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Environmental Burden of Diarrhoeal Diseases due to Unsafe Water Supply and Poor Sanitation Coverage in Nepal

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ABSTRACT

Background: Unsafe water and poor sanitation are major contributing factors of diarrhoea. Most of the water supply systems in urban and rural area of Nepal do not have basic water treatment facilities. This has resulted in frequent reports of fecal contamination in drinking water and outbreaks of waterborne diseases. The purpose of this study was to find out the burden of diarrhoeal diseases at different scenario of water supply system and sanitation status in Nepalese context.

Methods: A cross-sectional study was conducted in four different districts of Nepal analyzing six different scenarios based on availability of water supply and sanitation status. Village Development Committees (VDCs) and community selection was made purposively and 360 households, 60 from each scenario were selected conveniently to achieve the required number. Within the selected household, the head of the household or any member above 18 years of age was interviewed using a structured questionnaire. Observation was done for toilet and water sources besides questionnaire method.

Results: Incidence of diarrhoea per 1000 population was found to be the highest in scenario-IV (Spring without toilet) with 204.89 followed by scenario-VI (Tube well without toilet) with 145.30, while it was less in scenario-I (Tap water with toilet) with 46.05. Accordingly, the burden of disease (YLD) was also found to be the highest in scenario-IV and the lowest in scenario-I. Most of the households didn't treat water before drinking. Hand washing practice was found to be more than 90% regardless of toilet availability.

Conclusions: The greater risk of acquiring diarrhoeal disease and higher burden of disease in situation of unprotected water source and absence of toilet shows that these are still important contributing factors for diarrhoeal disease in Nepal. Use of sanitary toilets and protected water source are the important measures for diarrhoeal disease prevention in Nepal.

Keywords: diarrhoeal disease; environmental burden of disease; water supply and sanitation; scenario.

INTRODUCTION

Diarrhoeal diseases are one of the major infectious diseases in the world accounting for about 1.5 million under 5 deaths annually. It is one of the leading causes of morbidity and mortality in developing countries.[1-2] In particular, an estimated 94% of the diarrhoeal disease burden is attributable to environment, and is associated with risk factors such as unsafe drinking water and poor sanitation and hygiene.[3-4]

In Nepal, about 89 percent households have access to improved source of drinking water and about 38 per cent households have improved toilet facility that is not shared with other households.[5] However, the situation is not uniform in urban and rural areas. Households in urban areas have greater access to improved sources of drinking water than households in rural areas (93 percent versus 88 percent) and greater toilet facility (40 percent versus 9 percent), though the urban-rural gap has narrowed down in the last five years.[5] Most of the

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water supply systems in both urban and rural area of Nepal don't have basic water treatment facilities. This has resulted in frequent reports of fecal contamination in drinking water and outbreaks of waterborne diseases, particularly in monsoon. The study on burden of disease can demonstrate the feasibility of quantifying the contribution of disease, injuries and risk factor to population health.[6]

Hand washing, which provides protection against diarrhoeal diseases is promoted by the Government of Nepal and included in the framework of the Nepal Health Sector Program II.[7]Community based disease prevalence or scenario based disease burden has not been quantified till now in the context of Nepal. This study could help as a foundation for conducting large scale research and help implementing the intervention projects.

The main objective of the study was to determine the diarrhoeal disease burden based on different scenarios and provide the basis for further study.

METHODS

Study Design and Ethical Issues

A cross sectional study was conducted using quantitative method during the period August 2011 to January 2012 in selected communities of Nawalparasi, Chitwan, Dhading and Dolakha districts. Data were collected from the community using pre tested structured questionnaire. Information about the disease was collected for the period of one year preceding the data collection. Ethical approval was taken from the ERB of NHRC for conducting the study and study carried out as per the national ethical guidelines. The participants were briefed on the objectives, procedure, importance of the research and their voluntariness in participation before taking their verbal consent.

Selection of Study Sites

The districts were selected purposively and the scenario was mapped according to the source of water and availability of toilet facilities based on the data available from the District Water Supply and Sanitation office under Department of Water Supply and Sewerage. Study sites were selected with a purpose to meet the objectives of calculating the burden of diarrhoeal disease in different water sanitation scenario.

Study Scenarios

Six different scenario from selected four districts were identified based on range of water supply and sanitation viz Scenario I- Tap water with toilet, Scenario II- Tap water without toilet, Scenario III-Spring with toilet, Scenario IV-Spring without toilet, Scenario V- Tube well with toilet and Scenario VI- Tubewell without toilet.[3,11] These six scenarios were selected including various VDCs meeting the criteria from the above four districts. Tube well without toilet facility and tube well with toilet facility was selected from Unwach VDC of Nawalparasi and Fulbari VDC of Chitwan district respectively. Tap water without toilet facility and Spring with toilet facility were selected from different communities of Kumpur, Sankosh and Gajuri VDC of Dhading district. Tap water with toilet facility was selected from Bharatpur Municipality of Chitwan district and Spring without toilet facility from Orang VDCof Dolakha district.

Selection of Households

The study unit was individual household members. A total of 360 households, 60 each from six scenarios were chosen, following non-probability sampling. Households were then selected using convenient sampling till the required size was reached. However, more than one nearby VDCs were considered meeting the criteria of water and sanitation situation for household selection. The sampling technique being a non purposive and community wise data being not available for the water and sanitation scenario, the size of the community selected for each scenario was not calculated.

Data Collection

The data of diarrhoeal cases was collected using structured questionnaire by interviewing the head of the household or adult above 18 years of age available during the time of survey. Occurrence of diarrhoea in 12 months preceding the survey was the basis of estimating the number of cases and disease burden. The data on toilet and drinking water source was collected through the questionnaire as well as observation.

Data Management and Analysis

After cleaning and coding, the data were entered in Microsoft Excel. Data was then transferred into SPSS 16.0 version where it was cleaned, decoded and recoded before analysis. Socio-demographic characteristics were described according to the categories for the entire scenario together.

YLD was calculated for each scenario using the disability weightage of 0.086 and duration of illness as average number of days suffered from diarrhoea within each scenario converted into years. This was calculated using the findings from each scenario. The incidence was also calculated using the average number of diarrhoeal episodes and number of people suffered from diarrhoea within the scenario. The denominator for calculation was population size within each scenario of the households

taken. With this YLD was calculated with 3% discounting and uniform age weights initially for per thousand population and later converted to per hundred thousand population.

Six scenario of water and sanitation were grouped into three as per the water source for the estimation of risk. Hence, the risk of having diarrhoeal disease was calculated for water sources having toilet or not. This calculation was done using the data generated purely from the study. The occurrence of diarrhoea rather than total number of diarrhoeal cases within each household was considered to have suffered from diarrhoeal disease.

RESULTS

Occurrence of Diarrhoeal Disease within Different Scenario

Diarrhoeal disease occurrence in past one year shows that the population wise highest proportion is in scenario Spring without toilet (10.1%,n=327). The household proportion is highest in Tube well without toilet (41.7%, n=60). Similarly, the lowest diarrhoeal disease occurrence is in scenario Tap water with toilet (3.9 %, n=304) in the population and 15 % (n=60) in the household (Figure 1).

YLD (Years of life lived with disability) for Different Scenario

YLD was the highest for the scenario Spring without toilet with 18.10 years, followed by 9.14 years for scenario Tube well without toilet whereas scenario Tap water with toilet had the least YLD of 2.39 years per 1 lakh population (Table 1).

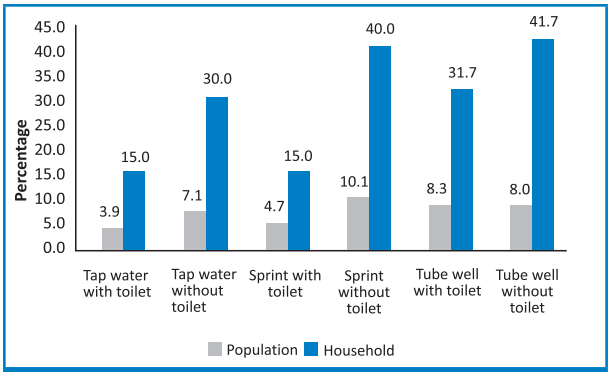

Figure 1. Occurrence of diarrhoeal disease within different scenario

This finding is somewhat not matching to the risk of diarrhoeal disease and this is due to the input data used for the calculation. For risk estimate, occurrence of diarrhoeal disease was used whereas for calculation of YLD, the average number of episodes of diarrhoea in the past year was used.

Table 1. YLD for different scenario

Scenario	Incidence of Diarrhoeal Disease/1000 Population	Average number of days suffered/ episode (Duration of diarrhoeal Disease)		Years Lived with Disability (YLD) per 100,000 Population
		Days	Years	
Tap water with toilet	46.05	2.21	0.006055	2.3977
Tap water without toilet	114.86	2.79	0.007644	7.5497
Spring with toilet	58.39	1.88	0.005151	2.5862
Spring without toilet	204.89	3.75	0.010274	18.1005
Tube well with toilet	115.89	2.97	0.008137	8.1088
Tube well without toilet	145.30	2.67	0.007315	9.1398

Table 2. Risk of diarrhoeal disease between scenarios

Scenario	Diarrhoeal Disease		Total	OR (95% CI)
	Yes	No		
Tap water without toilet	18	42	60	2.428 (0.989-5.963)
Tap water with toilet	9	51	60	
Total	33	87	120	
Spring without toilet	24	36	60	3.778 (1.572- 9.079)
Spring with toilet	9	51	60	
Total	27	93	120	
Tubewell without toilet	25	35	60	1.541 (0.730-3.256)
Tubewell with toilet	19	41	60	
Total	44	76	120	

Risk of Diarrhoeal Disease for Different Scenario with or without Toilet

The risk of having diarrhoeal disease was almost two and half times (OR 2.428,95% CI 0.989-5.963) higher in the scenario Tap water without toilet than Tap water with toilet. Similarly, the risk was nearly 4 times (OR 3.778, 95% CI 1.572-9.079) higher in the scenario Spring without toilet than Spring with toilet. The risk was one and half times (OR 1.541, 95% CI 0.730-3.256) higher in the scenario Tube well without toilet than Tube well with toilet (Table 2).

Risk estimation through binary logistic regression using scenario Tap water with toilet as reference shows that the risk of acquiring diarrhoeal disease was almost two and half times (OR 2.43 95% CI (0.99-5.96),p=0.053) higher than the reference scenario for scenario Tap water without toilet. Risk for the scenario spring without toilet was nearly four times higher than the reference scenario with statistical significance (OR 3.78, 95% CI (1.57-9.08), p= 0.003). Similarly, the risk for scenario tubewell without toilet was more than four times higher than the reference scenario again with statistical significance(OR= 4.05, 95% CI (1.69-9.71), p= 0.002) (Table 3).

Table 3. Risk of diarrhoeal disease for all scenarios using tap water with toilet as reference

	Diarrhoeal Disease				P Value	OR (95% CI)
Scenario	Yes	%	No	%		
Tubewell without toilet	25	41.67	35	58.33	0.002	4.05 (1.69-9.71)
Tubewell with toilet	19	31.67	41	68.33	0.034	2.63 (1.07-6.42)
Spring without toilet	24	40	36	60	0.003	3.78 (1.57-9.08)
Spring with toilet	9	15	51	85	1.000	1.00 (0.37-2.72)
Tap water without toilet	18	30	42	70	0.053	2.43 (0.99-5.96)
Tap water with toilet	9	15	51	85	Reference	

Hygiene and Sanitation Situation

Majority of the respondents were found not treating water and consuming directly from source. The proportion in different scenarios ranged from 3% in Spring without toilet to 38% in Tube well without toilet. Most of the respondents (27-78%) use Flush/Pour flush toilet followed by pit latrine. In scenario Tube well with toilet 40% use ventilated improved latrine.

In almost all of the scenario, more than 90% respondents and 100% in some were found to be washing hand after defecation and before eating food. However, an unexpectedly high (35%) proportion of the participants from scenario Tap water without toilet did not wash hands after defecation.

DISCUSSION

Diarrhoeal diseases are a major threat in Nepal due to inadequate and unsafe water supply, poor sanitation and poor living conditions.[8] Diarrhoeal diseases are still prevalent in many of the communities with poor water supply, sanitation and hygiene practices. Average incidence of diarrhoea in the rural population was 1.71 and 0.63 episodes/person/year in the age groups below and above 6 years respectively. The incidence was 1.09 and 0.33 episodes/person/year in the above two age groups respectively in the urban population. The average duration of disability was 0.01096 years, which is equivalent to national duration of disability due to diarrhoea in India.[3,9]

In this study, average estimated incidence and YLD differ from scenario to scenario and the lowest incidence and YLD was 46.05 per 1000 population and 2.41 per hundred thousand populations respectively for the scenario Tap water with toilet. The incidence and YLD was the highest for the scenario Spring without toilet with values 204.89 per 1000 population and 18.10 years per hundred thousand populations respectively. The estimated risk of acquiring diarrhoeal disease was found to be higher in the scenarios Spring and Tubewell with or without toilet compared to Tap water with toilet. World Health Organization has estimated the relative risk of diarrhoeal disease from global communities, based on the pathogen load on drinking water and sanitation coverage. The relative risk has been assumed to be 1 in ideal situation, corresponding to the absence of transmission of diarrhoea and 6.1 (at minimal) where no improved water supply and no basic sanitation prevails in a country that is not extensively covered by those services, and where water supply is not routinely controlled.[10] The estimated burden of diarrhoea due to water, sanitation and hygiene in Nepal based on exposure and WHO country health statistics 2004 is 18 (DALYs/1000 capita per year) and 13,900 deaths.[11]

Relative risk of diarrhoeal disease was higher in scenarios without toilet with respect to the scenario having toilet which shows that there could be high microbial load and greater risk of disease transmission in scenario

without toilet. Risk of disease transmission was found to be high in spring water in comparison to tube well and tap water. Sanitation and hygiene are the prime components to promote healthy living and is the best prevention practice to halt the disease transmission. Lack of full sanitation and relatively poor hygiene may be the reason for the occurrence of high disease burden in the community consuming spring water and not having toilet. In addition to that, poor economy and behavioral factors induced by low education may be considered for the diarrhoeal disease burden.[12-13]

CONCLUSIONS

Water, sanitation and hygiene related factor still can be considered as one of the important determining component for causal burden of diarrhoeal diseases in Nepalese context. Higher episodes of disease and higher disability rates in the scenario of unsafe water and poor sanitation show that use of sanitary toilets and protected water source are still the important measures of diarrhoeal disease prevention. Similarly, the greater risk of acquiring diarrhoeal disease in situation without toilet than with toilet shows that there could be fecal contamination of water leading to disease development. The higher burden of diarrhoeal disease in situation Spring without toilet among the six scenarios and with relatively lesser YLDs in situation Tube well without toilet followed by Tap water without toilet shows that unprotected water source could be important contributing factor for diarrhoeal disease.

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CONFLICT OF INTEREST

We declare no conflict of interest for this article.

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