Cost of Illness of Water-borne Diseases: A Case Study of Quetta

Mehwish Butt and Syed Muhammad Khair

Department of Economics, Faculty of Management Sciences, Balochistan University of Information Technology, Engineering and Management Sciences Quetta, Pakistan

Abstract

This study aims to investigate awareness about water quality and water borne diseases; analyze monetary burden of water borne diseases in Quetta city. Primary data were collected from some 200 households selected randomly by using cluster sampling technique. The results show that some 75% of households had knowledge about water quality and 66% of households had the awareness of water borne diseases. The quality of drinking water of Quetta city was found non-satisfactory and the household reported the existence of bad taste, foul smell/odor, change in appearance, and pathogens by 57%, 44%, 39%, and 60% respectively. Approximately 75% of households suffered from water borne diseases with children mostly prone to diseases among all affected. Moreover, some 32% of households happened to be targeted by water borne disease once in a month. The household's mean frequency of exposure to disease was 2.35 per year and the disease lasted for an average of 2 to 3 days per episode. Among the diseases, a large proportion of households 44% were affected by Diarrhea, followed by GI 25%, Cholera 21%, Typhoid 5%, and other diseases 5%. Among the cost items, hospitalization and medicines caused the highest cost. On average, annually each household had to bear Rs. 10,494 cost of water borne diseases. Majority of households opted health care services from private and public hospitals by 62%, and 26% respectively, while the remaining opted either for home remedies or herbal medicines (Hakeem). It also shows that among others, the incidence and financial burden of water borne disease is more intense on low income group as they borne comparatively higher cost of illness as proportion of their total income.

Key words: Water quality, waterborne disease, cost of illness, Quetta

Corresponding author's email: *syed.khair@buitms.edu.pk*

INTRODUCTION

On the earth, some 97% of water is saline and fresh water is only 3%. Some 97% of the earth water is found in seas and oceans, 1.5% in groundwater, and 1.5% in glaciers. Only 2.5% of the Earth's water is fresh water, and 98.8% of that water is in ice form and groundwater (Gleick, 1993). Increased population growth has led to the increased exploitation, degradation and deterioration of water resources globally.

Water is the basic human need and access to safe drinking water is one of the fundamental rights of human beings. World Health Organization (WHO, 2004) defined safe drinking water as "safe drinking water is, that does not represent any significant risk to health over the life time of consumption, including different sensitivities that may occur between life stages". Whereas, improved access to water represents the source from where households get water such as household connection, borehole, protected dug well, protected spring, or rain water connection (WHO, 2004).

Water quality has been deteriorating over the periods of time. Contaminated water has been causing serious health issues. Contaminated water may lead to a decreased human health, increased health care costs and increased productivity loses. Water borne diseases are "dirty water" diseases caused by human, animal or chemical wastes.

Currently about 20% of the world population lacks access to safe drinking water and more than 5 million people die annually from unsafe water or poor sanitation (Hunter et

al., 2009). Out of 5 million two million of deaths are of children (WHO, 1996).

Diarrhea is one of the major water borne diseases and causes morbidity and mortality mostly in children less than 5 years of age in developing countries (Pruss et al., 2002; Kosek et al., 2003).

According to WHO, globally there are 4 billion cases of diarrhea each year and many other illnesses due to lack of access to clean water (Pruss et al., 2002). Only due to diarrhea 4,900 people die daily and there is a loss of 443 million school days each year due to water related diseases. In the areas where there is no access to safe drinking water at home, children and women have to fetch water from far away areas. This induces a higher opportunity cost. This time could be used for education, employment or other productive work (UNDP, 2006b).

Pakistan has also been facing water quality and quantity issues. Pakistan's sources of drinking water are surface and ground water aquifers. Larger proportion of drinking water comes from ground-water resources and it is estimated that 70% of drinking water is groundwater (Tahir, 1998). Groundwater is also being contaminated through different sources such as raw sewage, industrial effluents, agricultural waste, land disposal of effluents, and deep soakage pits (Aziz, 2005). Groundwater in some areas such as Cholistan area, Makran coastal zone, Thar, Nara and Kohistan are found to be highly brackish (Chilton et al., 2001). In a study of Pakistan Council of Research in Water Resources (PCRWR), some 107 samples of groundwater were collected from across the country between 1988 and 2000. Some 31 samples were found to have contamination pesticides beyond FAO and WHO safety limits.

About 30% of disease and 40% of all deaths in Pakistan are found to be due to faecal contamination of drinking water (Draft South Asia-Water Vision, 2000). The main cause of water contamination is the supply of water through leaking pipes and cross connections with sewers lines (Aziz, 2005). As per USAID report an estimated 250,000 child deaths occur each year in Pakistan due to water borne disease. World health organization reports that 25-30% of all hospital admissions are connected to water borne bacteria and parasitic conditions, with 60% of infants' deaths caused by water infections. A research study conducted by Khattak (2011) examined water quality in 16 different locations of Quetta city found that there is variation in water quality at different places. Overall, it found higher contamination in tap and source water that indicates the seepage and leakage due to the interaction between water supply and sewer line. Poor quality of water was found in Baleli, Mahtarzai, Samalani, and Malahzai areas as water in the stated areas is saline and/or brackish and not safe to drink (Khattak, 2011). Further, it revealed that inorganic anions concentration was higher in source and tap water, than the specified WHO guide lines (Khattak, 2011). Due to contamination in drinking water some common water borne disease reported in Quetta were typhoid, hepatitis, gastrointestinal and dysentery (Khattak, 2011).

It is believed that estimating cost of illness (COI) is very useful and provides closer look over the monetary cost borne by society. It helps in determining the direct expenditures made on treating the disease by preventing the cause of disease it can help in saving the expenditures made to treat the particular disease. By deeply analyzing the costs incurred on each dimension, enables in understanding the different sectors where more expenditures are done, whether medicines, doctor's fees etc. it would specify the improvements to be done on which sector (Rice, 1994). The merits of estimating cost of illness may seem obvious; if nothing else, they are valuable tools for promoting attention towards a particular illness or condition and simulating the public policy debate (Rice, 1994). Policy makers use COI to allocate the budget on medical, prioritize the allocation of funds for prevention and research on different diseases (Rice, 2000). Cost of illness studies provide a way of finding cost benefit analysis for the health projects, hence provides an estimate to the decision making and policy formulation for health program (Rice, 2000). Keeping in view the seriousness of the issue in line with population growth, urban growth and increasing water scarcity in Quetta city a

further in-depth analysis in nine residential areas was designed with the following objective:

- To explore level of awareness of households about water borne diseases and water quality.

- To analyze cost of illness associated with consumption of contaminated water in Quetta city.

A review of previous work done on the issue

The studies paying attention to the estimation of cost of illness begins from almost 60 years ago conducted by Rice and his colleagues in estimating cost of illness. Since then, various studies have been conducted using cost of illness method to estimate the burden of a disease. The basic aim of measuring cost of illness is to estimate all the costs related to a disease. It includes the cost that is incurred in treating the disease and lost productivity that is borne by individual and society (Rice, 1994). The economic cost of illness is measured in terms of the direct outlays for prevention, detection and treatment and indirect costs or loss in output due to disability (morbidity) and premature death (mortality). These are the costs to society rather than to the sick individual or their families (Rice, 1976).

Direct cost of illness is defined as the cost incurred in treating the disease. It uses all the receipts made or bills paid in monetary terms for curing the disease. Such as hospital inpatient, physician in patient, physician outpatient, emergency departments outpatient, nursing home care, hospice care, rehabilitation care, specialist's and other health specialist's care, diagnostic tests, prescription drugs, drug sundries and medical supplies. These all are those expenses for which direct payments are made in monetary terms (Segel, 2006).

Besides these direct medical costs, some other non-medical direct costs are also considered. These costs incur in attaining the direct medical treatment such as transportation cost in visiting the health care service, relocation expenses, costs incurred in changing one's diet or the expenditures made in avoiding the adverse effects of

some environmental resources (Segel, 2006).

The next component of cost of illness study is the indirect cost or the productivity loses. Indirect cost includes the Morbidityand Mortality loss. Mortality cost counts the present value of future earning lost due to death and the value of services of housekeeping. The indirect cost is the negative impact of the illness on individual or society.

Productivity loss is defined as the work and leisure time lost due to illness or premature death. Productivity loss is measured by calculating the mean annual earning and days absent from job. Productivity loss would calculate the mortality loss (productive time lost, absenteeism and low performance due to illness). Indirect losses also measure the loses made by care giver in caring ill person or child (Segel, 2006).

Although Cost of Illness (COI) estimates different costs incurred due to illness but the data limitation limits the estimation of different intangible costs such as pain, grief, mental stress and frustration etc. such costs are ignored in the COI analysis. A study conducted in 1963 in estimating cost of illness outlined the problems involved in measuring the direct and indirect costs and presented a framework for calculating single-year cost of illness disability and death by major categories of illness. It was estimated that the highest expenditures were made on digestive system, mental disorder and circulatory system respectively. Direct cost of $22.5 billion was made and in productivity losses 1.8 million people died from all causes of disease; of which 57% were male and 43% were female. Output loses due to death were 60,000 man year or total value of $2.7 billion. Overall estimated annual economic cost was $58 billion (Rice, 1967).

In the study of economic impact of community wide water borne outbreak of gastrointestinal illness in Sewickley, Pennsylvania in 1975, direct cost and indirect cost was found out. Direct cost of medical expenditures, physician visits, prescription drugs, emergency rooms visits, cost of hospitalization, home visit by nurses and cost of bottled water was found and indirect cost of illness was limited to two

categories of costs that are lost wages/output and business loss due to missed work days. It was estimated to be $220,000. Over all total cost was $340,000, with almost $40 per capita, missed days 2,511 days of work and 155,000 in lost wages or output (Baker et al., 1979).

A decreasing trend of mortality and morbidity loses by cancer was found in a study in Japan and aimed at the estimation and projection of the economic burden. The reason of this decreasing trend was found to be improvement in health care services. It was suggested that new technology plays a vital role in the reduction of cost of illness (Haga et al., 2013).

The study in Washington State found the cost of illness of Asthma, Cancer, Lead exposure birth defects and neurobehavioral effects. Total cost of $ 1.875 billion in the illnesses was incurred in 2004. The study suggested that many costs due to the effect of degraded environment quality can be reduced by eliminating the contaminants (Davies, 2006).

METHODS

Quetta a bowl shaped valley has an area of 2,653 km^2 and surrounded by series of hills; named Chiltan, Takatoo, Murad and Zarghun. It has a population of about 2 million. District Quetta is the hydrological unit of Pishin Lora Basin. The major resources for domestic, commercial and agricultural water use are mostly by the extraction of ground water resources. The groundwater level of the district has declined very fast and considerably due to increased utilization of ground water resources through public and private tube wells (Quetta Water Supply and Environmental Improvement Project, 2010). Tap water supply to the households is made possible through Government agency Water and Sanitation Authority (WASA). As per 2004-05 Pakistan Social and Living Standard Measurement Survey, some 82% of the households are having tap water connections.

For the purpose of this study nine areas of the district are selected as mentioned by arrows in the map below.

Figure 1: Map showing sampling areas (Source: Google map).

Survey design and data collection

Households' data on waterborne diseases and cost of illness was collected from nine different residential areas of Quetta district. The areas are as follows: Spini road, Sabzal road, Shahbaz town, Kuchlaak, Saryab road, Archar road, Arbab karam khan road, Brewery road and Jinnah road. Convenience sampling was employed to select 200 households from the above mentioned areas.

Survey instrument

Structured Questionnaire was used to collect required information. Questionnaire solicited general information about households with an objective to collect information about personal profile of household head (education, income, gender, age, marital status and number of children), occurrence/episodes of disease, practices to avoid risk of being ill from contaminated water, direct costs associated with occurrence of disease and productivity losses such as mortality and morbidity.

Data analysis

The analyses were based on data collected from 200 households. Descriptive statistical tools and arithmetic tools were used to analyze data. Annual and per episode cost of illness was found by using simple arithmetic tools.

Estimation of cost of illness

Estimation of cost of illness provides the monetary measure of disease burden. Cost of illness includes Direct as well as Indirect Costs. Direct costs include the estimation of expenditures that are directly incurred in attaining treatment. Indirect costs are the costs incurred due to the impact of illness. Different approaches have been used in estimating costs whether Direct or Indirect

and the results are based on the analysis of the data collected from the area of study. Direct costs are measured by summing up all the monetary costs of related diseases. The data on these costs can be acquired from the health units or by asking individuals directly about the costs they incurred in treating the disease. In this research, the data regarding direct costs of water borne illness was collected through self-administered questionnaires from the household heads. Same methodology was used to acquire data through direct survey from the affected persons, their physicians and local businesses in assessing the economic impact of a community-wide water borne and gastrointestinal illness outbreak by (Baker et al., 1979). A community based survey on acquiring data on cost of illness was also used by (Malik et al., 2012) . Following factors are used for evaluating costs of water borne disease:

DIRECT COST = Medical cost = Medication + Hospitalization + Doctor's fees + Diagnostic tests
Non-medical cost = Transportation cost+ Replacement cost (alternative sources of drinking water)
INDIRECT COST = Morbidity + Mortality
Indirect cost = Lost earning/Benefits, Lost job, Lost time, Poor performance, absenteeism and Premature death

COI = Number of episodes x (Direct cost per episode + Indirect cost per episode)
Where:
    Direct Cost per episode = Direct medical + Direct Non-medical cost
   Indirect cost per episode = Productivity losses + mortality
So,
    Total cost of water borne disease = Direct cost + Indirect cost
Direct cost= Medication + Hospitalization + Doctor's fees + Diagnostic tests
Non-medical cost = Transportation cost+ Replacement cost (alternative sources of water)
Indirect cost = Lost earning/Benefits
Thus,

Total cost of water borne disease =
(Medication + Hospitalization + Doctor's fees + Diagnostic tests + Transportation cost + Replacement cost (cost on alternative sources of water) + Lost earning/Benefits
So
    Annual cost   = COI per year =
    Total cost × number of episodes
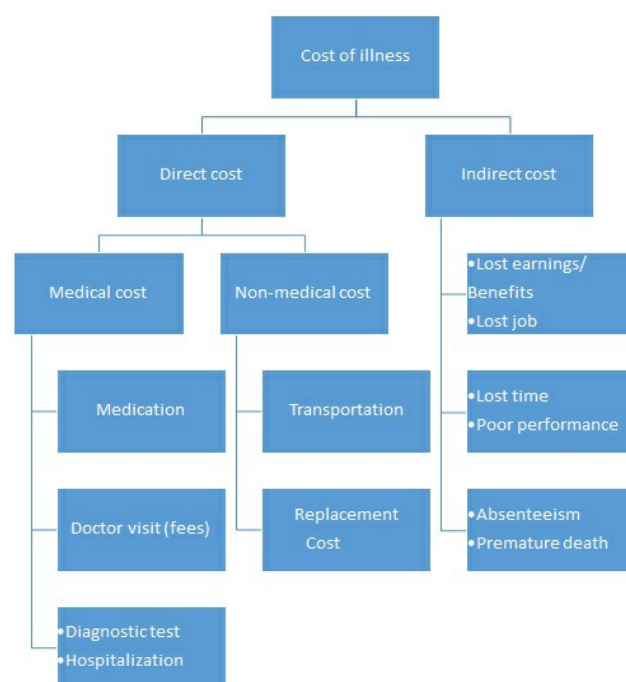
Figure 2: Cost of illness of waterborne diseases
This study is aimed at finding out monetary cost of direct COI and limits the indirect COI to earning loss. Other indirect loses (i.e. absenteeism and death) are described in descriptive statistics due to data constraints. Below model for estimating cost of illness has been taken from center for disease control and prevention (CDC).

RESULTS AND DISCUSSION
Socioeconomic characteristics of households Education level
Education plays an important role in person's ability to understand improved water quality as well as cost of illness. As in Table 1, among all respondents, only 10 % of respondents were reported with no education. The highest proportion of respondents 27% was found in the category of 6-10 and 11-14 years of education. Some 18% respondents are in the 15 years and above category of education level. The

figures show a significant proportion of respondents of around 90% as literate, which helps in increasing the credibility of information collected.

Table 1 : Education Level of respondents

Education Level (years of schooling)	Frequency	Percent (%)
0	19	9.5
1-5	38	19
6-10	54	27
11-14	53	26.5
15 and above	36	18

Source: Survey 2013

Income level
As shown in Table 2, the overwhelming majority of respondents (> 90%) earning a monthly income less than Rs. 60,000 which help determine the capacity to pay for improved water quality. The results also shows that majority of people belong to poor families and lie in the low income brackets.

Table 2: Household's income level (Rs. /month)

Income (Rs)	Freq.	Percent (%)
Below 20,000	0	0
20,000-40,000	107	53.5
41-000,60,000	82	41
Above 60,000	11	5.5
Total	200	100

Source: Survey 2013

Sources of drinking water
It was reported that households consume drinking water from different sources such as through private boring water well, Tap water (provided by the local government), from filtration plants or from water tankers through private sources. The percentage share of these sources of drinking water are shown in Figure 3 below. It shows some 47% of households get water from own source of water whereas 40% consumed tap water, while 6% get it from the filtration plant.

SOURCES OF DRINKING WATER

Tankers (7%)
Fetch from Filter Plants (6%)
Own Source (47%)
Tap Water (40%)
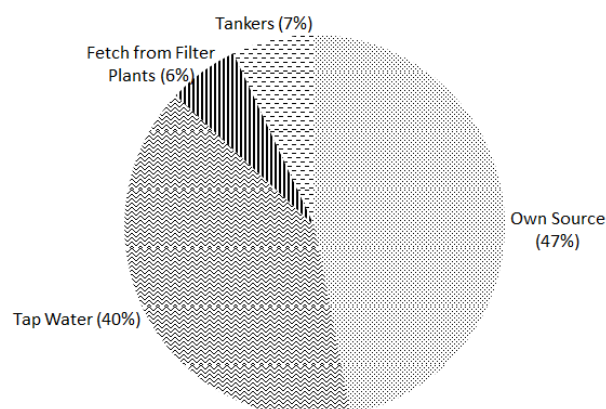
Figure 3: Sources of drinking water.

Perceptions about water quality
Perception about water quality identifies that what individuals feel about the water quality they consume. The survey results shows some 58% households are satisfied from water quality. Household perceptions about non-satisfaction on water quality were recorded on the following quality traits separately (defined as out of 100% for each): bad taste 57%, foul smell/odor 44%, change in appearance 39%, pathogens likely to exist 60% (Table 3).

Table 3: Households perceptions about water quality.

Characteristics	Percent (%)
Bad taste	57.29*
Foul smell/odor	43.68*
Change in appearance	39.07*
Pathogens likely to exist	60. 10*

Each characteristic is mentioned out of 100 %, for e.g., 57.29/100 %
Source: Survey 2013

Water borne diseases
Households are reported affected by numerous water borne diseases. According to survey results a large number of households (44%) were affected by

Diarrhea, followed by GI 25%, Typhoid 12.5%, and Cholera 21%, and other diseases 8% as presented in Table 4.

Occurrence of water borne diseases

Approximately 75% of households suffered from water borne disease. Children were mostly prone to diseases caused by contaminated water. Some 70% of all affected people were children. Approximately some 32% of households happened to be targeted by water borne disease once in a month. The household's mean frequency of exposure to disease was 2.35 per year and the disease lasted for an average of 2 to 3 days per episode.

As shown in Table 5, some 4.4% and 5.6% households preferred seeking herbal medicine (*Hakeem*) and dispensary respectively for health care service. Majority of households opted health care services from private doctors and hospitals (both private and public) with the following percentage; 23.9%, 38.9% and 25.79% respectively. Whereas only 1.26% relied on home remedies (Table 5)

Table 4: Classification of diseases prevailed in households.

Disease	Frequency	Percent (%)
Typhoid	25	05
Cholera	21	10.5
GI	50	25
Diarrhea	88	44
Other	16	05
Total	200	100

Source: Survey, 2013

Table 5: Households' preference for health care services.

Health Care Service	Frequency	Percent (%)
Herbal Medicine (Hakeem)	7	4
Dispensary	9	6
Private hospital/doctor	100	63
Public hospital	41	26
Home remedies	2	1
Total	159	100

* A person who treats diseases through herbs and shrubs.
Source: Survey 2013

Estimation of cost waterborne diseases

Cost of illness for both direct and indirect costs of households is presented in the following sections and as Table 6:

Direct cost of illness

Direct costs were incurred on transportation, doctor's fees, diagnostic tests, medicines, hospitalization and replacement cost. These total costs were Rs.41070, Rs.65620, Rs.80200, Rs.128610, Rs.257550 and Rs.67710 per episode respectively of sampled households. It shows that those with severe conditions of illness have to bear higher cost of consuming contaminated water. The reason of hospitalization for being highest expenditure is also due to the distrust and insufficient service level of public hospitals so households were compelled to move to private hospitals for availing better treatment facilities. Private hospitals are comparatively costly and charge higher prices. After hospitalization medicines are the next high expense consuming category. Medicines consumed total expenditure of Rs.128610 per episode and least expenditures consuming category was transportation; this is one of the non-medical direct cost. It may be low because Quetta is a small city and having short distances. Other non-medical direct cost is the avoidance/replacement cost. This is the cost

that an ill person has to bear to avoid the cause of illness. The person would choose some alternatives to avoid the consumption of presently consumed contaminated water which has posed many health issues. Households would decide to choose safe drinking water source according to their income level. Approx. 58% households are indulged in averting behavior. Most common practice adopted by households for cleaning water is boiling (40%). Installation of filter at home, purchase of mineral water, fetching water from filter plants and use of chemicals are also being practiced by households. Total replacement cost borne by households was Rs.67710 per month. Households expenditures on doing water purification practices depend on households' income level or the patient's health risks due to the consumption of contaminated water. So the total direct cost was Rs.640760 per episode and on average each household had to bear the direct cost of illness of Rs.3203 per episode. (Table 6)

Indirect cost of illness

The other component of cost of illness is indirect cost. Indirect cost indicates the productivity loss and mortality due to illness. This study has attempted to explore loss of job, absenteeism from job, benefit/salary/income or business loss, School/College or university absenteeism, house wife's loss of time in being ill and unable to do the house hold task properly and parents' time loss or absenteeism in caring ill family member or child. This study has analyzed the benefit/income or business loss due to consumption of contaminated water in monetary terms. Other indicators are determined in descriptive analyses. Total benefit/income or business loss was estimated to be Rs.252350 per episode. On average each household had to bear cost of approx. Rs.1262 per episode.

Over all total cost calculated in monetary terms for both direct and benefit/salary/income or business loss was Rs.893110 per episode. On average Rs.4465 cost per episode each household have been bearing due to the consumption of drinking contaminated water. If mean frequency of exposure to disease was 2.35

per year than annual cost of illness of water borne disease for 2013 was Rs.2098808, it means on average each household was bearing a cost of Rs. 10494 per year. Although this represented a huge cost but still it does not include the productivity loses in terms of absenteeism from work place, loss of potential working years due to death and the cost of bearing pain, suffering and anxiety due to illness. (Table 6)

Table 6: Cost of illness of water borne disease (Rs. /household).

Costs	Expenditures in 000 (Rs)
Direct costs	
Direct medical cost	
Doctor's fees	65.62
Diagnostic tests	80.2
Medicines	128.61
Hospitalization	257.55
Non-medical cost	
Transportation	41.07
Replacement cost	67.71
Total direct cost	640.76
Indirect cost	
Benefit/salary/business loss	252.35
Total indirect cost	252.35
Total cost	893.11
Annual cost	2098.81

Source: Survey, 2013

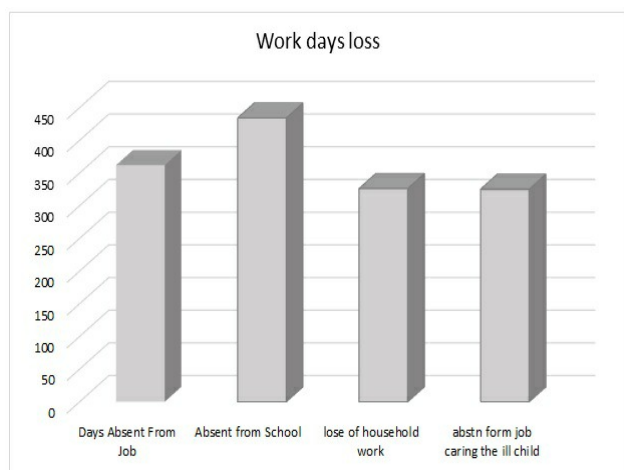**Work day's loss due to water borne disease**

It is estimated that total loss of working days from job was 362 days per episode. On average for approximately 3 days each ill person had to be absent from his/her job per episode. Students' absenteeism on average was around 3 days per episode and total days absent from school/college or university were 434 days per episode. House wife also have to bear the productivity loss by being ill, their efficiency of performing house hold tasks decreases and they are unable to do their tasks properly. It is analyzed that on average house wives lost one and half days from working and in total there were 326 days loss per episode. Not only those who were ill had to bear the cost and consequences of illness but those who give their time in caring the patient also had to lose their work time. Like parents especially mothers' have to be absent from their job or

leave their house hold tasks in caring ill child or other ill family member. Total 325 days per episode loss was estimated and on average 1.5 days loss per episode per household had to bear.

Total days lose in absenteeism from job, school/college or university absenteeism, house wife loss of time due to illness and inability to do the household tasks properly and the parents' time loss or absenteeism in caring ill family member or child is estimated to be 1447 days per episode.

On average each household had to bear the loss of 7 days per episode due to the consumption of contaminated drinking water. Hence annually 3400 days loss is estimated for 2013. On average each household lost 17 days per year. No loss of job was reported due to illness. Other category in indirect cost is mortality or deaths due to water borne disease. Some 18 deaths were reported in 2013 and most of them were children of (0-5 age) and elders (30-50 age). This shows children and elders are more prone to the effects of contaminated water and the cause of most of the deaths was diarrhea. Figure 4 shows the work days loss from each factor.

Figure 4: Days loss per episode due to illness *(Source: Survey, 2013)*

CONCLUSION

The aim of this study was to explore level of awareness of households about water borne diseases and analyze the cost of illness associated with consumption of contaminated water in Quetta city. The results showed that the quality of drinking water of Quetta city was non-satisfactory in respect of taste, odor, appearance, and

contained pathogens. Some 75% of households suffered from water borne diseases with children more prone to diseases. Moreover, some 32% of households happened to be targeted by water borne disease once in a month. The household's mean frequency of exposure to disease was 2.35 per year and the disease lasted for an average of 2 to 3 days per episode. Among the diseases, a large proportion of households 44% were affected by Diarrhea, followed by GI 25%, Cholera 21%, Typhoid 5%, and other diseases 5%. Estimates showed that households bear a higher cost of illness due to water borne diseases. The analyses of the cost of illness of water borne disease revealed that sampled households incurred Rs. 2098,808 annual cost in 2013 in treating water borne diseases. Among the cost items hospitalization and medicines caused the highest cost. Households had to bear a direct cost (cost incurred in treating disease) of Rs. 640,760 per episode and indirect cost (cost incurred due to illness) of Rs.252, 350 per episode. On average, annually each household had to bear Rs. 10,494 cost of water borne disease. It also shows that incidence and financial burden of water borne disease are more on low income group. Because, the low income group borne comparatively higher cost of illness as proportion of their total income. This indicates the need for better health care services to be provided at public hospitals so the costs incurred on illnesses could be reduced.

Limitations of the study
- The cost estimates are based on the respondents recall due to lack of written record with households with regard to disease treatment costs etc.
- The sample size was restricted due to time and resources constraint.
- The respondents reluctance to provide information on their income, they might have under stated their incomes.
- Cost of illness of water borne disease in monetary terms is measured for direct cost of illness but in indirect cost only earning loss is quantified in monetary terms. Loss of working time is not

measured in monetary terms moreover the psychological impact (grief pain and anxiety) of disease is also not considered. If these all costs could have been analyzed properly, it would have told the accurate economic impact of the water borne disease on society.

REFERENCES

• Aziz J A. (2005). Management of source and drinking-water quality in Pakistan. *Eastern Mediterranean Health Journal. 11(5-6):1087–98.*

• Baker EL, Peterson W, Allmen SVON and Fleming J. (1979). Economic Impact of a Community Wide Waterborne Outbreak of Gastrointestinal Illness. *Am J Public Health*. 69(5):1978–1979.

• Chilton PJ.(2001). Pakistan water quality mapping and management project. Scoping study – draft final report. Loughborough, UK, Water, Engineering and Development Centre, Loughborough University & London School of Hygiene & Tropical Medicine, (WELL Task 568).

• Davies K. (2006). Economic Costs of Childhood Diseases and Disabilities Attributable to Environmental Contaminants in Washington State, USA. *EcoHealth*.3(2):86–94.

• Gleick PH. (1993). Water in Crisis: A Guide to the World's Freshwater Resources. Oxford University Press, New York.

• Haga K, Matsumoto K, Kitazawa T, Seto K, Fujita S and Hasegawa T. (2013). Cost of illness of the stomach cancer in Japan - a time trend and future projections. *BMC Health Services Research.*13(1):283.

• Hunter PR., Zmirou-Navier D and Hartemann P. (2009). Estimating the impact on health of poor reliability of drinking water interventions in developing countries. *The Science of the Total Environment.* 407(8):2621–4.

• Khattak M I. (2011). Study Of Common Inorganic Anions In Water Samples Of Quetta City By Technique Of Ion Chromatography. *Sci.Int. (Lahore)*.23(2):135–141.

• Kosek MCB, Bern C and Guerrant RL. (2003). The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000. Bull. *WHO.* 81:197–204

• Malik A, Yasar A, Tabinda AB and Abubakar M. (2012). Original Article Water-Borne Diseases, Cost of Illness and Willingness to Pay for Diseases Interventions in Rural Communities of Developing Countries. *Iran J Public Health.* 41(6):39–49.

• Montgomery MAA and Elimelech M. (2007). Water and sanitation in developing countries:including health in the eqaution. Environmental Science and Technology. *Environ Sci Technol*. 41(1):17-24.

• Prüss A, Kay D, Fewtrell L and Bartram J. (2002). Estimating the Burden of Disease from Water, Sanitation and Hygiene at a Global Level. *Environmental Health Perspectives*. 110(5):537- 542

• Rice DP. (1967). Estmating the cost of illness. *Am J Public Health Nations Health.* 57(3):424–440.

• Rice PC. (1976). The Economic Cost of Illness Revisited. *Bullitin.* 44–50.

• Rice, D.P. (1994).Cost-of-illness studies: fact or fiction? Lancet. 1994; 344:1519–1520.

• Rice DP. (2000). Cost of illness studies: what is good about them?

Injury prevention. *Inj Prev* 6(3):177-179.

- Segel JE. (2006). Cost-of-Illness Studies, a Primer. RTI International RTI-UNC Center of Ecellence in Health Promotion Economics, 1–39.

- Tahir MA.(1998). Drinking water quality monitoring in the rural areas of Rawalpindi. In: Proceedings of the national workshop on quality of drinking water. Islamabad, Pakistan Council of Research in Water Resources.

- United Nations Development Programme (UNDP), (2006b) Human Development Report-Beyond scarcity: Power, poverty and the global water crisis. 1 UN Plaza, New York, 10017, USA.
- WHO/UNICEF. (2004). Meeting the MDG Drinking Water and Sanitation Target: A Mid-Term Assessment of Progress; WHO: Geneva.