investment such as community managed boreholes systems. In studies that were done in Uganda to determine how well community based borehole systems were maintained, some of the problems identified were that some boreholes were not a community preferred water source, there was corrosion of the pipes resulting in low yield, the water pipes were imported as result it became expensive to secure parts for maintenance (Uganda (Busoga) 1992). In South Africa some the reasons noted in for inefficiency borehole water supply system in the communities included, poor borehole development which resulted in boreholes drying out, inadequate pump design, poor pump selection and installation inadequate monitoring and maintenance[20]. From this study in Mohale's Hoek HSA an important factor surfaced, which needs to be investigated in depth to guide policy on community managed borehole water supply system in Lesotho.

Association between the children's hand washing practices and bloody diarrhea.

In this study the factor, that children do not wash their hands before handling food was associated with bloody diarrhoea. Hands are recognised vehicle for the transmission of contamination, especially in children. If children are not habitually educated to wash their hands at home and at schools, transmission of bloody diarrhoea and other diseases will ensue. HIV/AIDS pandemic exaggerates the situation because children find themselves liable to frequent food handling because they either become nurses to their sick relatives or they are orphans who need to fend for themselves. A study that was conducted among 305 Detroit school children found that young children who washed their hands four times day had 24% fever sick days due to respiratory illnesses and 51% fewer days lost because of stomach upsets (Food safety education 1998). In Ghana studies found that hand washing at school was made difficult by lack of hand washing materials in the researched school, however when observed the children showed appropriate hand washing skills[22]. In Kenya it was revealed that plentiful availability of water was not necessarily associated with frequent hand washing [13,17]. In Burkina Faso children showed behaviour change after implementation of hand washing program[5].

The study highlights the need for behaviour change among children, perhaps there is need to integrate hand washing in school hygiene curriculum and to provide materials for hand washing practices with a hope of inculcating hand washing practice among children from young age.

Association between whether one ate bread and bloody diarrhoea

The people's staple food in this study area is Mealie-pap. This food was not associated with bloody diarrhoea, perhaps the reasons are that most of time it prepared and eaten immediately, it is not kept for long time. Unlike bread many people prefer to eat mealie-pap warm.

There was an association between eating bread and bloody diarrhoea. Bread is a type of food that can be kept for a long time, as result it may be vulnerable to frequent handling resulting in possible contamination. Most of these communities are found in remote areas where the bread that is eaten is prepared from home. Bread can be kept for three days or more being handled all the time when food is prepared resulting in exposure to contamination.

CONCLUSION

It was deduced from the study that although the Government through its agencies has done much to combat frequent outbreaks, bloody diarrhoea still poses a public health problem in these catchment areas. There is need to improve water availability particularly during dry seasons. There may be need to identify reliable boreholes and establish reservoirs from them, that can supply the near by communities by gravity instead of digging many boreholes, some which get dry during the dry season.

Maintenance of the borehole seems an outstanding problem that needs to be investigated further. The best way by which the meagre resources sourced from communities can be put to best use to the benefit the same communities has to be established. There is need to use appropriate and low-cost water and sanitation technologies and to promote construction of safe latrines recommended by World Health Organization and the Ministry of Health. A policy guideline is required towards establishment and management of this community fund for maintenance of the boreholes.

45% of the people lived outside the recommended 200m distance from the water source. This may result in scarcity of water and compromised hygiene status. Scarcity of water facilitates transmission of diseases such as bloody diarrhea. Diseases could affect communities who otherwise have adequate water supply because basotho people still maintain a strong bond of extended family structures; the families interact all the time.

The factor that children do not wash their hands, calls for the emphasis of basic public health principle of personal hygiene. This can be addressed through health education in the communities and in schools with special focus on children who have become orphans or have to manage the household because their parents are sick.

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