Impact of Housing WATSAN Facilities on Health: Evidence from Pakistan Panel Household Survey 2010.

By

Zara Bari

Deparment Of Environmental Economics

Pakistan Institute of Development Economics Islamabad

Pakistan

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CERTIFICATE

This is the certify that this thesis entitled "Impact of Housing WATSAN Facilities on Health: Evidence from Pakistan Panel Household Survey 2010" submitted by Ms. Zara Bari, is accepted in its present form by the Department of Environmental Economics, Pakistan Instiitute of Development Economics (PIDE), Islamabad as satisfyin fir partial fulfilment of the degree of **Masters of Philosophy** in Environmental Economics.

Supervisor:

____
Dr. Durr-e-Nayab
Head of the Department of Health Economics
PIDE, Islamabad

External Supervisor:

____
Dr M. Rafiq
Assistant Professor
Peshawar University

Head, Department of Environmental Economics

____
Dr. Rehana Siddiqui
Department of Enviromental Economics
PIDE, Islamabad

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Abstract

Health is undoubtedly a basic requirement and an important factor of human life. One of the major factors in health degradation is housing environment, which includes housing material, household water source, household sanitation, household waste disposal and indoor air pollution. Health varies with different socioeconomic, demographic and environmental characteristics. The study analyzed the association of different socioeconomic and environmental factors on health. A detailed analysis was done on the effects of housing WATSAN facilities on health through bivariate analysis and multivariate analysis using logistic regression. The association was measured through three indicators: total population reported ill; population reported ill with water borne diseases; and children reported ill with diarrhea. Result showed that different socioeconomic had a very strong association on health of the individuals. Another objective was to measure effects of WATSAN facilities on health. the multivariate analysis the probability of falling ill increased in populations living in households having no piped water source and no drainage system. Whereas the population reported ill with water borne diseases and diarrhea showed significant association for both bivariate and multivariate analysis where the likelihood of falling ill with these diseases increase significantly in the houses lacking both the proper toilet facility and covered drainage system. As for the unsafe source of drinking water, it showed no relation in increasing the likelihood of falling ill with diarrhea and water borne diseases. Pakistan's socioeconomic and demographic factors strongly affect health; water borne diseases and diarrhea have more significant association with sanitation facilities rather than with source of drinking water.

Keywords: WATSAN, Waterborne Diseases, Diarrhea and Pakistan

Chapter One

Introduction and Background

1.1 Introduction

Over the past few decades the role of environmental factors has been highlighted in the health debate. One of the major factors in health degradation is housing environment, which includes housing material, household water source, household sanitation, household waste disposal and indoor air pollution. The interrelationship of housing and health is complex and has many associated factors including many socio-economic factors, nutrition, crowding, education, medical care and treatment facilities and ecological and ethnic factors that should be taken in account (Martin et al. 1976). More than 2.5 billion people (38 percent of the world's population) lack adequate sanitation facilities and almost one billion people still use unsafe drinking water sources (UNICEF, 2009). In many parts of the world, the main source of water contamination is due to sewage and human waste as poor sanitation is a major factor for water contamination.

The 1981-1990 was declared as International Decade for Drinking Water and Sanitation (WATSAN) and it was one of the initial steps taken by United Nations to improve the supply of drinking water, then with New Delhi Declaration this phenomenon has been constantly renewed and in 2000 the Millennium Development Goals (MDG) was announced by the United Nations. In the Millennium Development Goals (MDG) access to drinking water is explicitly stated (target 10 of MDG 7)**(**Kiendrebeog, 2011). The Millennium Development Goals (MDGs) targets to halve the proportion of people without sustainable access to safe drinking water and basic sanitation is unlikely to achieve even there has been a lot of investment and progress, as since 1990, 1.6 billion people have gained access to safe drinking water and 1.1 billion have gained access to improved sanitation facilities. Despite this progress a large number of people are still deprived from access to improved sanitation and safe drinking water (UNICEF, 2009).

Health is undoubtedly a basic requirement and an important factor of human life. WATSAN strongly influences the health of the individuals living in that household.

Lee Jong-wook (director general, WHO) in one of his famous saying; has stressed upon the significance of interrelationship of WATSAN and health;

I often refer to it as 'Health 101', which means that once we can secure access to clean water and to adequate sanitation facilities for all people, irrespective of the difference in their living conditions, a huge battle against all kinds of diseases will be won. (Source: Jehangir & Javed 2007)

At any given time almost half of the urban populations of Africa, Asia, and Latin America have a disease associated with poor sanitation, hygiene, and water (WHO, 1999). Globally the most significant faeco-oral disease is diarrhea causing around 1.6–2.5 million deaths annually mostly among children under 5 years of age residing in developing countries (Mathers et al., 2006 and Kosek et al., 2003).

1.2 Background

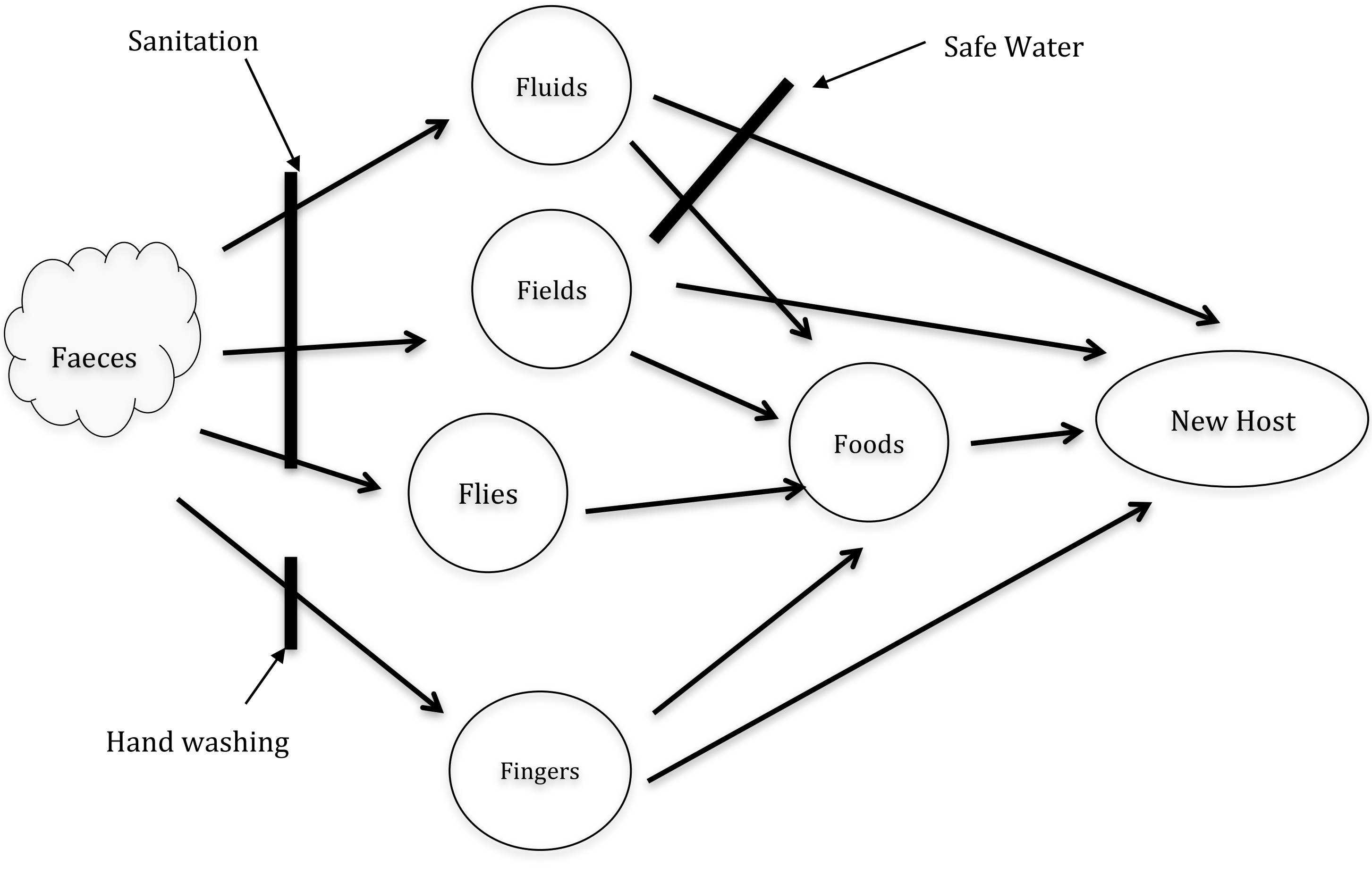
Health, productivity and quality of life are endangered if there is inadequate access to safe drinking water as recognized by international community. Sanitation and water quality are irreversibily interwoven thus showing that poor sanitation leads to water contamination. In many parts of the world, the main source of water contamination is because of sewage and human waste (UNICEF et al. 2004). The fecal-oral route is the route of transmission of diseases in which pathogens[1] in the feces are introduced in to the oral cavity of another potential host. Figure 1.1 gives the fecal-oral disease transmission pathways and interventions to break them.

There are many intermediate steps and routes through which the fecal particles come in contact with the hosts oral cavity like when water that come in contact with feces is used for drinking prior to proper treatment (e.g. boiling) or when people involved in food preparation fail to thoroughly wash their hands after going to the bathroom or when people do not wash their hands before eating. Transmission of infection by the fecal oral route can also occur through house files that directly transport the pathogens from feces to food items by sitting on them. This fecal-oral route transmission can be controlled thorough adequate sanitation facilities for safe

[1] A pathogen or infectious agent is a microorganism such as virus, bacteria or fungus that causes disease in its host.

disposal of human excreta, personal hygiene, safe storage of water and also its treatment before using it.

Figure 1.1: Fecal-oral Disease Transmission Pathways and Interventions to Break Them



Source: Mara, Lane Scott &Trouba 2010

1.2.1 Cost of Illness

WATSAN has significant impacts not only on health, but also on social and economic development, particularly in developing countries. The economic cost of illness has been a matter of great interest for a number of years. Cost-of-illness studies measure the economic burden of a disease or diseases and estimate the maximum amount that could potentially be saved or gained if a disease were to be eradicated (WHO, 2009). The economic cost of illness is measured in terms of direct outlays for prevention, detection and treatment whereas indirect cost or loss is due to absence from employment or other economic activities with that the households has the probability of losing their future consumptions because of negative impact on savings (WHO, 2009).

It has been estimated that each year 44 million households worldwide face catastrophic health expenditures defined as spending more than 40% of their non subsistence income on health care payments and about 25 million are pushed into poverty (Xu et al., 2003, 2007). The most commonly studied diseases in reference to economic costs have been malaria and HIV/AIDS (Chima et al., 2003; Russell, 2004). Households experiencing the ‘direct’ financial Costs in order to obtain the health services and goods that they need, economic impact studies have also revealed a more 'indirect' set of consequences that may possibly befall households. Where indirect costs were included, they tended to exceed direct costs; in the case of malaria, for example, direct costs of treatment and prevention have been found to be in the range of 2%-3% of household income, compared to 2-6% for indirect costs (Russell, 2004).

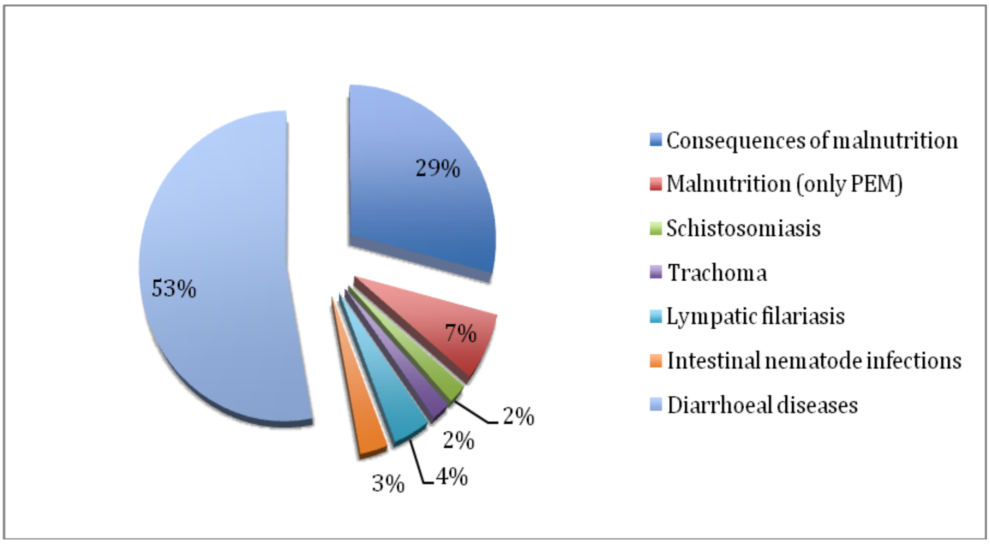
1.2.2 Global Burden of Disease attributed to WATSAN:

Almost 10% of the disease out of the total burden of disease worldwide can be prevented by improvements in sanitation, hygiene, drinking water and water resource management (WHO, 2008). Over 2 billion people gained access to improved water sources from 1990 to 2010, and the proportion of the global population still using unimproved sources is estimated at 11 per cent (WHO, 2012).

Globally the burden of poor access to WATSAN falls majorly on the poorest of the poor. In the low and middle-income countries the approximate coverage of improved water is 79% and sanitation is 49% whereas its 98% for both in high-income countries (UNICEF et al. 2004) and within developing countries almost similar pattern prevails depending on geography and household characteristics.

Lack of sanitation contributes to about 10% of the global disease burden, causing mainly diarrheal diseases. An estimate that mortality due to water, sanitation and hygiene associated diseases was around 2.2 million, hence giving the gravity of the situation (UNESCO, 2003). Figure 1.2 break down the global burden of diseases that can be avoided by improvements in hygiene, sanitation and water supply. It is dominated by mortality and morbidity from diarrhea, which is almost 53% of all the associated diseases.

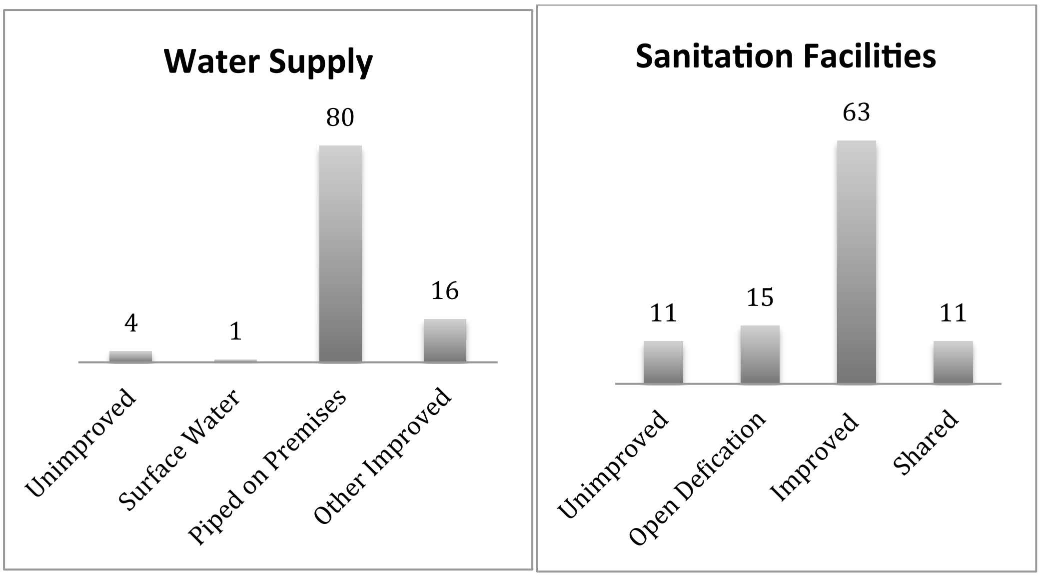
Figure 1.2: Global Total Burden of Ill Health Preventable by Improvements in Hygiene, Sanitation and Water supply



Source: Bartram and Cairncross, 2010

In developing countries much ill health is attributable to lack of proper water supply and sanitation facilities. Almost 63% of the world's population (4.3 billion people) has proper sanitation facilities, a basic latrine or flush system. 15% of the global population defecates in open while 11% rely on unimproved toilet facilities making them the most venerable group to fall ill with sanitation related diseases (Figure 1.3).

Figure 1.3: % of Population at Global Level with Water and Sanitation Facilities



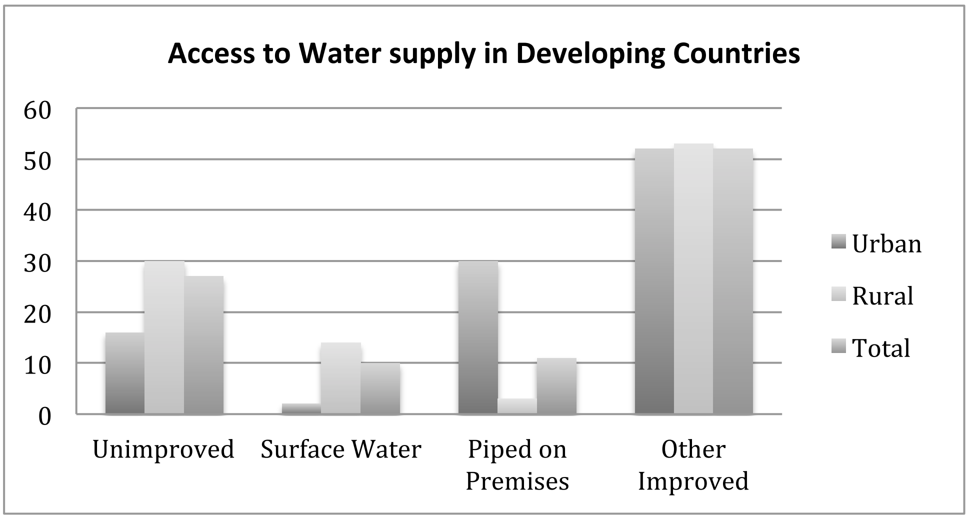
Source: UNICEF & WHO 2012

The situation for drinking water can be observed in Figure 1.3 where 96% of the population has piped or other improved sources of water supply and only 5% rely on unsafe water supply. Though in developing world especially in Asian countries it is not necessarily the case that the piped water is the safe source of water supply as it can get contaminated at the source or through the pipes thus making it unsafe for consumption and can be the source of many water borne disease[2] (Bartram & Cairncross, 2010).

The WATSAN is one of the major issues in less developed world as this part of the world is more deprived than the Developed Countries as shown in Figure 1.4 and 1.3 respectively. In developing countries the urban rural disparity is evident as compared to rural households urban households are 30% more likely to have an improved water source and 135% more likely to have improved sanitation facilities (UNICEF et al. 2004, Moe and Rheingans, 2006). In the Asia and Pacific region, 700 million are without water supply and 2 billion are without adequate sanitation.

[2] Definition of water borne disease is given in chapter 2

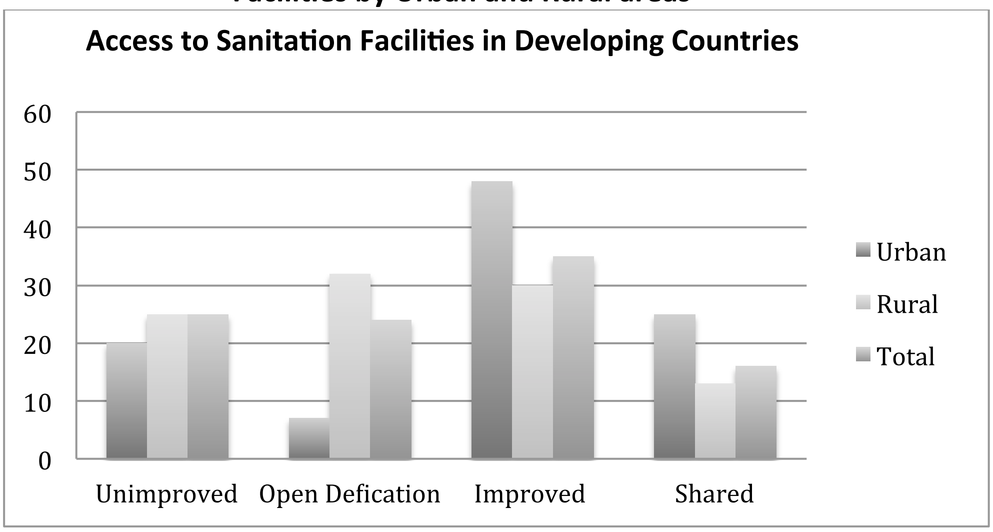
Figure 1.4: % of Population in Less Developed Countries with Access to Water Supply by Urban and Rural areas



Source: UNICEF & WHO 2012

This problem is specifically severe in the rural areas, where 70% of the world's poor reside (ADB, 2006). In rural areas where chances for access to infrastructure are limited, the access to safe drinking water and sanitation facilities remains crucial and especially in the rural areas of most of the developing countries. Figure 1.4 shows that 30% of the rural population of developing countries relies on unimproved water source and almost 10% use surface water (lake, ponds etc.) for consumption forcing them to travel long distances everyday on foot to collect unsafe drinking water (Unicef, 2009).

Figure 1.5: % of Population in Less Developed Countries with Access to Sanitation Facilities by Urban and Rural areas



Source: UNICEF & WHO 2012

In developing countries the situation of sanitation facilities is graver than the water source, where considerable percentage of people are using either unimproved toilet facility or/and are pushed to defecate in the open, 25% and 23% respectively. This lack of sanitation increases the chances of catching infections through fecal-oral transmission (figure 1.5).

1.2.3 WATSAN with associated Disease burden in Pakistan

Pakistan being a less developed and a poor country in socio-economic context as almost 49% of the country population is at or below poverty line (OPHI, 2011) half of them are deprived of proper sanitation facilities, mostly being illiterate, thus making them the most venerable group to adverse health effects (Ali, 2000). In developing countries it is a critical situation where about half of the population has no access to safe drinking water and improved sanitation (WHO, 2009). Thus providing safe drinking water and access to improved sanitation within the household environment can reduce the risk of mortality and morbidity especially among children under age five (WHO, 2009).

Water and Sanitation is the ignored sector in Pakistan. A huge number of people in Pakistan do not have access to safe drinking water and lack toilets and satisfactory sanitation systems (Table 1.1). As of 2005, approximately 38.5 million people did not have safe drinking water source and approximately 50.7 million people lacked access to improved sanitation facilities in Pakistan (Jehangir and Javed, 2007). By year 2015, if this trend continues, 52.8 million people will be deprived of safe drinking water and 43.2 million people will be lacking adequate sanitation facilities in Pakistan (Jehangir and Javed, 2007). Table 1.1 gives a snapshot of the housing environmental facilities and the associated number of deaths.

Table 1.1:Housing Environment Indicators (Regional Comparisons)

Country	Population without access to improved services		Deaths due to indoor and outdoor air and water pollution/million people
	Water %	Sanitation %	
Bangladesh	20	47	821
Pakistan	**10**	**55**	**896**
Nepal	60	55	737
India	12	69	954

Source: Human Development Report 2010

Approximately 50% of urban water supply is inadequate for drinking and personal use as estimated by Pakistan Council of Research and Water Resources (PCRWR). This research concludes that an average of 25.61 % of Pakistan's 159 million inhabitants have access to safe and adequate drinking water. There is nothing to doubt that the greater part of the Pakistan's population is exposed to the risks of drinking unsafe and polluted water (Mahmood and Maqbool, 2006).

Table 1.2: Deaths and DALYs ('000) lost Attributed to Water, Sanitation and Hygiene (WSH)

Country	Deaths			DALYS		
	Total Deaths	Total WSH-Related Deaths	% Of Total Deaths	Total DALYS	Total WSH-related	% of total DALYs
Nepal	233.3	24.7	10.60%	7469.1	873.5	11.70%
India	10378.5	782	7.50%	299909.8	28213.3	9.40%
China	9135.5	200.2	2.20%	200273.1	8707.1	4.30%
Pakistan	**1386.4**	**187.9**	**13.60%**	**44821.2**	**6437.5**	**14.40%**

Source: WHO 2008

Table 1.2 gives an account of the number of deaths and DALYS[3] lost due to water sanitation and hygiene (WSH) in Pakistan with its neighboring countries. As observed Pakistan is in a graver situation when compared with its geographical neighbors where almost 13% of the deaths and almost 14% of DALYS are lost due inadequate water and sanitation facilities. This suggests that just by improving the sanitation and water supply facilities a considerable burden of diseases can be averted.

[3] The disability-adjusted life year (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

1.3 Research Questions

While working on the study about impact of housing water supply and sanitation facilities some questions are raised, some of these important ones are given below:

- Does the household environment linked to the water and sanitation system have an influence on the health of its residents?
- What are the age and sex differentials of WATSAN related diseases?
- What are the urban/rural and provincial (geographic) differentials of WATSAN related diseases?
- What is the economic cost (direct/indirect) of water borne/water based diseases related to WATSAN on the households?

1.4 Objectives

With the above questions in mind the current study has the following objectives:

- To investigate the effects of the WATSAN system on health of the individuals residing in that household.
- To analyze the age and sex (demographic) differentials of WATSAN related diseases.
- To identify the urban/rural and provincial (regional) differentials of WATSAN related diseases.
- To calculate the direct and indirect economic cost of WATSAN related diseases.
- To formulate recommendations for improvement in housing environment for better health of the residents.

1.5 Hypotheses

The hypotheses regarding the study of impact of housing water supply and sanitation facilities on health in Pakistan are:

- Improved housing water supply and sanitation facilities have an opposite effect on the health of the individuals living in that household.
- The demographic factors significantly influence the WATSAN related diseases.

- The regional factors have a noticeable effect on WATSAN related diseases.
- With an improvement in housing WATSAN facilities the health of the individuals can be improved

1.6 Rationale of the Study

Considering the impact of sanitation facilities and water source of a household on the health of the individuals living in that household is important for health and environmental policies and programs in Pakistan. In terms of burden of disease Pakistan has a double burden of disease (both communicable and non-communicable), which contains significant proportion of diseases caused by improper water supply and poor sanitation facilities. The study aims to analyze the significance of the linkages between the sources of water supply, type of toilet facility, type of drainage facility and health. Better understanding of these linkages will contribute towards better health and highlight the importance of improved sanitation facilities and water supply in Pakistan.

1.7 Shortcomings of the Study

One of the major limitations of the current study is that the hygiene practice is not taken into account at both personal level and storage practices. Personal hygiene involves hand-washing practice and it has a significant affect on the health of the individuals, which prevents them from catching many infections. The tap to mouth route of water intake involves the storage and water boiling practices which can turn safe water to unsafe water and vice versa, so they have significant effect on health but inclusion of these aspects are beyond the scope of the this study. Also the sanitation related non-water borne diseases are not covered. Time cost is an aspect of economic cost of illness but it is not dealt with in the current study due to data limitations.

1.8 Organization of the Study

The study is presented in seven chapters and a brief outline of each is as follows:

- Chapter one has provided an introduction, background review of household

WATSAN related diseases and water supply and sanitation facilities trends in different developing countries and in Pakistan. This chapter also briefly introduces the cost of illness internationally and also nationwide. The research questions, objectives, hypotheses, rationale and shortcomings of the study are also stated in this chapter.

- A detailed review of literature is done in the second chapter.
- Chapter three focuses on the data used for the study and illustrate the methodology, which is used to achieve the objectives of the study. This chapter also gives a detailed conceptual framework devised for the current study.
- Chapter four presents the basic demographic, geographic and the environmental characteristics of the sampled population.
- Chapter five describes the detailed measurement of the effects of housing WATSAN related diseases on health of the individuals residing in that household through detailed bivariate and multivariate analysis
- Chapter six measures the direct and indirect economic cost of WATSAN related diseases.
- Chapter seven summarizes the major findings and conclusions of the study. It also elaborates on the policy issues arising from the findings and their policy recommendations.

Chapter Two

Literature Review

Developing countries face many health issues due to inadequate sanitation and water supply. Pervious studies conducted on this subject also highlight that health of the individuals can be improved by identifying, preventing and reducing the housing environmental hazards thus in return can help in the well being of the individuals living in that household. The main focus of this chapter is to define environmental health, water related diseases and inter-linkages of WATSAN and health in the available literature. In addition the chapter focuses on the measurements of economic cost of illness by various studies.

2.1 Definitions

2.1.1 Definition of Environmental Health

Environmental health is generally defined as those health outcomes that are a result of environmental risk factors. The World Health Organization has defined environmental health as, "all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviors. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments" (WHO 2008).

2.1.2 Definitions of access to drinking water and sanitation

Access to safe drinking water is estimated by the percentage of the population using improved drinking water sources, Similarly access to sanitary means of excreta disposal is estimated by the percentage of the population using improved sanitation facilities.

- **Improved Water Source:** An improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with fecal matter (UNICEF & WHO, 2008).

- **Improved Sanitation:** An improved sanitation facility is defined as one that hygienically separates human excreta from human contact (UNICEF & WHO, 2008).

Further to the definitions, the different types of water supply and sanitation facilities are explained in more detail in table 2.1. As the table shows that how these facilities are explained in literature and on what basis they are marked as improved and/or unimproved. The detail of each sanitation technology with their exposure pathways are given in appendice table: 2 A

Table 2.1: Types of Improved and Unimproved WATSAN Facilities

Facility	Improved	Unimproved
Water supply	• House connection • Stand post/pipe • Borehole • Protected spring or well • Collected rain water • Water disinfected at the point-of-use	• Unprotected well • Unprotected spring • Bottled Water
Sanitation	• Sewer connection • Septic tank • Pour-flush • Simple pit latrine • Ventilated Improved Pit-latrine	• Service or bucket latrines • Public latrines • Latrines with an open pit • Flush connected to open drain, • Dry raised pit, • Dry pit

Source: UNICEF & WHO, 2008

Note: Bottled water is not considered improved due to limitations in the potential quantity, not quality, of the water.

2.1.3 Definition of Sanitation related Water borne Diseases

- **Waterborne diseases:** caused by the ingestion of water contaminated by human or animal feces or urine containing pathogenic bacteria or viruses. This group includes cholera and other diarrheal diseases, typhoid, hepatitis A and E, and many other diseases, which are spread by people swallowing fecally contaminated matter containing the organisms that cause these diseases. The main health benefits of both water supply and sanitation interventions lie in the reduction of fecal-oral diseases; of all of these, diarrheal disease is by far the most important (WHO, 2008)
- **Water-based diseases:** caused by parasites found in intermediate organisms living in water. These are parasitic infections of humans in which the parasite spends a part of its life cycle in an intermediate aquatic host. The most significant of these parasitic diseases are digestive and intestinal problems. Improvements in water supply can significantly reduce these infections (WHO, 2008).
- **Water- related insect vector diseases:** caused by insects that breed in water; include dengue, filariasis[4], malaria, on- chocerciasis[5] and yellow fever[6](WHO, 2008).

The most significant diseases attributed to unimproved WATSAN facilities with their causative agents, symptoms and mode of transmission are shown in detail in table 2.2. All the enlisted diseases are water borne having a fecal-oral mode of transmissions that are caused due to unimproved WATSAN facilities.

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[4] **Filariasis (philariasis)** is a parasitic disease that is caused by thread-like nematodes (roundworms. These are transmitted from host to host by blood-feeding arthropods, mainly black flies and mosquitoes.

[5] **Onchocerciasis** also known as **river blindness** and **Robles disease**, is a parasitic disease caused by infection by *Onchocerca volvulus*, a nematode (roundworm)

[6] **Yellow fever**, also known as **Yellow Jack** or "Yellow Rainer" and other names, is an acute viral hemorrhagic disease. Yellow fever presents in most cases in humans with fever, chills, anorexia, nausea, muscle pain and headache, which generally subsides after several days

Table 2.2: Important Diseases Related to Improper Housing Water Supply and Sanitation Facilities

Disease	Causative Agent	Gastro-intestinal & other Symptoms	Mode of Transmission	Housing Environmental risk factors
Diarrhea	*Rotavirus Shigella* *Salmonella E.histolytica Giardia intestinalis*	Watery stools at least three times a day, with or without blood or slime. Might be accompanied by fever, nausea or vomiting	Fecal-oral Water Borne Diseases	Contaminated drinking water or food, or poor sanitation
Cholera	*Vibrio cholerae bacteria*	Modest fever, severe, but liquid diarrhea (rice water stools), abdominal spasms, vomiting, rapid weight loss and dehydration, rapid deterioration of condition	Fecal-oral Water-based Diseases	Untreated water, poor disinfection, pipe breaks, leaks, groundwater contamination, campgrounds where humans and wildlife use same source of water.
Typhoid fever	*Salmonella typhi bacteria*	Starts like malaria, sometimes with diarrhoea, prolonged fever, occasionally with delirium	Fecal-oral Potentially Water borne or can be water washed[7]	Sewage, non-treated drinking water
Hepatitis-A/Jaundice	*Hepatitis A virus*	Nausea, slight fever, pale- coloured stools, dark- coloured urine, jaundiced eye whites and skin after several days	Fecal-oral Potentially Water borne or can be water washed	Poor hygiene, contaminated foods and water
Intestinal nematode infections	*Ascariasis, trichuriasis, hookworm*	Nausea, vomiting, diarrhea.	Water-based disease	Contaminated drinking water with eggs

Source: Author's adaptation from Mara, 1999 and Bartram & Cairncross, 2010

[7] **Water-washed diseases** are caused by poor personal hygiene and skin or eye contact with contaminated water, it include scabies, trachoma and flea, lice and tick-borne diseases.

2.2 Linkages of WATSAN with Health

The poor housing conditions contribute to a wide range of health problems that ranges from psychological to physiological ill health effects. There is a huge and significant amount of literature that convincingly relates the different effects of poor housing and particular health conditions (Bateman & Smith, 1991).

With 1.1 billion people lacking access to safe drinking water and 2.6 billion without adequate sanitation, the magnitude of the water and sanitation problem remains significant (WHO and UNICEF 2005). Each year contaminated water and poor sanitation contribute to 5.4 billion cases of diarrhea worldwide and 1.6 million deaths, mostly among children under the age of five (Hutton and Haller 2004). Intestinal worms—which thrive in poor sanitary conditions—infect close to 90 percent of children in the developing world and, depending on the severity of the infection, may lead to malnutrition, anemia, or retarded growth, which, in turn, leads to diminished school performance (see Hotez and others 2006; UNICEF 2006). About 6 million people are blind from trachoma[8], a disease caused by the lack of water combined with poor hygiene practices.

Globally, around 2.4 million deaths (4.2% of all deaths) could be prevented annually if everyone practiced appropriate hygiene and had good, reliable sanitation and drinking water. These deaths are mostly of children in developing countries from diarrhea and subsequent malnutrition, and from other diseases attributable to malnutrition (Hutton J et al 2007). Households with no toilet facility or with well as a source of drinking water had a high risk of dying compared to households with flush toilet and piped water (Macassa et al 2004).

Household Environmental health relates to human activity or environmental factors that have an impact on socioeconomic and environmental conditions with

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[8] Trachoma is an infectious disease caused by the *Chlamydia trachomatis* bacterium, which produces a characteristic roughening of the inner surface of the eyelids. Also called **granular conjunctivitis** and **Egyptian ophthalmia**, it is the leading cause of infectious blindness in the world. Globally, about 40 million people have an active infection and as many as 8 million people are visually impaired as a result of this disease

the potential to reduce human disease, injury, and death, especially among vulnerable groups—mainly the poor, women, and children under five in developing countries (Listorti and Doumani 2001; Lvovsky etal 2001). UNICEF et al. (2004) estimates that 1 billion urban dwellers and 900 million people in rural populations must be provided with sanitation in order to reach the MDG for sanitation in 2015 (UNICEF et al. 2004). Diarrheal dehydration is a leading child killer in developing countries, largely because of inadequate sanitation. It claimed the lives of an estimated 2.2 million children under age 5 in 1995 alone (Duncan et al., 2010). It is seen through literature that in Pakistan majorly studies have been done on diarrheal diseases and especially on children less than 5 years of age .The housing environment indicators taken were the source of drinking water and type of toilet facility and were linked with the diarrhea morbidity among children under five years of age. It was seen that children with access to piped water or a motor pump were less prone to be sick than the ones having other sources i.e. hand pump, well or river. Similarly, the household with latrine/flush system has less children falling sick than those without the flush system (Arif and Ibrahim, 1998).

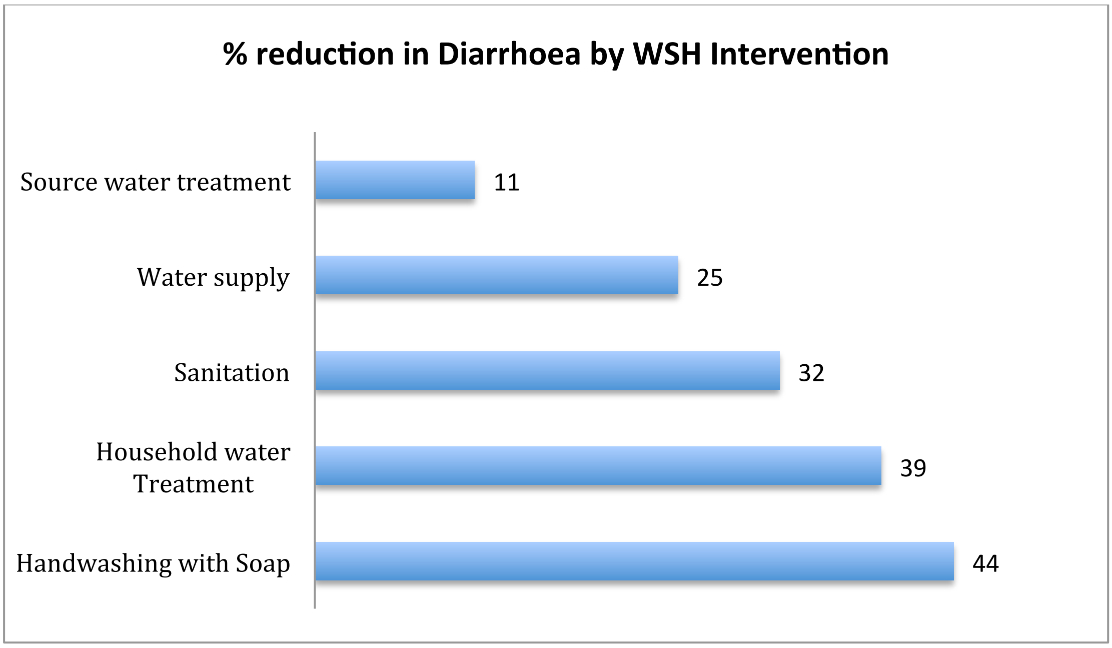
The housing environment factors of neonatal and post-neonatal mortality in Pakistan were seen by Mehmood (2002) who found that households connected with piped water had lower post-neonatal mortality than those depend on wells for drinking water. Whereas, the results did not find any evidence of improved child survival in households who had flush toilet facilities than those who did not (Mehmood, 2002).

In Pakistan around 30% to 40% of all the reported diseases and deaths are related to availability of poor water quality and its the leading cause of deaths in infant and children (up to 10 years of age) while every fifth citizen suffers from illness and disease caused by polluted water (PCRWR, 2002). A study carried out in Rawalpindi, Pakistan showed almost 80,000 cases of water borne diseases were registered. Almost 80% infections and 33% deaths were due to WATSAN related diseases (Tahir et al, 1994).

Hettige and Rauniyar conducted a study in Punjab, Pakistan, 2011, to see the impact of water quality and sanitation on rural households. The impact on primary health measures (e.g., diarrhea incidence and severity) did not turn out to be significant on average, though there were cases where significant reduction was found, such as in diarrhea incidence for the entire middle socioeconomic group. Another study conducted in Nurpur Shahan, Pakistan revealed that the relationship between source of drinking water and diarrhea was insignificant whereas the relationship between sanitation facilities and diarrhea was found to be significant (Zainab et al. 2011).

Many studies have revealed that improved sanitation can reduce rates of diarrheal diseases by 32%–37% (Fewtrell et al., 2005 and Waddington et al., 2009). Figure 2.1 gives the significance of water supply and sanitation reduction in diarrhea morbidity. A longitudinal cohort study in Salvador, Brazil, found that an increase in sewerage coverage from 26% to 80% of the target population resulted in a 22% reduction of diarrhea prevalence in children under 3 years of age (Barreto et al., 2007).

Figure 2.1: Diarrhea Reduction Potential of Water, Sanitation and Hygiene (WSH) Interventions



Source: UNICEF, 2009

A cross-sectional study was designed to look into the drinking water quality influencing factors and their health outcome in three districts; Toba-Tek Singh, Multan, and Rawalpindi of Punjab province in Pakistan. Six hundred married females of 20-60 age groups were interviewed. The findings of the study revealed that socio economic characteristics were one of the risk factors for diarrheal illness i.e. family type, mothers' education, household income and health outcome. Importantly, it was further revealed that the families who adopted measures to improve the drinking water quality at home were at lower risk of diarrheal illness (Kausar, 2012).

2.3 WATSAN and Millennium Development Goals

In September 2000, the Millennium Development Goals (MDGs) adopted by 180 UN Member States that set clear, time-bound targets for making real progress on the most pressing development issues being faced globally. By achieving the MDG targets it will positively affect the lives and future prospects of billions of people around the globe thus setting the world on a progressive course at the start of the 21st century.

Goal 7 of the MDG ensures the environmental sustainability and targets 10 and 11 are specifically implanted under WATSAN.

- Goal 7 Target 10 states: "Halve by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation; proportion of the population with sustainable access to an improved water source"
- Goal 7 Target 11 states: "Have achieved by 2020, a significant improvement in the lives of at least 100 million slum dwellers. Proportion of the population with access to adequate sanitation facilities; to halve by 2015, the proportion of the population who do not have access to basic sanitation"

In one of the address of Kofi Annan, United Nations Secretary General emphasized on the importance of WATSAN facilities saying:

"We shall not finally defeat AIDS, tuberculosis, malaria, or any of the other infectious diseases that plague the developing world until we have also won the battle for safe drinking water, sanitation and basic health care" (Jehangir & Javed 2007; page # 12).

By including WATSAN in MDGs, the global community has acknowledged its importance as it cross cuts a series of goals and targets and those goals and targets are not achievable unless WATSAN facilities are improved (Table 2.3). So the promotion and insuring global access to WATSAN facilities is very essential for the development interventions.

Table 2.3: Inter-linkages between MDGs and WATSAN

Development Goal		Link to Water and Sanitation
Goal 1	Eradicate extreme poverty and hunger	***Without access to WATSAN:*** • Time and energy are lost searching for and collecting water • Poor health and frequent illness lead to lower productivity and lower income. • Household time, energy and budgets are consumed by coping with frequent illness • Child malnutrition is rampant, worsened by frequent illness due to lack of safe water and sanitation. ***With access to WATSAN:*** • Better health leads to greater capacity to develop and maintain a livelihood • Time and energy can be reallocated for productive activities and/or self employment
Goal 2	Achieve universal primary education	***Without access to WATSAN:*** • Diarrheal diseases and parasites reduce attendance and attention. • Girls are often obliged to stay home from school to help carry water and look after family members who are ill • School attendance by girls is reduced, and drop-out rates higher, where schools have no separate toilet facilities for boys and girls ***With access to WATSAN:*** • Schools are healthy environments • School enrolment, attendance, retention and performance is improved • Teacher placement is improved • Girls feel safe and can maintain dignity while at school
Goal 3	Promote gender equality and empower women	***Without access to WATSAN:*** • Women and girls face harassment and/or sexual assault when defecating in the open • Women in rural areas spend up to a quarter of their time drawing and carrying water - often of poor quality ***With access to WATSAN:*** • Women and girls enjoy private, dignified sanitation, instead of embarrassment, humiliation and fear from open defecation • The burden on women and girls from water carrying is reduced • The burden on women and girls from looking after sick children is reduced • Increasing women's roles in decision-making to match their responsibilities, and bringing about a more equitable division of labor are known to help improve water supply, sanitation and hygiene. Demonstrating this can help to improve women's status in other ways.
Goal 4	Reduce Child Mortality	***Without access to WATSAN:*** • Diarrheal disease, including cholera and dysentery, continues to kill more than 2 million young children a year • Bottle-fed milk is often fatal due to contaminated water • Hookworms, roundworms and whipworms breed and debilitate millions of children lives ***With access to WATSAN:*** • Better nutrition and reduced number of episodes of illness leads to physical and mental growth of children • There is a sharp decline in the number of deaths from diarrheal diseases

Goal 5	Improved Maternal health	***Without access to WATSAN:*** • Contaminated water and bad hygiene practices increase chances ofinfection during labour • Women face a slow, difficult recovery from labour ***With access to WATSAN:*** • Good health and hygiene increase chances of a healthy pregnancy • There is a reduced chance of infection during labor
Goal 6	Combating HIV/AIDS, Malaria & other diseases	***Without access to WATSAN:*** • People face difficulty in cleaning, bathing, cooking and caring for ill family members • There is a higher chance of infections due to contaminated water, lack of access to sanitation and hygiene, worsening overall conditions of diseased people • Of the global burden of disease, 23% is a result of poor environmental health, 75% of which is attributable to diarrhea. ***With access to WATSAN:*** • Fewer attacks on the immune system of HIV/AIDS sufferers, allowing better health • Better, more hygienic and dignified possibilities to take care of ill people, lifting their burden • HIV treatment is more effective where clean water and food are available. • HIV infected mothers require clean water to make formula milk • Less occurrence of contaminated water sources and standing water around water points reduces breeding grounds for mosquitoes • Clean water and hygiene are important in reducing a range of parasites including trachoma and guinea worm
Goal 7	Ensure environmental sustainability	***Without access to WATSAN:*** • Squalor, disease and degradation of natural surroundings, especially in slums and squatter settlements (Water resources are under stress) • Rural rivers and soils continue to be degraded by feces • Due to urbanization, numbers without adequate sanitation double to almost 5 billion by 2015 ***With access to WATSAN:*** • There is a sharp decrease in environmental contamination by feces and wastewater • There are clean water and sustainable treatment and disposal procedures • Better health is linked to a reduction in poverty, putting less strain on capacity of natural resources
Goal 8	Develop Global Partnership for Development	***Without access to WATSAN:*** • Poor health leads to low productivity • Lack of schooling decreases employment chances ***With access to WATSAN:*** • Public, private and civil society partnerships help deliver water and sanitation services to the poor • The poor themselves are empowered through their involvement in the sector, developing a capacity for planning, implementation, maintenance and management that transcends into other sectors • There are more options for employment creation, as water supply and sanitation provision is labour intensive

Source: Mathew, 2005 (Page # 17 & 18)

By achieving MDGs WATSAN targets a number of benefits can be attained and one of the major one is economic benefit/cost[9] (Hutton & Haller 2004, WHO, 2008 UNICEF, 2009). The estimated economic benefits of investing in WATSAN come in several forms:

- Savings of US$ 7 billion a year in health care for health care agencies and saving of US$ 340 million for individuals.
- For age group 15 to 59 years a gain of 320 million productive days a year, an extra 272 million school attendance days a year, and for children under five years an added 1.5 billion healthy days, together they make US$ 9.9 billion productivity gains per year.
- Time savings resulting from more convenient WATSAN services, adding 20 billion working days a year, giving a productivity payback of US$ 63 billion a year.
- The values of deaths averted, based on discounted future earnings, amounting to US$ 3.6 billion a year.

The WHO study from which the above figures are taken shows a total payback of US$ 84 billion a year from the US$ 11.3 billion per year investment needed to meet the WATSAN target of the Millennium Development Goals (Hutton & Haller 2004, WHO, 2008 UNICEF, 2009).

2.4 Measures of Economic Costs of Water Borne Diseases

The economic cost of illness is measured in terms of direct costs and indirect costs. Direct costs are those costs which are incurred for prevention or treatment of illnesses while indirect are the economic costs foregone for lost days of employment or economic activity and also has the ability to negatively impact on future consumptions.

Direct costs measure the opportunity cost of resources used for treating a particular illness (Kirschstein, 2000). Direct medical costs include hospital inpatient, physician

9 The details of economic costs are discussed in the next section (2.4)

inpatient, physician outpatient, emergency department outpatient, nursing home care, hospice care, rehabilitation care, specialists' and other health professionals' care, diagnostic tests, prescription drugs and drug sundries, and medical supplies (Segel, 2006). Nonmedical direct costs include transportation costs to health care providers; relocation expenses; and costs of making changes to one's diet, house, car, or related items. However, some nonmedical direct costs are generally not included in cost-of-illness studies, such as research, training, and capital costs (e.g., construction).

Indirect costs represent the other portion of estimated costs. These include mortality costs; morbidity costs due to absenteeism, and informal care costs in terms of the opportunity cost of hiring outside care (Segel, 2006). Most notable are the losses in production or income that then translates into lost current consumption, and possibly lost future consumption because of the impact on savings or debt (WHO, 2009). The literature, which has been majorly reviewed, focuses on poor housing characteristics including water supply and sanitation facilities, linked with health and also the economic cost of illness through direct and indirect cost. Table 2.4 gives an insight in to the direct and indirect economic benefits that can be gained due to improvement in WATSAN facilities.

Recent literature in the context of low and middle-income countries identified numerous research studies that have assessed direct and indirect costs of illnesses (AUSAID & ADB, 2008). The important analysis of both direct and indirect cost of illness at household/microeconomic level has been the understanding of coping strategies that household adopts in order to alleviate the unwanted consequences of illness which includes exchange of labor within household and sale of assets to pay for health care (Sauerborn Adams & Hien, 1996).

There is huge amount of evidences from the developing world suggesting that household consumption is adversely affected by health shocks as in Indonesia a study revealed that a 10,000 rupiah reduction in income resulting from a health shock reduces non-health consumption by 10% (Gertler and Gruber, 2002). Certain studies have measured the shock of ill health on household productivity i.e. through reductions in savings, changes in household activity patterns, or reduced educational investment (Kochar, 2004 and Ramu et al., 1996).

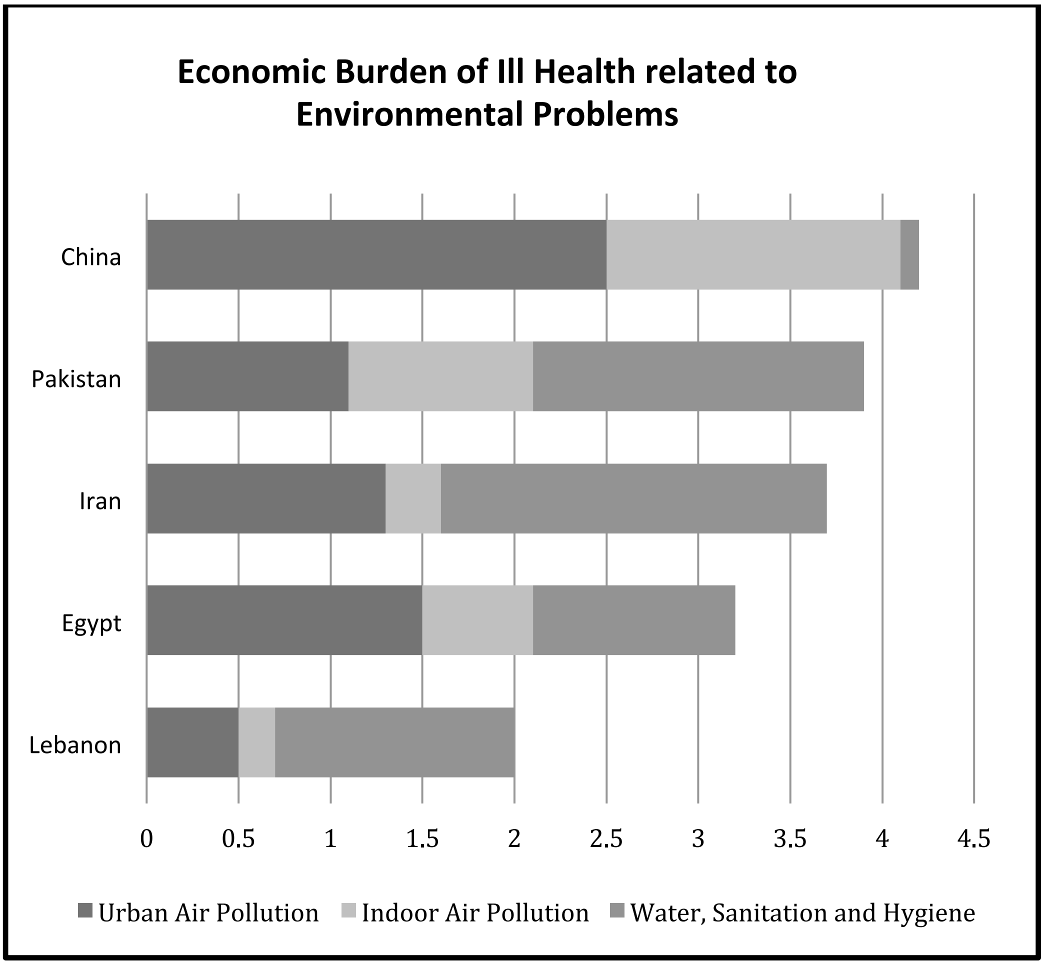
Table: 2.4:Direct and Indirect Economic Benefits Arising from Water and Sanitation Improvements

Beneficiary	Direct economic benefits of avoiding Sanitation Related Diseases	Indirect economic benefits related to health improvement	Non-health benefits related to water and sanitation improvement
Health sectors	Less expenditure on treatment of Sanitation Related Diseases	Value of less health workers falling sick with Sanitation Related Diseases	More efficiently managed water resources and effects on vector bionomics
Patients	▪ Less expenditure on treatment of Sanitation Related Diseases and less related costs ▪ Less expenditure on transport in seeking treatment ▪ Less time lost due to treatment seeking	▪ Value of avoided days lost at work or at school ▪ Value of avoided time lost of parent/caretaker of sick children ▪ Value of loss of death avoided	More efficiently managed water resources and effects on vector bionomics

Source: Author's adaptation from Hutton& Haller, 2004

Recent researches have calculated the economic cost of environmental health risks as percentage of GDP lost (World Bank, 2008). Figure 2.2 shows the percentage of GDP loses attributed to environmental problems in Pakistan in comparison to different countries. The figure breaks down environmental problems into urban air pollution, indoor air pollution and water, sanitation and hygiene and their respective GDP loses. In comparison China is ranked highest in GDP loses due to environmental problems then comes Pakistan followed by Iran, Egypt and Lebanon.

Figure 2.2: Environmental Costs as Percentage of GDP

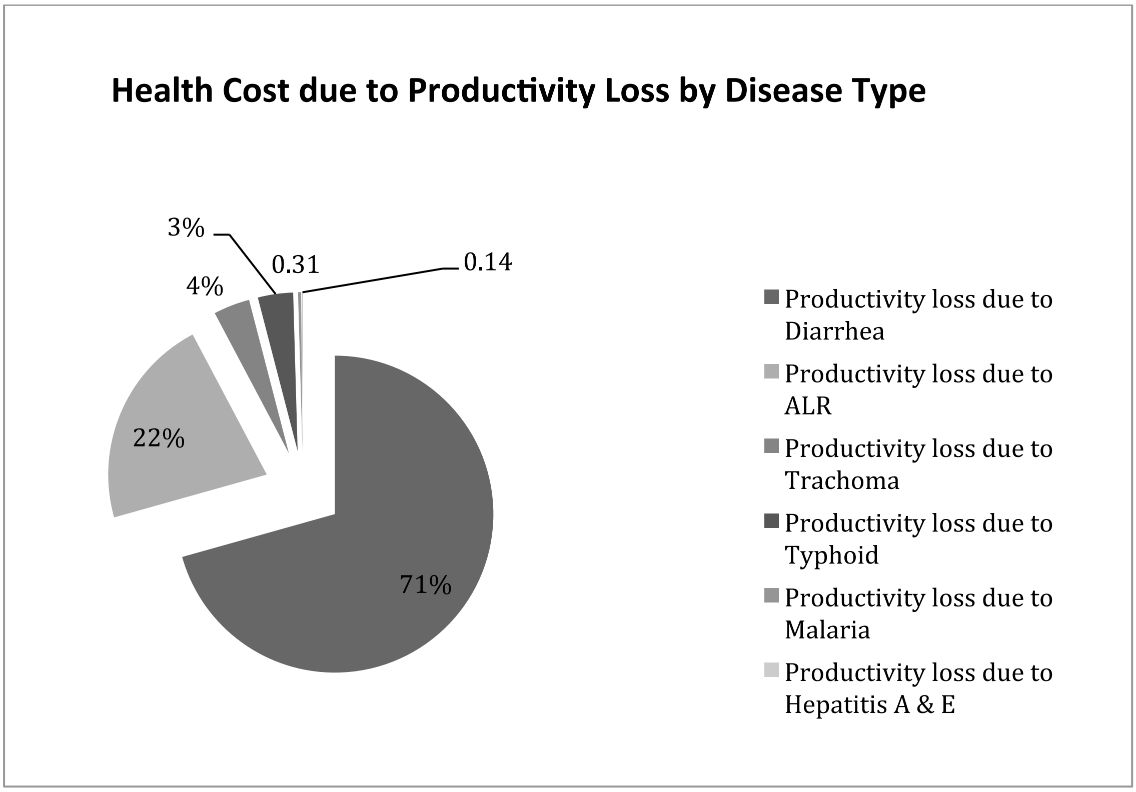


Source: World Bank, 2008

Pakistan loses almost 4% of its total GDP due to the environmental problems out of which almost 50% (1.8%) loss is due to water, sanitation and hygiene related issues. In Pakistan the most ignored sector is water, sanitation and hygiene as compared to the other countries. Only if water, sanitation and hygiene sector is improved in Pakistan it can save almost half of its GDP loses.

The productivity loses due to water borne diseases in Pakistan were estimated to be around 40 billion PKR as shown in figure 2.3. As seen in the figure 70% of the productivity loses is due to diarrhea and almost 22% productivity loses due to ALR followed by other water borne diseases.

Figure 2.3: Productivity looses by Water Borne Diseases in Pakistan



Source: AUSAID, ADB, 2008

The study found that the cost of treatment for water borne diseases comprised 12.4% of the total health cost as shown in figure 2.3.

This chapter is a compilation of various literature and past studies in the field of WATSAN is given. The chapter describes definitions of environmental health, improved water and sanitation sources by the World Health Organization, it further explained the definition of WATSAN facilities in the existing literature and on what basis they are marked as improved or unimproved source. In addition to this it gives definitions of sanitation related water borne diseases, this section described the definitions and the difference between waterborne, water based and water related insect vector diseases. A detail of all the diseases related to WATSAN was explained with their causative agents, disease symptoms and their modes of transmission.

Moreover, the chapter gave detail insight into the linkages of WATSAN and health and the effects of WATSAN on MDGs. The chapter gave a comprehensive view into the national and international literature on the inter-linkages of WATSAN and health, describing the burden of diseases attributed to the lack of the WATSAN facilities. The impact of WATSAN on MDGs was also the focus of the current chapter as it emphasized the importance of WATSAN and their potential effects in achieving all the 8 MDG goals. Also giving the concept and calculation of economic costs of illness/diseases attributed to improper water and sanitation facilities. Furthermore, details of measurement of direct and indirect economic costs are also discussed. This literature review built a strong foundation for the current study.

It is evident from the literature that the main focus of the past studies was diarrheal diseases in children in relation to different socio-economic, demographic, environmental and geographical factors. Various studies by Arif and Ibrahim (1998), Mahmood and Ali (2002), Asma Arif and G M Arif (2012) shows that for the purpose of analysis/correlation of health and various socio-economic demographic and housing WATSAN facilities, the most common method used was logistic regression.

The present study has some unique features that distinguish it from earlier literature that along with the diarrheal diseases, other water borne diseases like Jaundice and Intestinal Diseases are analyzed for all the age groups, place of residence, household income, source of water supply, toilet facilities and Sewage/Drainage facilities. Another unique feature of the study that it not only focuses on the correlation of the selected diseases with different socio-economic, demographic and housing WATSAN facilities but also covers the direct (cost of medicines, treatment, doctor fee, hospitalization & laboratory charges) and indirect (lost days of activity) economic costs incurred by the individuals falling ill with the selected diseases. Thus this study is a useful addition to the existing literature on inter-linkages of health with housing environmental factors and their subsequent economic costs.

Chapter Three

Data Source & Methodology

This chapter deals with the brief description of the relevant dataset used for achieving the objectives of the study and the methodology designed to measure the impact of housing water supply and sanitation facilities on health.

3.1 Data

Data source for analyses in this study is taken from Pakistan Panel Household Survey, 2010 (PPHS). The survey covers a wide range of socio-economic characteristics of the survey population. The reason for using the PPHS dataset is that it contains detailed information on morbidity ranging from childhood to adult diseases with detailed information on housing environmental characteristics. Moreover, this data set covers the economic aspects of household health expenditures, which are essential for the cost analysis carried out in this study.

This survey was conducted in year 2010 with a sample size of 4142 households, 1342 in urban and 2800 rural. The data analysis is based on bivariate (Cross Tabulations) as well as multivariate analysis. SPSS is used for this research where frequencies cross tabulation and graphs are run, which shows the effect of different household environmental variables on health of the individuals.

3.2 Dependent Variable

The dependent variable for analysis is the population reported ill and the following question was used:

Over the past 12 months did find it difficult to perform their normal activities for a week or more due to illness or accident or disability?

This question was asked from the female member of the household for all the other members, as it is generally the female of the house that attends to the sick and has better information to report.

The illnesses that will be focused in the present study are:

- Diarrhea, Intestinal problem and Jaundice

- Intestinal problem and jaundice are referred to as water borne diseases. These water borne diseases will be analyzed for all age groups (discussed in section 3.3.2).
- In PPHS survey information on diarrhea was only collected for children. To cater to the problem of age misreporting and to cover every child under the age of 5 years PPHS survey defined children till the ages of 6, for this reason the age group 0-6 years was computed to define children in the current study.

A wide range of data on different diseases was collected in PPHS. The above-mentioned diseases are chosen for the present study because the incidence of these illnesses is mainly related to poor housing WATSAN facilities. The inter-linkages of these diseases with WATSAN facilities have been reviewed in detailed in chapter 2.

3.3 Explanatory Variables

The health of individuals is affected by a number of factors like age, sex, place of residence, living conditions and many more, some have a positive affect while others negatively affects health. The explanatory variables are divided into four categories

- Geographic Variable: this include province and region of residence
- Demographic Variable: this includes different age groups and sex of individuals in the selected households.
- Socio-Economic Variable: this includes education and employment status.
- Environmental Variable: this focuses on the WATSAN facilities in that household.

3.3.1 Geographic Variables

The geographic variables include the following

1) Place of residence

Place of residence has a significant effect on the health of individuals; it is divided into urban and rural. Rural population usually has fewer facilities in terms of housing sanitation and water supply so tend to reflect different disease patterns.

2) Province of residence

In Pakistan provinces have significant effect on health of individuals as different provinces have different levels of infrastructures. Data from all the four provinces in Pakistan is included in the analysis namely, Punjab, Sindh, KP and Balochistan.

3.3.2 Demographic Variables

1) Sex

The sex of the individuals has a considerable effect on health especially in Pakistan where gender preference values prevail. Males are more likely to seek treatment when compared with females (Ali, 2000, Mahmood & Ali, 2002).

2) Age

Disease affects differently at different ages where children (ages 0-6 years) and old age groups (60+ years) are the most vulnerable groups. For the analysis of total ill population and water borne diseases, the sample population is divided into 4 broad categories:

- 0[10]-6 years
- 7-14 years
- 15-59 years
- 60+ years

The current age groups are used to identify Children (0-6), adolescence (7-14), the working age population (15-59) and the elderly 60+. As mentioned earlier that diarrhea in PPHS only covers in ages 0-6 years, so in the current study all the individual ages are analyzed (0,1,2,3,4,5,6 years) for diarrhea.

3.3.3 Socio-Economic Variables

1) Education

- ***Mother's Education***: Mother's education plays an important role in health of the children. In PPHS women were asked about the years of education they have received, this study divided them into four categories:

[10] Age 0 refers to all the children less than 1 year of age

- **Illiterate**: never been to school
- **Primary**: 1 to 5 years of schooling
- **Secondary & Matric**: 6 to 10 years of schooling
- **Higher**: 11 years and above

The relationship between mother's education and the child's health is only analyzed for diarrheal diseases in the current study.

- ***Education of the Head of the Household:*** The education of the head of the household plays a significant role in health outcomes of the individuals living in that household. Categories of education of the head of the household are divided in the same manner as that of mother's education. This variable is used for analysis of total ill population and water borne diseases as these include all the age groups (0-6, 7-14, 15-59, 60+ years) so it was more appropriate choice to take the education of the head of the household.

2) Work Status

Work status is measured through the question:

Did he/she do any work for pay?

It is categorized as, the one who answered "yes" are considered as "working" and those who answered it as "no" are considered to be "not working". The relationship between the work status and occurrence of illness and water borne diseases will be analyzed through this variable. Work status will also be used in measurement of economic cost of illness.

3) Household Income

The average annual household income is measured through the question:

How much money did you make in the past 12 months?

It is categorized in 5 broad groups starting from households having average annual income of Rs. 10,000. Second group of households having Rs. 10,001-30,000 annual income and then the ones having Rs. 30,001-50,000, Rs. 50,001-100,000 and Rs. 100,001+ average annual incomes. The relationship between the household income and incidence of illness, water borne diseases and diarrhea will be analyzed through this variable.

3.3.4 Environmental Variables

1) Source of drinking water

Safe and clean drinking water is important for human health, especially for children whose immune systems are still maturing. Even if contaminated water is used for washing or bathing, it increases the chances of catching infection in both adults and children. Its categories include **Piped/motor pump** and **Othe**r, where piped category is considered to be as the safe and appropriate source. The Piped/Motor Pump includes; piped water, motor pump and hand pumped water. Other water source includes; open well, closed well, canal/pond, river/stream/spring and tanker.

2) Type of toilet facility

Toilet facilities are very important for the health and hygiene for, both, children and adults. Proper use of flush toilets can reduce risk of parasite infection, morbidity and poor nutrition status. The toilet facilities are divided into **Flush system** and **Other.** The household having the flush system is considered to be more health-friendly facility. Flush system includes flush connected to public sewerage. Other includes; flush connected to pit, flush connected to open drain, dry pit latrine and no toilet in the household.

3) Drainage and sewage facility

Proper drainage and sewage facility are important for the hygiene of the household thus preventing from a number of infections. This variable is categorized into three categories **Covered drainage system**, **Open drain** and **No system**.

3.4 Methods of Measuring Economic Cost of Water Borne Diseases

Measuring the economic costs of water borne diseases in one of the important aspect of the current study. The reason for selecting PPHS data for the current research is that it include several indicators for the measurement of both direct and indirect costs.

1) Direct Cost of illness/disease

The direct costs of illness is measured through combining three indicators into one, which include the following:

- *Expenditure on medicines*
- *Expenditure on doctor consultant fees*
- *Expenditure on hospitalization and associated laboratory tests*

All these where computed into: Direct Cost of treatment (consultation fees, medicines, hospitalization, laboratory tests), This variable will measure loses in production or income which translate into direct financial burden on households in obtaining health services and goods.

2) Indirect cost of illness/disease

For the indirect costs of illness is measured through the following indicators

- How many days it took to get back to normal routine work?
- How did you finance the total cost on treatment?

Through the first indicator the days lost where calculated. The second indicator calculates loss of savings, sale of assets, mortgage of assists and relying on unsecured loans as indirect set of consequences that may befall on households which can lead to possible economic loses of future.

3.5 Bivariate Analysis

In the current study, the bivariate analysis is done to test whether there is a significant association between the dependent variable and each selected independent variable. The study checks the association (positive or negative) between the selected diseases (diarrhea, water borne diseases) and with housing WATSAN facilities. Bivariate analysis is carried out only by cross tabulations, the statistical significance of the cross-tabulated variables are assessed by using chi-square test at 5% significance (p=0.05).

3.6 Multivariate Analysis

After measuring the effects of housing sanitation and water supply on health in bivariate analysis, logistic regression will be run with different geographic, demographic and Hosing sanitation and water supply variables. Three Logistic regressions will be used to check the relationship of dependent variables (total ill, water borne diseases and diarrheal diseases) on different independent variables. The dependent variables were dichotomous and the answers were recorded as 'yes' or 'no'.

The equation for the logistic regression is

$$ln\ (p)/(1-p) = a + \Sigma\ bi\ xi + ui$$

Where *p* is the probability of an individual having illness during 1 year preceding the survey, *a* and *bi* are estimated regression coefficients, and *xi* are the Housing characteristics consisting of sources of drinking-water, toilet facilities, type of drainage and place of residence.

In the first logistic analysis the dependent variable is total ill. This logistic regression will analyze the relationship between total ill population with different socio-economic, geographic, demographic variables especially focusing on housing WATSAN facilities. For the second and third logistic analysis the dependent variable are the water borne diseases and diarrheal diseases. They were computed into *Yes* and *No* categories and thus were transformed into binary. In case of second and third logistic analysis the main idea is to measure the extend of dependency of these two disease categories (Water borne diseases and diarrheal diseases) on housing WATSAN facilities.

In logistic regression one category of every independent variable is taken as reference category, for the age variable in the logistic analysis 1 and 2 age group 0-6 is taken as reference category while in the 3rd logistic analysis as it only includes children of age groups 0-6 the age group of 0 is taken as reference category. This age category (0 age) is the only category with different reference in the diarrheal logistic analysis than the other two logistic analyses while all the same reference categories are used in all three analyses. Similarly the benchmark category male is taken in the variable of sex. For the type of residence and the province of residence variables the urban and Punjab are taken as reference category.

In housing source of Drinking water independent variable the category of piped/motor pump is taken as the reference category. The reference category among the housing toilet facility is flush system, while the category of covered drainage system is taken as reference in the housing Drainage system variable.

3.7 Conceptual Framework

The conceptual framework represents the main components of the study, showing their interrelationships or linkages. It is intended that this framework will provide logical understanding of the analysis being carried out in the present study.

Sanitation facilities and availability of safe and clean drinking water are essential for human health. Majority of the pathogens are transmitted through fecal-oral route, which is a major cause of infections, intestinal problems, stomach problems such as diarrhea. This transmission can be water-borne; i.e. when water contaminated by human feces is drunk, food-borne; i.e. when feces contaminate food is eaten or direct transmission i.e. when mothers contaminate food during its preparation (Feachem, 1984). Thus this highlights the importance of safe disposal of human excreta, availability of safe drinking water and personal hygiene to avoid the major agents of transmissible diseases (Figure 3.1).

The households with latrine does not mean that it is being used by that household, as it is a common practice in many communities where adults use the latrine and children are allowed to defecate in the open. So it is very difficult to assume whether it is the availability of sanitation facilities or is it the using pattern of latrine is causing parasitic infections, same is the case with water supply as well. Nevertheless, it is likely that increased water availability coupled with improved personal and household hygiene and safe disposal of human feces can significantly reduce the transmission of diseases (Arif and Ibrahim, 1998). As seen in the figure 3.1 use of unsafe water and defecation in the open due lack of proper sanitation facilities leads to contamination of surface and ground water thus causing higher chances of catching infections.

Figure: 3.1
Proposed Model for Health and Economic Effects of Poor Housing Water Supply and Sanitation Facilities

Source: Author's Adaptation from different sources

Disease or injury has the potential to interfere with household's income and choices in a number of ways. Majorly the disease/illness affects the household in two different ways, firstly by reducing the normal productivity level of the diseased/ill individual and secondly the household may need to increase its consumption of health services and goods. This reduced earning due to inactivity or low labor income, plus additional expenditures on health services may decrease the household's consumption of non-health goods and services (e.g. food, social activities, and durable goods). Or they might try to maintain their non-health and health goods and services by relying or resorting on cash savings, loans or selling of household assets (Steinberg et al., 2002). It can be seen in figure 3.1 that how improper WATSAN facilities in a household negatively affect the well being of that household.

The lack of sanitation infrastructure contributes in degradation of natural environment as well as more it pollutes surface and ground water, which may be fetched by another consumer. Any investment in WATSAN sector will ensure better quality of life that is health wise, environmentally, socially and economically.

This chapter gave insight into the data source, with the details of the dependent and independent variables and the methodology that is used to deduce the results (given in chapters 4, 5 & 6). The chapter presented a description of the conceptual framework developed for the current study.

Chapter Four
Basic Profile of Sample Population

This chapter deals with the chosen socio-economic, demographic and housing characteristics as these factors have the potential to affect the health of the individuals. Foremost a detailed description of the selected variables of the total survey will be given and then chapter will describe the basic socio-economic, demographic and housing profile of the sample population.

4.1 Sample Characteristics of PPHS 2010:

This section will give detail description of the total households covered in Pakistan Panel household survey 2010 before going in to the details of selected characteristics. Table 4.1 shows households covered in PPHS 2010.

Table 4.1: Households covered in PPHS 2010

	Rural households	Urban households	Total Sample
Pakistan	**2800**	**1342**	**4142**
Punjab	1221	657	1878
Sindh	852	359	1211
KP	435	166	601
Balochistan	292	160	452

Source: Computed from PPHS 2010

The total sample consists of 4142 households with 2800 rural and 1342 urban households. In Punjab 1878 households were surveyed out of which 1221 were rural and 657 were urban households. Second highest households covered were in Sindh (1211) followed by KP (601) and Balochistan (452).

The selected characteristics such as age, gender, province, place of residence, and employment status along with the housing characteristics are given in Table 4.2. The table shows that among the four constructed age groups, about 16% of the sample is in the age group of 6 and less, 17% are in age group 7-14 years and the share of 15-59 years is 60%.

Table 4.2: Sample Characteristics

Characteristics	N	%
Sex		
Male	15957	52.1
Female	14670	47.9
Age Groups		
0-6	4962	16.2
7-14	5237	17.1
15-59	18375	60.0
60+	2052	6.7
Province		
Punjab	12172	39.7
Sind	9934	32.4
KP	4975	16.2
Baluchistan	3546	11.6
Place of Residence		
Urban	9070	29.6
Rural	21557	70.4
Source of Drinking Water		
Piped/Motor Pump	14140	46.2
Others [a]	16487	53.8
Total	30627	100.0
Type of Toilet Facility		
Flush System	17961	58.6
Others[b]	12666	41.4
Drainage and Sewage Facility		
Covered Drainage System	3426	11.2
Open Drain	9097	29.7
No System	18104	59.1
Working Status		
Working	13588	68.2
Nonworking	6336	31.8
Education Of Head Of the Household[11]		
Illiterate	2584	62.4
Primary	493	11.9
Secondary &matric	745	18.0
College & higher	319	7.7

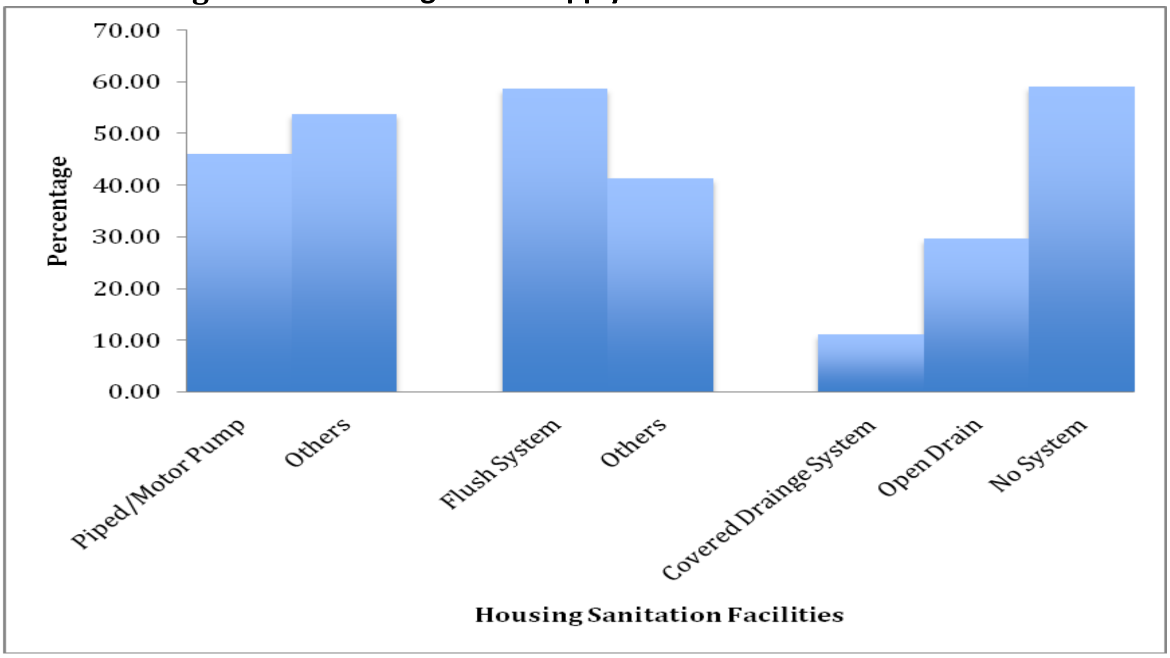
Source: Computed from PPHS 2010

[11] The education of the head of the household will be used in analysis of total ill population and for population reporting ill with water borne diseases. In case of diarrhea mother's education is taken in account (section 4.4) as diarrhea is reported only in children (0-6years)

Almost 30% of the population was reported to be urban while 70% was reported to be living in rural areas. As shown in the table above, 68% of the sample populations is working and 32% is nonworking. The education of the head of the household as seen in table 4.2 is categorized into illiterate (62%), primary (12%), secondary & matric (18%) and college & higher (8%).

As seen in table 4.2 the selected housing water supply and sanitation (WATSAN) facilities include source of drinking water, type of toilet facility and drainage & sewage facility. The graphical representation of these selected WATSAN facilities is given in Figure 4.1. The households with piped water source are 46% while 54% have other sources of drinking water.

Figure 4.1: Housing Water Supply and Sanitation Facilities

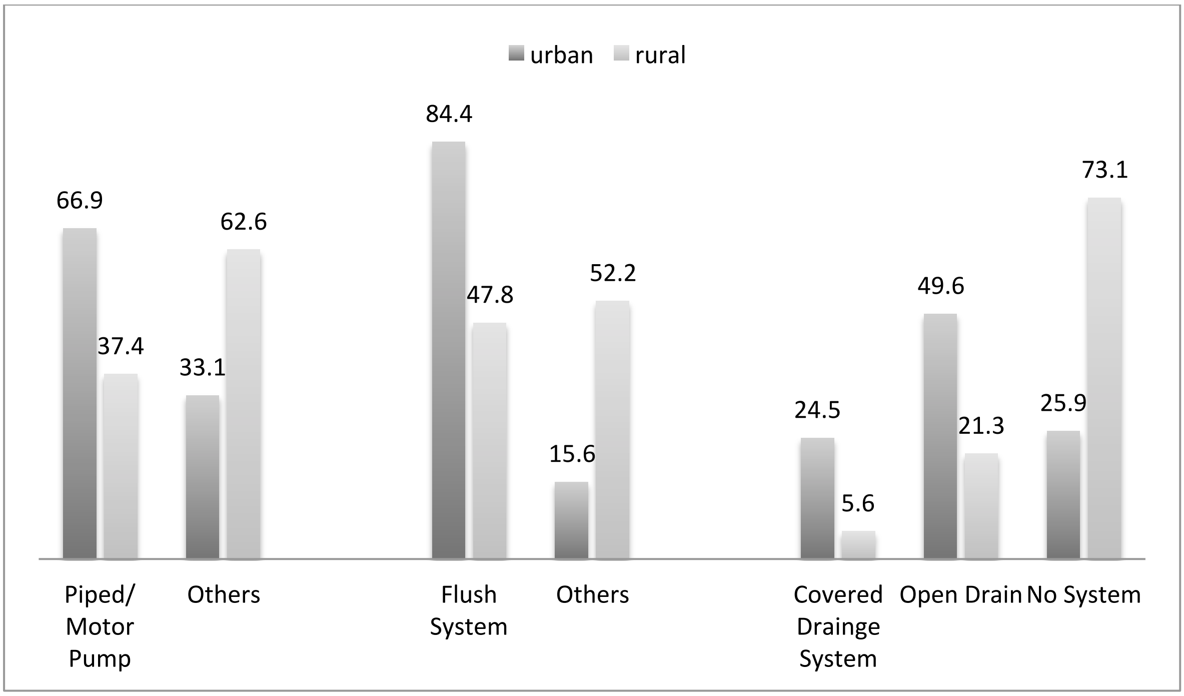


Source: Computed from PPHS 2010

Toilet facilities with flush system were available to almost 58% of the surveyed households and the remaining 41% are deprived of proper flush system. Only 11% of the households reported to have a covered drainage system while 29% have open drainage system and majority of the households that is 59% have no drainage system (Figure 4.1). The distributions of housing WATSAN facilities are further observed in detail by provincial and urban/rural areas.

The selected housing facilities are observed by urban/rural areas in Figure 4.2. As expected urban population have better facilities than rural population, having piped water supply, proper flush system and drainage facilities in their houses.

Figure 4.2: Housing Water Supply and Sanitation Facilities by Urban and Rural

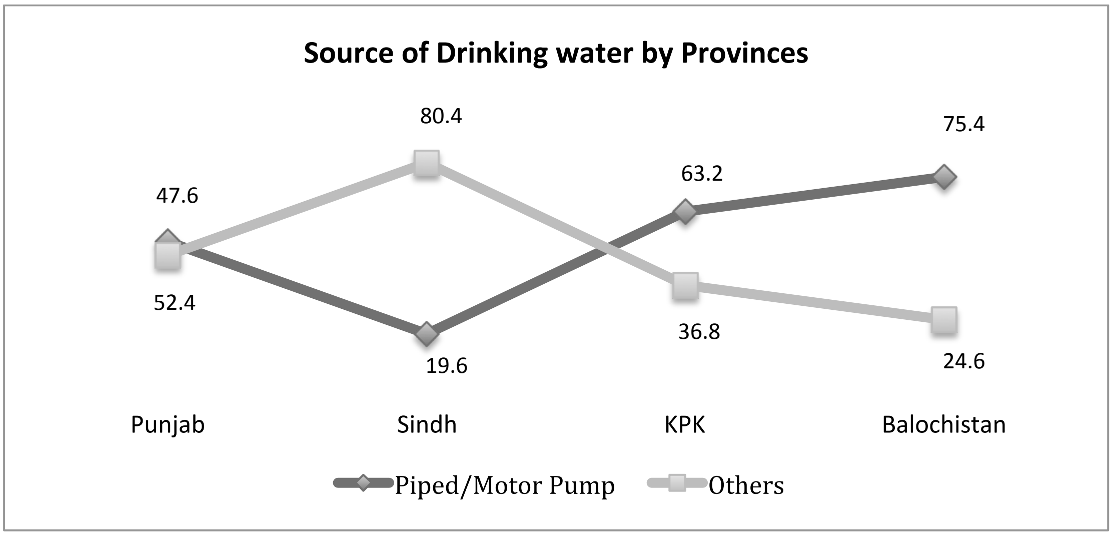


Source: Computed from PPHS 2010

As it is observed in the figure above, urban households have better WATSAN facilities showing 84% households have proper flush system whereas 52.2% rural households have no flush system. A similar trend is observed in the type of drainage facility where 73% rural households have no drainage system while 49.6% & 24.5 % urban households have either covered drainage system or open drain respectively.

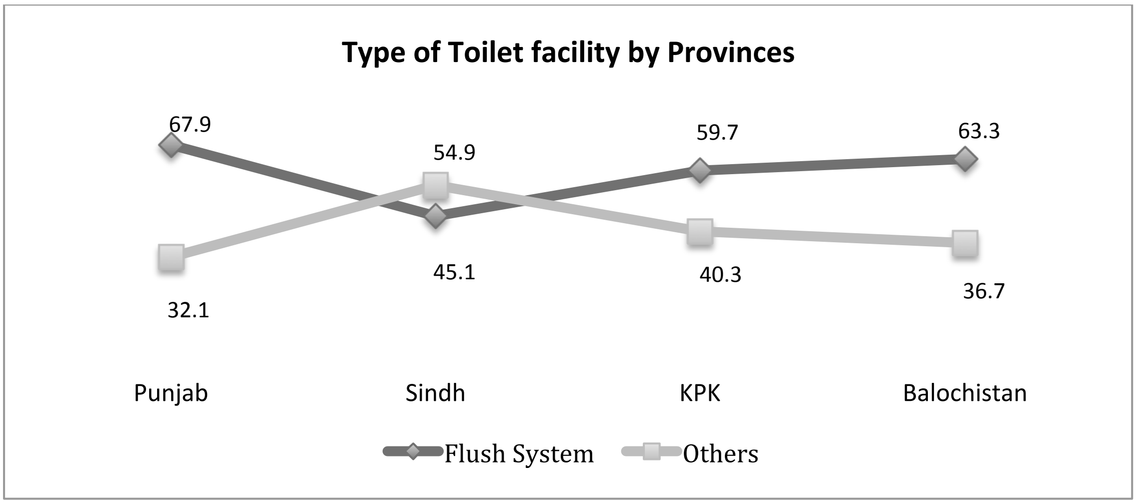
The availability of housing WATSAN facilities in provinces is observed in Figures 4.3 to 4.5. In almost all the provinces it is observed that majority is deprived of piped water source except for KP, as in Punjab a difference of 4.5% is observed between the population having access to piped water source and other sources, more having other sources. In Sindh and Balochistan there is a very huge gap between the two and majority is deprived of piped water source (Figure 4.3). The household with types of toilet facilities by provinces is shown in Figure 4.4. It is observed that in Punjab 68% households have proper flush system, it is also seen in KP and Balochistan majority households have flush system availability. Only in Sindh it seems otherwise as there are less households with proper flush system (45%).

Figure 4.3: Source of Drinking Water by Provinces



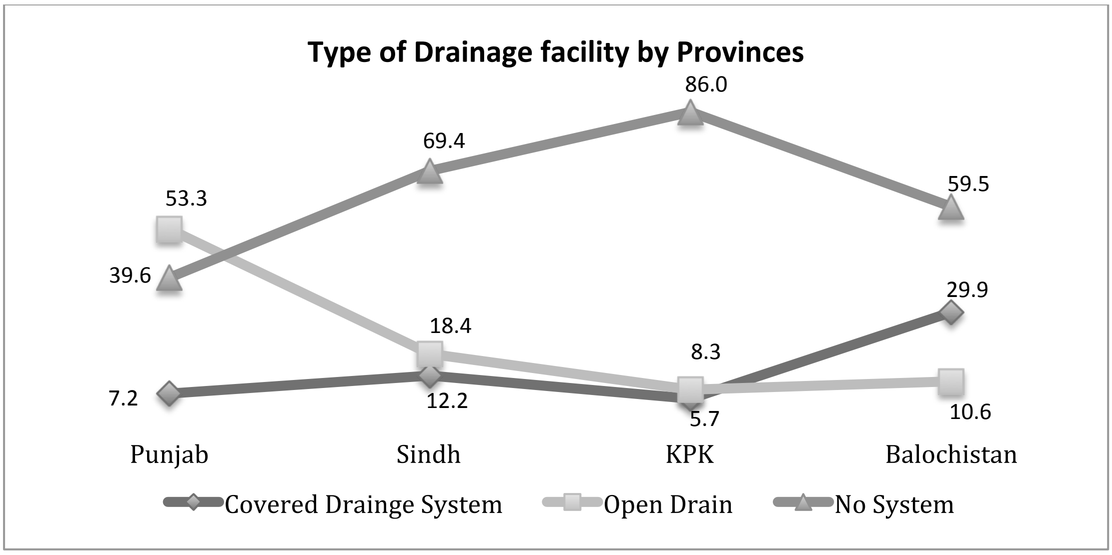
Source: Computed from PPHS 2010

Figure 4.4: Type of Toilet Facility by Provinces



Source: Computed from PPHS 2010

Figure 4.5: Type of Drainage Facility by Provinces



Source: Computed from PPHS 2010

Types of drainage facilities are covered drainage system, open drain and no system and their distribution in provinces can be seen in Figure 4.5. In Punjab majority of the households have open drainage system (53%) then are the households with no system are 40%. In Sindh it is reported that most households have no drainage system approximately 70%. In KP as compared to other provinces most of the households are deprived of proper drainage system as 86% households reported of having no drainage system. In Balochistan 60% households have no drainage system, 30% have covered drainage system and 11% have open drainage system.

After the detailed review on sample characteristics of PPHS 2010 survey and the distribution of selected housing WATSAN facilities among provinces and urban/rural areas, the next sections focuses on the prevalence of selected diseases among selected demographic and geographic characteristics.

4.2 Population Reported Ill by Selected Demographic and Geographic Characteristics

This section gives the prevalence rates of population reported by selected demographic and geographic characteristics that are by sex, age groups, urban/rural areas and provinces. The sample consists of 8693 individuals who reported ill and their basic profile and distribution by selected demographic and geographic characteristics are given in Table 4A in Annexure.

A broad view of population reporting ill during 12 months preceding the survey (results from PPHS, 2010) by age and sex is given in the Table 4.3.

Table 4.3: Proportion of Population that Reported Ill (%) by Sex and Age Group

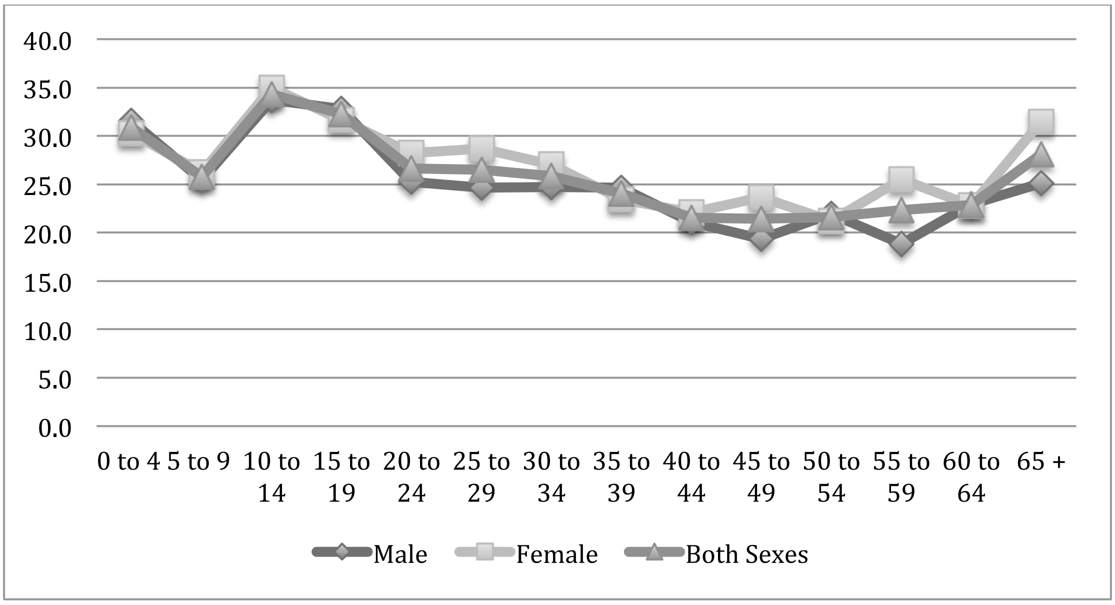
Ages	Male	Female	Both Sexes
0-6	30.7	29.6	30.2
7-14	29.6	31.4	30.5
15-59	25.8	27.3	26.5
60+	25.5	29.8	27.5
All	27.7	29.1	28.4

Source: Computed from PPHS 2010

About 28% of the population reported ill, for males and females this proportion is approximately 27% and 29% respectively. It can be observed that age groups 0-14 years have the highest levels of illness followed by age group of 60+ years (27%). Pakistan like many developing countries has shown high incidence of morbidity and mortality among children between ages 0-4 and the aged population (Mahmood & Ali, 2002), almost similar results can be observed with the exception of the age group 7-14 years that shows high rate of illness. It can be observed in table that the percentages of females who reported ill are higher than males reflecting the poor health status of females. The biological advantage of females over males is reflected in the table especially among younger age groups 0-6 years, as fewer females were reported ill as compared to male counterparts though the difference between the two is very small. The reporting biases cannot be ruled out particularly the gender preference values in Pakistan as male sick child is immediately identified resulting in higher reporting of male children (Ali, 2000, Mahmood & Ali, 2002).

Figure 4.6 shows different age groups along with their disease patterns, surprisingly the age group of 10-14 years has the highest disease rates followed by age group of 15-19 years and then age group of 0-4 years that is 34%, 32% and 30% respectively. These findings and estimates seem to be a bit higher, the reason of this higher disease rate can be due to the reference period of PPHS 2010, which was 12 months prior to the survey.

Figure 4.6: Disease Patterns by Sex and Age Groups



Source: Computed from PPHS 2010

The place of residence affects the health status of the individuals especially in developing countries like Pakistan, as urban areas are better equipped with infrastructure for health services than rural areas shown in Table 4.4.

Table 4.4: Proportion of Population that Reported Ill (%) by Sex and Region

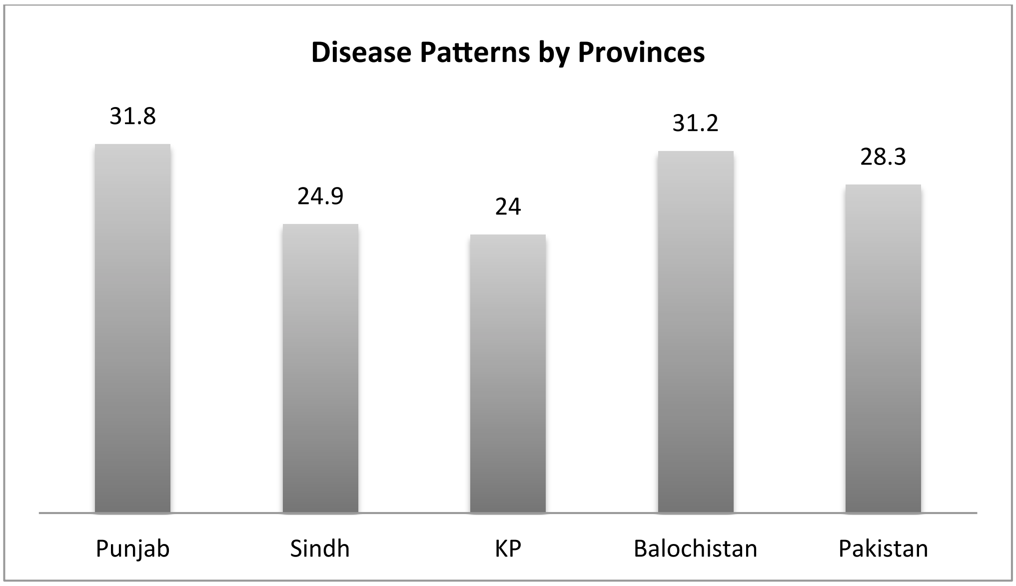
Region	Male	Female	Total
Urban	26.7	27.1	26.9
Rural	28.1	30.0	29.0
All	27.7	29.1	28.4

Source: Computed from PPHS 2010

Similar pattern can be observed in the table where higher rates of population reported ill in rural households than in urban areas indicating only 2% difference. As expected the female rate is more than the males.

In the different provinces of Pakistan the rates of ill population is observed in Figure 4.7. The highest rates of illness can be seen in Punjab, approximately 32% suggesting a very high morbidity prevalence rate.

Figure 4.7: Population Reported Ill (Rates) by Province of Residence



Source: Computed from PPHS 2010

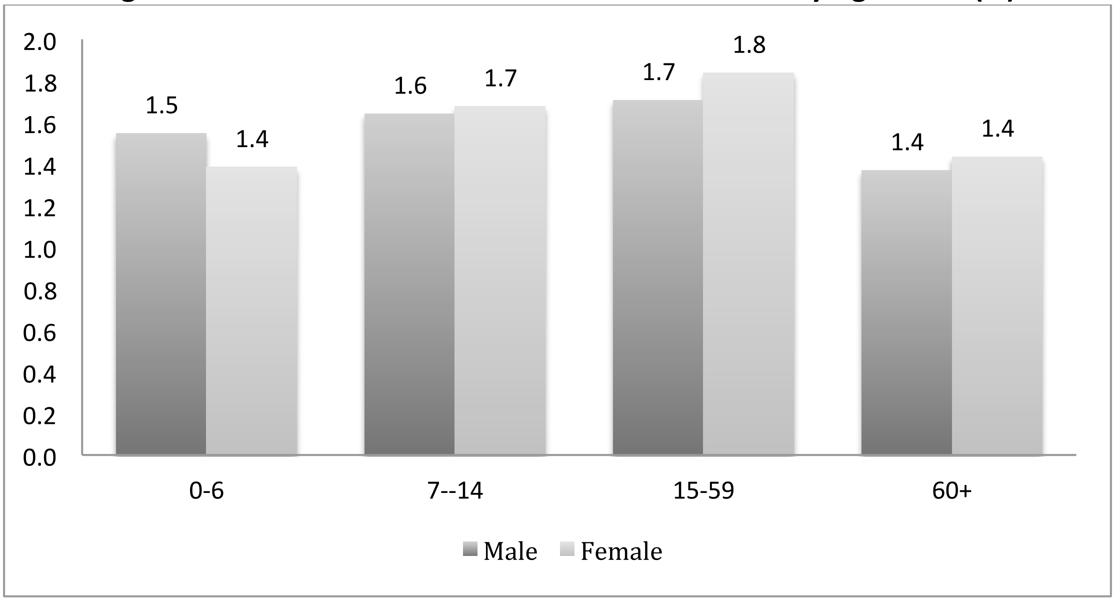
The second highest morbidity was reported in province of Balochistan approximately 31% followed by Sindh and KP, which seems to have the same morbidity prevalence rate (25% approximately).

4.3: Population reported Ill with Water Borne Diseases

This section gives the prevalence rates of population reported ill with water borne diseases by selected demographic and geographic characteristics. The total sample population in PPHS 2010 with water borne diseases is 526 individuals and their basic profile and the distribution by age groups, sex, region, province and working status can be seen in the Table 4B in Annexure.

The prevalence rates of population reported ill with water borne diseases by sex and age groups can be observed in Figure 4.8. The rates remain almost the same through different age groups, though in age group 0-6 years males are reported slightly higher with water borne morbidity than females. Whereas in other age groups of 7-14 years and 15-59 years females are reported marginally higher with water borne diseases than males.

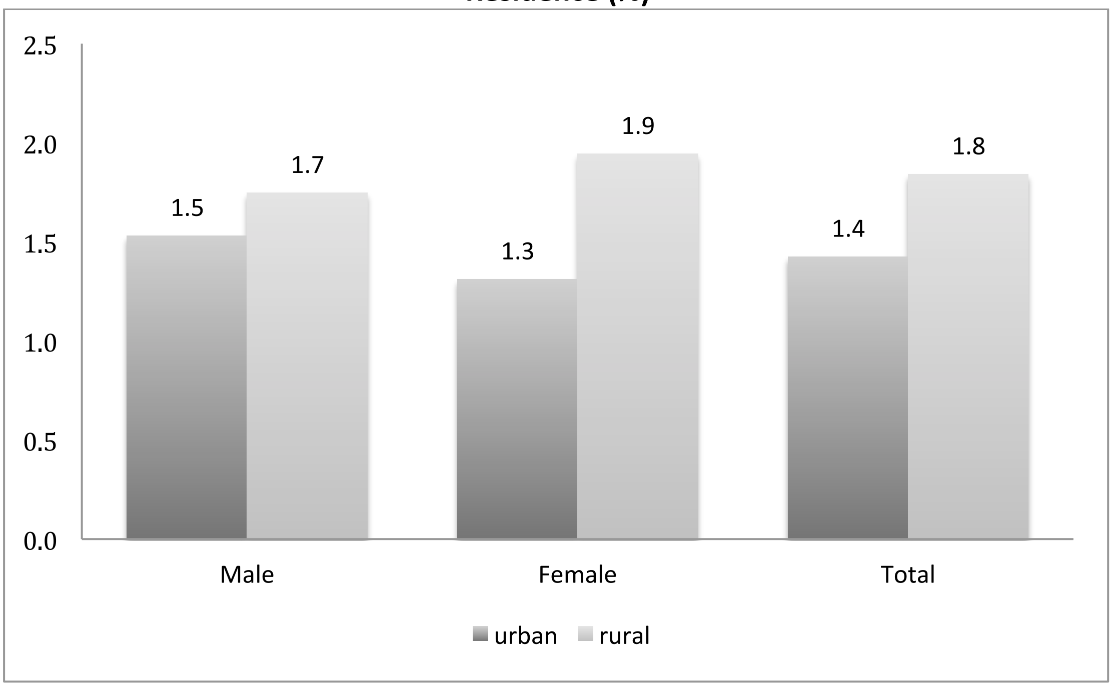
Figure 4.8: Prevalence Rate of Waterborne Diseases by Age & Sex (%)



Source: Computed from PPHS 2010

The prevalence rates of population reported ill with water borne diseases are controlled by region of residence and gender differentials in Figure 4.9. An expected pattern can be seen as rural population is reporting more with water borne diseases than the urban population. In region of residence differentials it is observed that females are reported to be more ill with water borne diseases than males in rural areas.

Figure 4.9: Prevalence Rate of Waterborne Diseases by Gender and Region of Residence (%)



Source: Computed from PPHS 2010

Prevalence rates of water borne diseases by age, gender and province of residence are given in the Table 4.5. It can be seen that in Punjab females are reported slightly less than males with water borne diseases. In Balochistan there are hardly any females reported with water borne diseases. Where as in Sindh and KP females are observed to have reported more with water borne diseases than males.

Table 4.5: Prevalence Rate of Waterborne Diseases by Age, Gender and Province of Residence

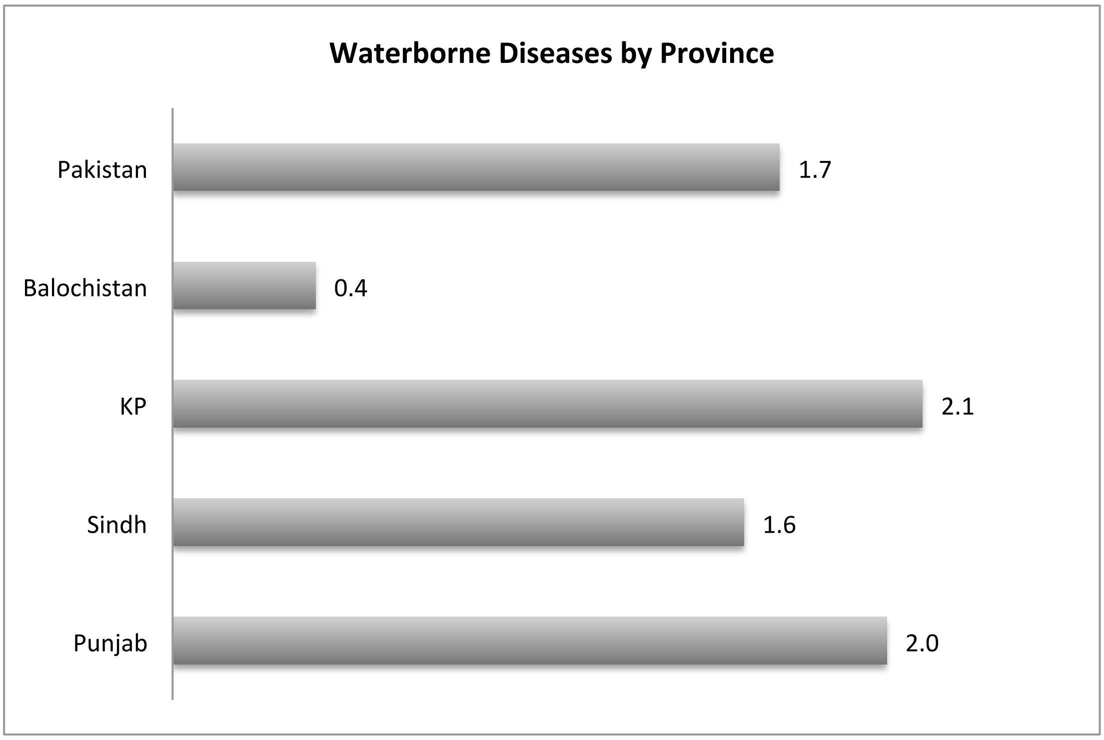
Age Groups	Punjab		Sindh		KP		Balochistan		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
0-6*	2.0	1.9	1.7	1.3	0.9	1.0	0.4	0.5	1.5
7-14*	2.0	1.9	1.4	1.7	2.9	2.3	0.2	0.3	1.7
15-59	2.0	2.3	1.7	1.5	2.0	2.4	0.5	0.5	1.8
60+*	1.2	0.8	1.6	2.8	1.8	2.2	1.2	0.0	1.4

** Significant at 5%*

Source: Computed from PPHS 2010

In Pakistan the total population reported ill with water borne diseases is almost 1.7% and a distribution among provinces can be seen in Figure 4.10. Highest share of water borne diseases is seen in KP and then comes Punjab followed by Sindh and Balochistan.

Figure: 4.10: Prevalence Rate of Waterborne Diseases by Province of Residence (%)



Source: Computed from PPHS 2010

4.4: Children reported ill with Diarrhea

This section focuses on the prevalence rates of diarrhea among children by gender, urban/rural areas and provinces. As diarrhea is seen in children ages 0-6 years with 415 cases that are almost equally distributed in six ages. The basic profile and distribution of diarrhea by selected demographic and geographic characteristic are shown in Table 4C in Annexure. It shows 26% of the children with diarrhea are under 1 year and 26% have completed their first birthday. Children aged 0 and 1 years are reported with diarrhea more than other children and as the age increases the reporting of diarrhea decreases.

The age and gender rates of the children reported with diarrhea are shown in Table 4.6. The gender differentials fluctuate with age of the children, although the overall levels are very similar for both sexes. For both male and female children diarrhea morbidity rate peak at age 0 and 1. The rate in age group 0 is substantially higher for males than for females and vice versa for age group 1. After age 1 it declines steadily for both sexes. This pattern could be due to exogenous factors such as an increased exposure to contaminated weaning foods in the second year of life, at an age when the immune system is weaker in younger children than in older children (Arif & Ibrahim, 1998). From ages 0 to 6 years it is observed that male children are reporting higher with diarrhea cases than female children except for the age of 1 year where female children are reporting higher, 4.2 percent more than male children.

Table 4.6: Prevalence Rate of Diarrhea Morbidity among Children (0-6) By Age and Gender

Age (Years)	Total	Male	Female	Male-Female Difference
0**	15.4	17.2	13.5	3.7
1	17.7	15.8	20.0	-4.2
2	11.3	12.7	10.0	2.7
3*	8.3	9.5	7.1	2.4
4*	4.9	5.4	4.3	1.1
5*	3.6	4.2	2.9	1.3
6*	2.4	3.3	1.0	2.3
All	**9.7**	**10.3**	**9.0**	**1.3**

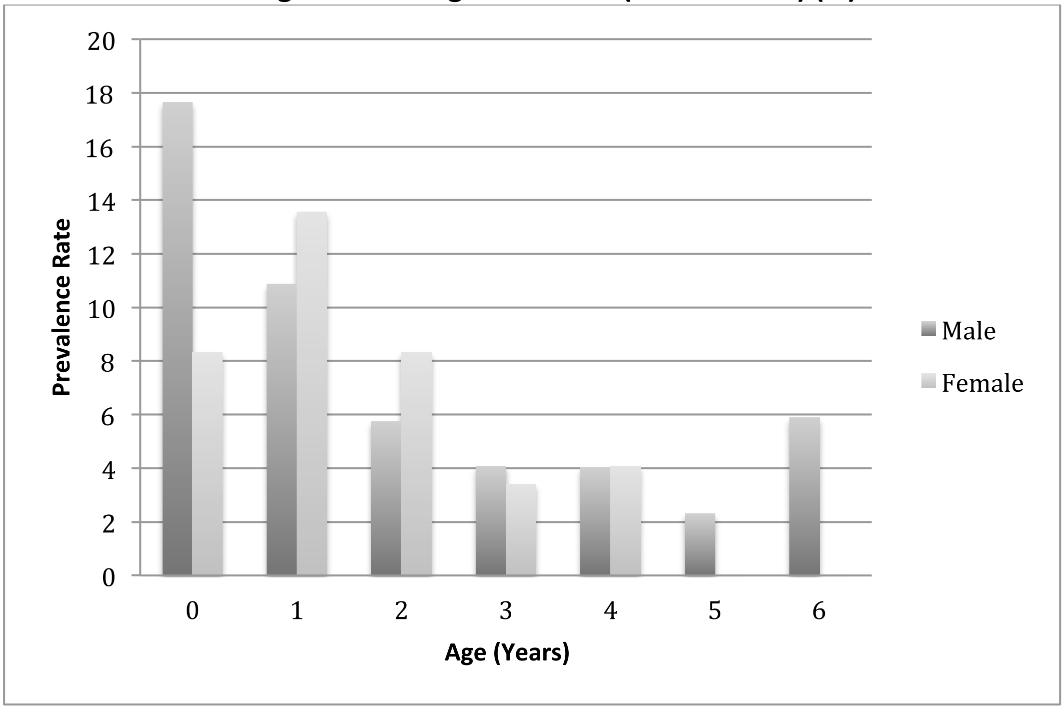
**Significant at 5%*

*** 0 refers to Children under the age of 1 year*

Source: Computed from PPHS 2010

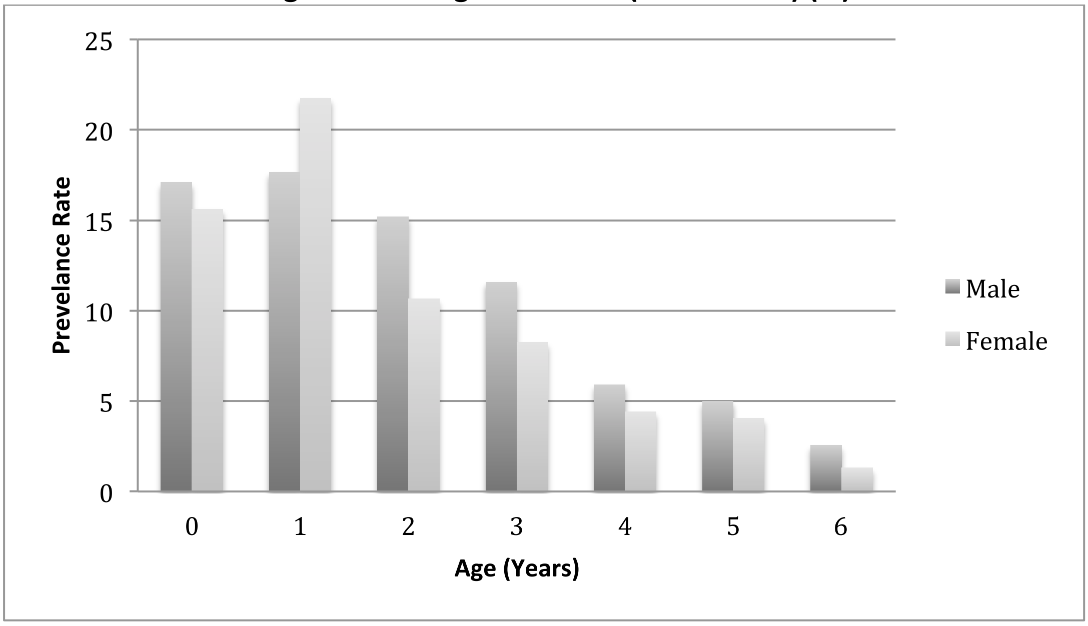
A similar pattern was observed when the prevalence rates of diarrhea are controlled for rural/urban areas (Figures 4.11 & 4.12). The diarrhea prevalence rates are almost the same in male children of age group 0 in both urban and rural areas. The highest rates are in age groups of 0 and 1 year and decrease from ages 2 to 6 years. Children with diarrhea of age group 0 living in urban areas exhibit a major divide in gender with males having much higher prevalence rate than females of age group 0 whereas there is not much gender divide in children of age 0 living in rural areas. Females aged 1 year have high prevalence rate of diarrhea than male children in both urban and rural areas.

Figure 4.11: Prevalence Rate of Diarrhea Morbidity by Age Controlling for Gender (Urban Areas) (%)



Source: Computed from PPHS 2010

Figure 4.12: Prevalence Rate of Diarrhea Morbidity by Age Controlling for Gender (Rural Areas) (%)



Source: Computed from PPHS 2010

The prevalence rates of diarrhea morbidity among children under-six years for male/female, rural/urban areas and the four provinces of the country are given in Table 4.7. The urban/rural prevalence of diarrhea remain unchanged here as well, as there is much higher rate of diarrheal morbidity in rural areas than in urban areas. The highest rates of diarrhea are observed in Sindh with not much difference between genders.

Table 4.7: Prevalence Rate of Diarrhea Morbidity among Children (0-6), By Rural/Urban Area and Province

	Urban			Rural			
	Male	Female	Total	Male	Female	Total	Total
Punjab	2.2	6.7	4.3	6.6	5.9	6.3	5.7
Sindh	13.5	11.9	12.6	18.6	18.3	18.5	17.0
KP*	10.1	4.5	8.0	10.9	10.1	10.5	9.9
Baluchistan	8.2	11.1	9.6	10.3	15.0	12.5	11.5
Pakistan	8.5	8.6	8.6	11.6	12.3	11.9	11.0

** Significant at 5%*

Source: Computed from PPHS 2010

Balochistan is the second highest in occurrence of diarrhea with female children being more ill with diarrhea than male children. In KP males residing in urban areas are reported with diarrhea more than females, whereas in rural areas there is no difference between male and female. KP followed by Punjab with lowest rates of diarrhea and females residing in urban areas have higher rates of diarrhea than males. The diarrheal rates among Children by mothers education is given in the **Appendices table D.**

4.5 Conclusions:

This chapter gives a detailed description of the sample characteristics of the PPHS 2010 survey and the distribution of selected housing WATSAN facilities among provinces and urban-rural areas. The households with piped water source were 46% while 54% have other sources of drinking water. Toilet facilities with flush system were available to almost 58% of the surveyed households and the remaining 41% are deprived of proper flush system. Only 11% of the households reported to have a covered drainage system while 29% have open drainage system and majority of the households that is 59% have no drainage system. The prevalence rates for total morbidity, ill with water borne diseases and diarrhea among children are analyzed by their demographic and geographic differentials. About 28% of the population reported ill (total ill), for males and females this proportion is approximately 27% and 29% respectively. It was found that age groups 0-14 years have the highest levels of illness followed by age group of 60+ years (27%). In age differentials it was observed that generally younger age groups have high prevalence of diseases in all the selected illnesses as 0-14 years for total ill and water borne diseases and for diarrhea ages 0 and 1 year. As expected rural areas have higher occurrence of all the selected diseases than in urban areas. According to data large proportion of population from Punjab reported with morbidity, KP population reported more for water borne diseases and Sindh has the highest prevalence for diarrhea. After acquiring the information of selected characteristics of sampled population it would be convenient to measure the effects of WATSAN facilities on the selected diseases in the next chapters.

Chapter Five
WATSAN and Health Analysis

Health varies with different socioeconomic, demographic and environmental characteristics. It is important for the current study to analyze the association of different socioeconomic and environmental factors on health. In this chapter firstly a detailed analysis is done on the effects of housing WATSAN facilities on health through bivariate analysis. The association is measured through three indicators: total population reporting ill; population reporting ill with water borne diseases; and children reporting ill with diarrhea according to the PPHS 2010. To have a further insight into these factors a multivariate analysis is done using logistic regression.

5.1 Effects of Housing WATSAN Facilities on Health: A Bivariate Analysis

In this section a bivariate analysis is done on three housing WASTAN facilities, namely, source of drinking water, type of toilet facility and type of drainage facilities on selected morbidity indicators. Each WATSAN facility is analyzed on three categories that are total ill population, population ill with diarrhea and population ill with water borne diseases.

5.5.1 Source of Drinking Water:

Adequate sanitation, safe and clean drinking water and appropriate toilet facilities are vital for the health of both children and adults. The access to proper piped water in the household can directly benefit in lowering the incidence of Illness like diarrhea in children and other water borne diseases like jaundice and intestinal problems (Mehmood, 2002). In the current study water borne diseases include jaundice and intestinal problems

Table 5.1 gives the rates of population reported ill by sex, place of residence and source of drinking water. In contrast to the literature it is observed that population with piped/motor pump source of drinking water are more likely to fall ill than the ones with other "unsafe sources"[12]. The reason can be the total ill contains diseases that might not be caused by the lack of WATSAN facilities **(the percentage distribution all the diseases covered in PPHS 2010 are given in Appendices Table 5A).** Whereas more females are reported to get ill than the males and a trend in urban/rural areas has also been seen where urban population is better off than rural population, this can be because according to PPHS 2010 data rural population reported with higher morbidity rates than urban population.

Table: 5 .1 Proportion of Population reporting ill by sex, place of residence and source of drinking water (%)

	Piped/Motor Pump			Others			Difference		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Urban	27.4	28.1	27.7	26.7	27.1	26.9	**0.7**	**1**	**0.8**
Rural	29.8	31.7	30.7	27.1	28.9	28	**2.7**	**2.8**	**2.7**
Total	28.6	29.9	29.2	26.9	28	27.4	**1.7**	**1.9**	**1.8**

Source: Computed from PPHS 2010

Research has indicated that contaminated water used for washing, bathing, and food preparation purposes can increase the chance of catching infections/diseases especially diarrhea among children (Mahmood, 2002)[13]. Table 5.2 shows the incidence of diarrhea with source of drinking water is evident, as households with piped/ motor pump source are less likely to have diarrhea than those with other sources of water supply. Regional differences can also be seen with urban population having a favorable edge over the rural population. There is no significant difference in diarrheal morbidity and source of drinking water among gender, as male children are reporting negligibly higher to fall ill with diarrhea in others category than the female children.

[12] Complete definitions are given in the Chapter 4

[13] In addition to diarrhea information on childhood fever was also obtained both the Bivariate and multivariate analysis for child hood fever are given in the Appendices tables (5 -A,B,C,D,E,f &G)

Table 5.2: Children (0-6 age group) reported with diarrhea by sex, place of residence and source of drinking water

	Piped/Motor Pump			Others			Difference		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Urban	6.1	9.5	7.7	9.6	8.7	9.1	**-3.5**	**0.8**	**-1.4**
Rural	10.7	10.7	10.7	13.3	13.1	13.2	**-2.6**	**-2.4**	**-2.5**
Total	8.6	10.2	9.4	12.7	12.3	12.5	**-4.1**	**-2.1**	**-3.1**

Source: Computed from PPHS 2010

When looking at the difference a total of 3 percentage points can be observed with urban at difference of 1.4 and rural 2.5 percentage points, the higher incidence of diarrhea in rural areas can be because majority of the rural households reported a lack of piped source of water.

Source of drinking water along with the place of residence (urban/rural) and gender has been observed for water borne diseases (Table 5.3). it ca be observed in the table that the difference between the probability to fall ill with Waterborne diseases is slightly more(0.2 % points) more in "other" category than in the piped/motor source.

Table 5.3: Population reporting ill with water borne diseases by sex, place of residence and source of drinking water (%)

	Piped/Motor Pump			Others			Difference		
Region	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Urban	1.4	1.3	1.4	1.9	1.3	1.6	**-0.5**	**0**	**-0.2**
Rural	1.7	1.8	1.7	1.8	2	1.9	**-0.1**	**-0.2**	**-0.2**
Total	1.6	1.6	1.6	1.8	1.9	1.8	**-0.2**	**-0.3**	**-0.2**

Source: Computed from PPHS 2010

There was no significant difference found for male and females, where females reported negligibly higher rates of waterborne diseases than their male counterparts (difference of 0.1 % point).

In the current study we have assumed that piped/motor pump source of water is cleaner and more reliable than the other sources whereas in Pakistan and many other developing countries there is a possibility that maybe water is coming from an already contaminated source (Arif & Ibrahim, 1998). Various researches have indicated that the water storage, water handling and its route from tap to mouth is more significant in determining the quality of the water (Esrey et al., 1994) than its end source. Due to lack of data on these factors in the PPHS 2010 looking into their effects is beyond the scope of this study.

These water borne diseases are observed across different age groups as well (Table 5.4). In the age groups 0-6 there is no difference observed in individuals falling ill with water borne diseases whether they are residing in households with piped/motor pump water supply or other sources of drinking water. While in rest of the age groups (4-14, 15-60, 60+) individuals residing in households with piped/motor pump water supply are less likely to fall ill with water borne diseases than those residing in households with other water sources.

Table 5.4: Population reporting ill with water borne diseases by age groups and source of drinking water (%)

Age Groups	Piped/Motor Pump	Others	Total
0-6	1.5	1.5	1.5
7--14	1.5	1.8	1.7
15-60	1.7	1.9	1.8
61+	1.0	1.8	1.4
Total	1.6	1.8	1.7

Source: Computed from PPHS 2010

There is a slight expected trend where individuals living in households with piped/motor pump supply of water were less likely to fall ill with water borne diseases than individuals living in households with other sources of water supply.

5.1.2: Type of Toilet Facility:

Toilet facilities are very important for the health and hygiene of both, children and adults. Studies have indicated that the proper use of flush toilets can reduce risk of infections (Mahmood, 2002). The use of proper flush system in a household will ensure a proper disposal of human excreta (feaces and urine) thus reducing the feaco-oral transmission of pathogens. Table 5.5 shows the rates of population reported ill by sex, place of residence by type of toilet facility.

Table 5.5:Population reporting ill by Sex, Place of Residence by Type of Toilet Facility (%)

	Flush System			Others			Difference		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Urban	26.3	27.6	27	28.6	24.2	26.5	**-2.3**	**3.4**	**0.5**
Rural	27.8	29.4	28.6	28.4	30.5	29.4	**-0.6**	**-1.1**	**-0.8**
Total	26.7	27.1	26.9	28.4	30.5	29.4	**-1.7**	**-3.4**	**-2.5**

Source: Computed from PPHS 2010

It is shown in the table above that the population with proper flush system in their households are less likely to report ill (27%) than the population with other system (29%). More females reported to be ill than male population and individuals residing in rural households are more likely to fall ill as compared to those residing in urban households. When the difference is observed it can be seen that a total of 2.5 percentage points difference is present between the probability of fall ill in households with no flush system, within rural households this difference is negligibly high (0.8 % Points).

Table 5.6 shows the incidence of diarrhea among children by the type of toilet facility in the house. Children having proper flush system were less likely to fall ill with diarrhea (9.7%) than those without the proper flush system (13.1%). Among the urban and rural households the probability of catching diarrhea among children is higher in the latter.

Table5.6: Children (0-6 age group) reported with diarrhea by sex, place of residence and type of toilet facility

	Flush System			Other			Difference		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Urban	6.9	8.2	7.6	8.7	13.5	11.2	**-1.8**	**-5.3**	**-3.6**
Rural	11.5	10.8	11.2	13.2	13.5	13.4	**-1.7**	**-2.7**	**-2.2**
Total	9.6	9.7	9.7	12.8	13.5	13.1	**-3.2**	**-3.8**	**-3.4**

Source: Computed from PPHS 2010

A total of 3.4 percentage difference was observed in the likelihood of children falling ill with diarrhea in houses with no flush system, in this the rural children showed less probability (2.2 % points) to fall ill with diarrhea than the children residing in urban households. This high urban diarrheal rates can be because when rural households don't have flush systems the population usually have vast open spaces (open fields/ farms) for defecation thus the probability of getting in contact with feces and the related disease transmission less. While the urban areas are usually congested, so the chance of getting in contact with the fecal material is higher.

The effects of toilet facility on water borne diseases are seen across gender and urban rural households. As observed earlier with source of drinking water, the population residing in households with flush system are less likely to fall ill with water borne diseases than the individuals residing in households without the access to the flush system (Table 5.7).

Table5.7: Population reported ill with water borne disease by sex, place of residence and type of toilet facility

	Flush System			Others			Difference		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Urban	1.5	1.3	1.4	1.7	1.3	1.5	**-0.2**	**0**	**-0.1**
Rural	1.8	1.8	1.8	1.7	2.1	1.9	**0.1**	**-0.3**	**-0.1**
Total	1.6	1.6	1.6	1.7	2	1.9	**-0.1**	**-0.4**	**-0.3**

Source: Computed from PPHS 2010

The table above shows that females are slightly more prone to fall ill with water borne diseases than males, reason might be because females spend more time indoors than their male counterparts as they are responsible for households chores (washing, cleaning, cooking) (Arif & Ibrahim, 1998). A total of 0.3-percentage point difference can be observed for falling ill with waterborne diseases in households with no toilet facility, while no difference between the urban and rural was reported. The water borne diseases has been observed between age groups with the availability of toilet facility (Table 5.8).

Table 5.8: Population reporting ill with water borne diseases by age groups and type of toilet facility (%)

Age Groups	Flush System	Others	Total
0-6	1.3	1.7	1.5
7--14	1.7	1.7	1.7
15-60	1.7	2.0	1.8
61+	1.3	1.7	1.4
Total	1.6	1.9	1.7

Source: Computed from PPHS 2010

As seen in the table above the general trend of population with the availability of proper flush system is safer from water borne diseases than the ones without it. With in age groups it can be seen that households with flush system are less probable to fall ill with water borne diseases than individuals living households with no system except for age group 7-14 years no difference has been observed. It has also been observed that all the age groups are affected by the type of the toilet facility but almost 50% reside in the younger age groups of 0-14 years (**Age group 0-6:**1.7 **+ Age group 7-14:** 1.7 **= 3.4)**, it can be because this age group is more likely to spend more time in their households.

5.1.3 Type of Drainage Facility

Like flush system drainage and sewage facility is equally important for the safe and proper disposal of human waste thus lowering the chances of infections/diseases. Research has suggested that improvement in proper sewage and sanitation facilities can reduce the chances of diarrheal and other diseases by 32% to 37% (Fewtrell et al., 2005 and Waddington, Snilstveit, 2009). A research carried out in Brazil found out that increase in sewerage coverage from 26% to 80% of the targeted population resulted in 22% reduction of diarrhea and other water borne diseases (Barreto et al., 2007).

Table 5.9 shows the rates of population reported ill by sex, place of residence by type of drainage facility. Results observed are contrary to the literary review, as results suggest that population with covered drainage system are more likely to report ill than the population with open drainage and no system.

Table 5.9: Population reporting ill by sex, place of residence by Type of Drainage Facility (%)

	Male	Female	Total
Covered Drainage System			
Urban	33.0	35.4	34.2
Rural	31.3	35.5	33.4
Total	32.1	35.5	33.8
Open Drain			
Urban	23.8	25.3	24.5
Rural	35.6	38.4	36.9
Total	29.7	31.8	30.7
No System			
Urban	26.2	22.8	24.6
Rural	25.7	27.1	26.3
Total	25.9	24.9	25.5

Source: Computed from PPHS 2010

As mentioned earlier in the chapter that PPHS 2010 covered diseases, which are, included in the total ill category that have no causative link to the drainage system, thus giving contrary results. The trend is seen in urban population (table 5.9) as urban population with no drainage system are less likely to report ill than the open drainage and covered drainage system.

Table 5.10 gives a view of diarrhea incidence among children of 0-6 years living in the households with covered drainage, open drain and those households with no drainage system. Highest incidence of diarrhea is found in children living in houses with no drainage system followed by children residing in houses with open drain and covered drainage system.

Table 5.10: Children (0-6 age group) reported with diarrhea by sex, place of residence and drainage and sewage facility

	Male	Female	Total
Covered Drainage System			
Urban	6.9	4.8	5.8
Rural	13.3	18.9	15.9
Total	9.3	10.0	9.7
Open Drain			
Urban	6.2	10.4	8.2
Rural	13.2	10.5	11.9
Total	9.8	10.5	10.1
No System			
Urban	9.4	10.7	10.0
Rural	12.2	12.4	12.3
Total	11.9	12.2	12.0

Source: Computed from PPHS 2010

An expected trend has been observed in urban and rural households where children of urban households with covered drainage system reported to have diarrhea at 5.8%, those urban households with open drain are at 8.2% and urban households with no system are at 10.7%.

Type of the drainage facility in relation to water borne disease has been observed in table 5.11 by males/females and urban/rural. A difference has been observed with the population with covered drainage system are at low risk of water borne diseases than with open drain and population with no system are at higher risk.

Table 5.11: Population reported ill (Rate) with water borne diseases by sex, place of residence and drainage and sewage facility

Covered Drainage System	**Male**	**Female**	**Total**
Urban	1.3	0.9	1.1
Rural	1.3	1.5	1.4
Total	1.3	1.1	1.2
Open Drain			
Urban	1.4	1.5	1.5
Rural	1.8	2.0	1.9
Total	1.6	1.8	1.7
No System			
Urban	2.0	1.3	1.6
Rural	1.8	2.0	1.9
Total	1.8	1.9	1.8

Source: Computed from PPHS 2010

The females reported to fall ill with waterborne diseases slightly higher than their male counterparts, suggesting the vulnerability of female population of getting affected by the housing environment than males. Similar trend can be observed between urban and rural population, latter at disadvantage as being more prone to disease (Table 5.11).

The table 5.12 shows the effect of the covered drainage system, open drain and no system of drainage on the water borne diseases.

Table 5.12: Population reporting ill with water borne diseases by age groups and drainage and sewage facility (%)

Age Groups	Covered Drainage System	Open Drain	No System	Total
0-6	1.0	1.7	1.5	1.5
7--14	1.0	1.5	1.9	1.7
15-60	1.4	1.8	1.8	1.8
61+	0.6	1.0	1.8	1.4
Total	1.2	1.7	1.8	1.7

Source: Computed from PPHS 2010

It is thus evident that the proper drainage system has a positive effect on the health of the individuals especially as in the case of water borne diseases. It has also been observed that the type of drainage and sewage facility affects all the age groups although almost 50% reside in the younger age groups of 0-14 years, it can be because this age group is more likely to spend time indoors as mentioned earlier.

5.2 Multivariate Analysis

The relative influence of different socioeconomic, demographic and environmental variables on the probability of population falling ill in 12 months prior to the 2010 PPHS survey is assessed in this section by a multivariate technique. The logit equation specified in Chapter 3 provided the basis for this assessment. For multivariate analysis, logistic regression is used due to dichotomous nature of the dependent variable that is having two outcomes. The explanatory variables included in the regression are selected due to their relevance in the existing literature. For logistic regression a reference category for every variable has to be setup for comparing it with the rest of the categories.

5.2.1 Logistic Regression Analysis of Population Reported Ill:

Results of logistic regression are given in Table 5.13 and reference categories are identified separately. The continuous variable of age shows that with each passing year the probability of population falling ill decreases by 0.91 times.

According to the results male are the benchmark category for gender and females are 1.98 times more likely to fall ill than males and these results are consistent with bivariate analysis. Results of population reporting ill with region of residence collaborate with bivariate analysis as urban is taken as the reference category where the probability of rural population falling ill is 1.83 times more.

Table 5.13: Shows Logistic Regression Analysis of Population reported Ill

Variable	Category	Coefficients	Odds Ratio
Age		-.085	.919
Sex			
	Male[Rc]	-	-
	Female	.014	1.986
Type of Residence*			
	Urban[Rc]	-	-
	Rural	.175*	1.839
Province*			
	Punjab[Rc]	-	-
	Sindh	.454*	1.574
	KP	.570*	1.769
	Baluchistan	.270*	1.310
Education of Head of the Household*			
	Illiterate[Rc]	-	-
	Primary	-.197*	.821
	Secondary & Matric	-.132*	.877
	College & Higher	-.250*	.779
Working Status*			
	Working[Rc]	-	-
	Nonworking	.476*	1.610

Annual Household Income		-.031	.969
Source of Drinking Water			
	Piped/Motor Pump^{Rc}	-	-
	Others	.031	1.032
Toilet Facility*			
	Flush System^{Rc}	-	-
	Others	-.288*	.750
Drainage System*			
	Covered Drain System^{Rc}	-	-
	Open Drain System	.223*	1.250
	No System	.624*	1.866
Constant		**.858**	
***Significant at 5%, **Significant at 10%**			
R^C Stands for Reference Category			
Percentage Predicting Correctly		**70.5%**	

Source: Computed from PPHS 2010

According to the results of place of residence Punjab is taken as reference category and all the other three provinces have high probability of people falling ill than Punjab. Sindh is 1.57 times, KP is 1.76 times and Balochistan is 1.31 times more likely having population falling ill than Punjab. As expected in the education of the head of the household as the education increases the probability of population falling ill decreases and in this section illiterate are considered as reference category. In working status working people are considered as reference category and nonworking population is 1.61 times more likely to fall ill. In annual household income which a continuous variable it is observed that with increase in annual household income there is a 0.96 times decrease in illness probability of the population.

The relation of WATSAN facilities with total ill population in bivariate analysis came out to be insignificant whereas in multivariate analysis the relationship is positive as shown in table. In housing environmental characteristics source of drinking water, type of toilet facility and type of drainage facility are taken into account. Source of drinking water has a positive and strong association with probability of falling ill, where piped water source is taken as reference category and population with other sources are 1.03 times more likely to fall ill. The probability of people living in households having other system (no flush system) is less likely to fall ill than people living in households with flush system (reference category). In drainage facility, covered drainage system is taken as reference category and it can be observed that people living in households with open drainage system are 1.25 times more likely to fall ill and the one with no drainage facility are 1.86 times more likely to fall ill.

In this model variables of sex and type of toilet facility are insignificant. Those factors are considered significant which are at the minimum of 0.05 level of confidence interval.

5.2.2 Logistic Regression Analysis of Population reported Ill with Water borne Diseases

The relationship of socioeconomic, demographic and environmental variables with the probability of population reporting ill with water borne diseases is shown in Table 5.14. For the age variable it is seen that with every one year increase in the age the probability of falling ill with water borne diseases increases by 1.0 times, so it is more likely to be reported in older ages than in children. Females are almost 0.94 times less likely to have water borne diseases than males (reference category).

According to the results of place of residence the population residing in rural areas are 1.65 times more likely to fall ill with water borne diseases than urban areas which is taken as reference category. Analysis of province, Punjab is taken as reference category shows that population in Sindh, KP and Balochistan are 1.49, 0.87, and 4.57 times more likely to have water borne diseases than Punjab.

Regarding education, individuals residing in households with head of the households having primary, secondary and college education are 0.76, 1.13 and 0.86 times less likely to have water borne diseases than the head of the household who is illiterate (reference category). In working status, working individuals are considered as reference category and nonworking have 1.34 times more probability of falling ill with water borne diseases as compared to working individuals.

Table 5.14: Shows Logistic Regression Analysis of Population reported Ill with Water borne Diseases

Variable	Category	Coefficients	Odds Ratio
Age*		.334	1.000
Sex			
	Male^{Rc}	-	-
	Female	-.057	.945
Type of Residence			
	Urban^{Rc}	-	-
	Rural	.422*	1.656
Province*			
	Punjab^{Rc}	-	-
	Sindh	.401*	1.493
	KP	-.129	.879
	Baluchistan	1.520*	4.570
Education of Head of the Household			
	Illiterate^{Rc}	-	-
	Primary	-.262	.769
	Secondary & Matric	.122	1.130
	College & Higher	-.147	.863
Working Status*			
	Working^{Rc}	-	-
	Nonworking	.295**	1.344
Annual Household Income*		.045	1.046
Source of Drinking Water			
	Piped/Motor Pump^{Rc}	-	-
	Others	-.131	.877
Toilet Facility*			
	Flush System^{Rc}	-	-
	Others	.087	1.091
Drainage System*			
	Covered Drain System^{Rc}	-	-
	Open Drain System	.263	1.769
	No System	.067	1.070
Constant		**4.293**	
***Significant at 5%, **Significant at 10%**			
R^C Stands for Reference Category			
Percentage Predicting Correctly		**70%**	

Source: Computed from PPHS 2010

According to the annual household income, the probability of population falling ill with water borne diseases increases 1.04 times with increase in annual household income.

The households, which have piped water as source of drinking water is taken as reference category and the households with other unsafe sources are 0.87 times more likely to have water borne diseases. It is also observed that the households with other facility (no flush system) have 1.09 times more probability of fall ill with water borne diseases than the households with flush system (considered as reference category). The drainage system of the households is divided into covered drainage system, open drain and no drain system. Covered drainage system is taken as benchmark category and the individuals residing in households with open drain and no drain system have 1.76 and 1.07 times more probability to fall ill with water borne diseases than the individuals residing in households with covered drainage system.

In this model variables of province, employment status, type of toilet facility and type of drainage facility are significant with the minimum of 0.05 level of confidence interval. While, the remaining variables are insignificant at 0.05 level of confidence interval.

5.2.3 Logistic Regression Analysis of Children reported Ill with Diarrhea:

Diarrhea morbidity in children under six years of age is estimated using logistic regression is shown in Table 5.15. Results in the table shows that the child's age to be strongly associated with diarrhea, there is a increase in the diarrhea morbidity with child's age, with every passing year the probability of children to have diarrhea increases 1.46 times.

The gender variable has a effect on the probability of diarrhea morbidity suggesting that females under six years are 0.82 times less likely than males to get diarrhea.

Table 5.15: Shows Logistic Regression Analysis of Children reported Ill with Diarrhea

Variable	Category	Coefficients	Odds Ratio
Age*		.382	1.466
Sex			
	Male[Rc]	-	-
	Female	-.199**	.820
Type of Residence*			
	Urban[Rc]	-	-
	Rural	.512*	1.669
Province*			
	Punjab[Rc]	-	-
	Sindh	1.307*	3.695
	KP	.962*	2.616
	Baluchistan	1.014*	2.758
Mothers Education			
	Illiterate[Rc]	-	-
	Primary	-.036	.965
	Secondary & Matric	-.069	.934
	College & Higher	-.269	.764
Annual Household Income		-.060	.942
Source of Drinking Water			
	Piped/Motor Pump[Rc]	-	-
	Others	-.126	.881
Toilet Facility*			
	Flush System[Rc]	-	-
	Others	.180	1.197
Drainage System*			
	Covered Drain System[Rc]	-	-
	Open Drain System	.460*	1.584
	No System	.009	1.991
Constant		**3.238**	
***Significant at 5%, **Significant at 10%**			
R^C Stands for Reference Category			
Percentage Predicting Correctly		**71%**	

Source: Computed from PPHS 2010

Type of residence has a positive and significant (at 5 percent level of confidence) effect on the probability of getting diarrhea, showing that children residing in rural areas are 1.66 times more likely than children residing in urban areas to have diarrhea morbidity. In provinces Punjab is considered as reference category and children in Sindh, KP and Balochistan are 3.69, 2.61 and 2.75 times more likely to get ill with diarrhea. The results of both provinces and urban/rural areas collaborates with the bivariate analysis. Mothers education show a negative effect on diarrhea, children of those mothers with primary, secondary and higher are less likely than the children of illiterate mothers (reference category) to get ill with diarrhea. In annual household income, it s observed that with the increase in household income the probability of children falling ill with diarrhea decreases 0.94 times.

The piped water is taken as reference category and it shows that households with other unsafe source of drinking water are 0.88 times less likely to fall ill with diarrhea. The pattern of risk according to toilet facilities was as expected. Children living in houses having proper flush system are less likely to be sick due to diarrhea than children with no such facilities. In terms of controlling diarrheal morbidity, sanitation and drainage facilities seem to be more important than water supply. Children living in households with open drainage system and no system are 1.58 and 1.99 times more likely than children living in households with covered drainage system (reference category) to get ill with diarrhea.

The variables of age, type of residence, province and drainage system are significant with the minimum of 0.05 level of confidence interval.

5.3 Conclusions

This chapter deals with measurement of effects of housing WATSAN facilities on health and its association with several socioeconomic, geographic and demographic factors.

Both bivariate and multivariate analyses are done for the measurement of effects of housing WATSAN facilities on health. In bivariate analysis of total ill population it is observed that the relationship with source of drinking water and type of drainage facility are negative. Households with piped water source are reported to be more ill and households with covered drainage system are more likely to fall ill whereas in multivariate analysis these relationships are observed to positive and mostly significant. The bivariate analysis of population reported ill with water borne diseases showed a positive trend with housing WATSAN facilities and so is a positive trend is observed in multivariate analysis. The children reported ill with diarrhea shows positive and significant results with housing WATSAN facilities in both bivariate and multivariate analysis. According to the multivariate results diarrheal and waterborne morbidity showed positive and significant relationship with type of toilet facility and type of drainage facilities whereas both these diseases showed negative results with source of drinking water.

Regionally it was observed that the probability of having diseases was found to be higher in rural areas. Same is the case observed with working status and gender variables where nonworking are more likely to fall ill than working and females are generally more prone to diseases than males. In annual household income the probability of falling ill decreased with higher income groups. Regarding education, individuals residing in households with head of the households having primary, secondary and college education were less likely to fall than the head of the household who is illiterate.

Chapter Six

Economic Cost of Illness

This chapter evaluates the direct and indirect economic costs of total morbidity, population reported ill with water borne diseases and children reported ill with diarrhea. Of all the categories direct cost of illness is estimated (total expenditure on treatment) and then indirect cost of illness is measured through lost days of activity and the source of financing for treatment.

Cost-of-illness is the economic burden of disease on individual or households that could have been saved if the disease were to be eradicated (WHO, 2009). Recent studies suggest that by improving the sanitation system it can save about $7 billion per year in health systems cost (Hutton & Haller, 2004). Studies carried out in Ghana and Pakistan suggests that improvement in environmental conditions could safe 8%-9% of GDP annually (Word Bank, 2008).

6.1 Direct Cost

The direct economic cost of illness is measured in terms of direct outlays of prevention, detection and prevention (Kirschstein, 2000). Direct medical costs include hospital inpatient, physician inpatient, physician outpatient, emergency department outpatient, nursing home care, hospice care, rehabilitation care, specialists' and other health professionals' care, diagnostic tests, prescription drugs and drug sundries, and medical supplies (Segel, 2006).

Percentage of population reporting being ill and the total expenditure on treatment by gender and type of residence is seen in Table 6.1. It is observed that mostly Rs.7001+ is being spent on the treatment of total illnesses. However, there is a slight difference of health expenditure on between urban and rural population, where almost 29% of urban population and 27% of rural population are spending Rs.7001+. Generally, urban population health expenditure is reporting to be slightly higher than rural population, despite the fact that according to PPHS 2010 data rural population reported with higher morbidity rates than urban population.

Table 6.1: Percentage of Population Reporting Ill by Total Expenditure on Treatment

		Health Expenditure							
Region	Sex	<500	500-1000	1001-2500	2501-4000	4001-7000	7001+		Mean Expenditure (Rs)
Urban									
	Male	18.6	13.2	20.9	7.4	11.3	28.7	100	10606
	Female	18.0	12.8	23.0	7.9	9.3	29.1	100	10954
	Both Sexes	18.3	13.0	21.9	7.6	10.3	28.9	100	10770
Rural									
	Male	17.2	15.3	18.7	9.6	11.8	27.5	100	7259
	Female	16.9	15.0	19.9	9.5	11.2	27.5	100	8920
	Both Sexes	16.9	15.0	19.9	9.5	11.2	27.5	100	8073

Source: Computed from PPHS 2010

As far as the gender is concerned, no significant difference is observed in health expenditures, although female health expenditure is negligibly higher than males that might be due to the fact that morbidity rates are reported higher in females.

In addition mean expenditures are also calculated, Rs.10770 by urban population and Rs.8073 by rural population are being spent on treatment annually. As mean expenditure amount is quite high it can be due to the reason that majority of the illnesses reported are of chronic in nature and tend to last long, requiring longer treatment periods. The other reasons of this high health expenditure can be the reference period of PPHS which is period of one year preceding the survey and these health expenditures include hospitalization cost, medicines cost and consultation fees.

High levels of childhood diarrheal morbidity was reported in PPHS 2010, these high levels creates economic burden on the affected households. Table 6.2 shows the population reporting Ill with diarrhea and the total expenditure on their treatment. It can be seen that majority of the population is spending Rs.7001+ on the treatment of diarrhea. Moreover, 37% rural population is spending Rs.7001+ that is significantly higher than urban population where almost 26% are spending Rs.7001+. It is observed that rural population is bearing more expenditure on treatment of diarrhea than urban population, as seen in the previous chapters that the incidence of diarrhea was high in rural areas because majority of the rural households reported a lack of proper WATSAN facilities.

Table 6.2: Percentage of Population Reported Ill with diarrhea by Total Expenditure on Treatment

Region	Sex	Health Expenditure							Mean Expenditure (Rs)
		<500	500-1000	1001-2500	2501-4000	4001-7000	7001+		
Urban*									
	Male	15.4	7.7	23.1	7.7	15.4	30.8	100	12177
	Female	28.6	21.4	14.3	7.1	7.1	21.4	100	12591
	Both Sexes	22.2	14.8	18.5	7.4	11.1	25.9	100	10903
Rural									
	Male*	17.7	14.5	21.0	3.2	14.5	29.0	100	8469
	Female	14.5	9.1	9.1	14.5	7.3	45.5	100	9794
	Both Sexes	16.2	12.0	15.4	8.5	11.1	36.8	100	9103

** Significant at 5%*

Source: Computed from PPHS 2010

A noteworthy difference can be seen between urban and rural female expenditure, as 45% rural females are spending Rs.7001+ while only 21% urban females are spending Rs.7001+ on treatment of diarrhea. These results show close relevance with high reporting of diarrheal morbidity in rural areas as well as poor availability/conditions of WATSAN facilities in those areas.

No significant difference can be observed between mean expenditure on treatment of diarrhea by urban and rural populations. However the mean expenditure is slightly higher of Rs.10903 by urban population than Rs.9103 by rural population, although it should have been other way around as incidence of diarrhea is higher in rural areas but keeping in mind that urban populations have more resources to finance their treatment. According to other similar studies the direct cost of a single episode of diarrhea can cost from Rs.679 ($6.4) to Rs7000 ($66.5) (Sowmyanarayanam et al, 2010 and Rheingans et al, 2012). So this high mean expenditure can be due to the fact that it is calculated over the span of a year and multiple episodes of diarrhea can happen, plus the expenditure counts for hospitalization cost, medicines cost and consultation fees.

Table 6.3 shows population reporting ill with water borne diseases and their total expenditure on health. Water borne diseases include jaundice and intestinal problems and these diseases can be chronic in nature thus can last long requiring longer treatment periods. In addition, these diseases are usually treated by specialist doctors that in turn leads to high cost of treatment.

Table 6.3: Percentage of Population Reported Ill with Water Borne Diseases by Total Expenditure on Treatment

		Health Expenditure							
Region	**Sex**	**<500**	**500-1000**	**1001-2500**	**2501-4000**	**4001-7000**	**7001+**	**Total**	**Mean Expenditure (Rs)**
Urban*									
	Male	8.8	3.5	12.3	8.8	14.0	52.6	100	17600
	Female	6.4	6.4	6.4	10.6	12.8	57.4	100	24755
	Both Sexes	7.7	4.8	9.6	9.6	13.5	54.8	100	20714
Rural									
	Male	5.2	2.6	12.3	11.0	20.6	48.4	100	13546
	Female	2.0	5.2	8.5	19.6	24.8	39.9	100	22281
	Both Sexes	3.6	3.9	10.4	15.3	22.7	44.2	100	17933

** Significant at 5%*

Source: Computed from PPHS 2010

Considering the nature of these water borne diseases it is observed that almost 50% of the population spends Rs.7001+, thus making mean expenditure higher. Treatment cost is higher for females residing in urban areas and males residing in rural areas as compared to their counter parts with apparent difference in mean expenditures of urban population (Rs.20714) and rural population (Rs.17933).

6.2 Indirect Cost:

The indirect cost represents loses in production or income due to number of days loss of employment/economic activity and it also includes the loss of future consumption because of impact on savings. In some studies it has been indicated that indirect costs has exceeded the direct cost of illness thus highlighting the significance of indirect costs (Russel, 2004).

Number of days lost of population reporting ill by sex and place of residence is shown in Table 6.4. In PPHS 2010 data most of the illnesses reported are of chronic nature and tend to last for longer durations for example heart diseases, diabetes, renal problems etc. so almost 44% of the population reporting ill are losing 31+ days annually.

Table 6.4: Number of days lost of population reporting ill by sex and place of residence

Days	Male			Female			Total		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Less than 7	34.9	33.8	34.3	33.8	31.8	32.8	34.3	32.8	33.5
7-14 Days	12.6	12.4	12.5	12.5	11.2	11.9	12.5	11.8	12.1
15-30 Days	9.6	7.4	8.6	9.6	9.3	9.4	9.6	8.3	8.9
31+ Days	42.9	43.9	43.4	44.1	47.7	45.9	43.5	45.8	49.6

Source: Computed from PPHS 2010

It can be observed that rural population tend to lose more days due to illness than urban population which might be due to the fact that health facilities are better in urban areas than rural areas. As far as the gender is concerned females are losing more days than their male counter parts, as morbidity rates are also higher in females.

As diarrhea has been seen in children from age group 0-6 years so there is not much economic activity (also in terms of schooling) in that age group. Various studies use the opportunity cost approach which assumes the economic value of unpaid work to be at least as much as the wage rate that the same person would command in the market place (Cooper & Rice, 1976). Table 6.5 shows number of days lost of population reporting ill with diarrhea by sex and place of residence. Here an assumption is made that the days lost are of mothers as usually they give up their routine activities to take care of the sick children.

Table 6.5: Number of days lost of population reporting ill with diarrhea by sex and place of residence

Days	Male			Female			Total		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Less than 7*	13.3	26.5	24.1	31.3	25.4	26.7	22.3	25.9	24.1
7-14 Days*	26.7	11.8	14.5	12.5	8.5	9.3	19.6	10.1	14.8
15-30 Days*	6.7	20.6	18.1	12.5	11.9	12	9.6	16.2	12.9
31+ Days	53.3	41.2	43.4	43.8	54.2	52	48.5	47.7	48.1

** Significant at 5%*
Source: Computed from PPHS 2010

It can be seen in the table above that females are losing more days than males and especially females residing in rural areas tend to lose more than females residing in urban areas. On a whole females are loosing more days than males but no significant difference can be observed on the basis of place of residence.

Table 6.6 shows the number of days lost to get back to the normal activity due to water borne diseases by sex and place of residence. As discussed earlier, water borne diseases so almost 75% of the population reporting ill with water borne diseases are losing 31+days per annum.

Table 6.6: Number of days lost of population ill with Water borne Diseases by sex and place of residence

Days	Male			Female			Total		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Less than 7	19.4	5.6	12.3	14.1	6.6	8.4	16.7	6.1	11.4
7-14 Days*	8.3	8.7	8.6	4.7	5.6	5.4	6.5	7.1	6.8
15-30 Days*	4.2	9.2	7.8	4.7	11.7	10	4.4	10.4	7.4
31+ Days	68.1	76.5	74.3	76.6	76.1	76.2	72.3	76.3	74.3

** Significant at 5%*
Source: Computed from PPHS 2010

As far as the regional divide is concerned rural population is loosing more days than urban population mainly due to the fact that living conditions are better in urban areas and also the improved availability and accessibility of health facilities.

Moreover, it can also be seen from the table above that females are losing more days than their male counterparts.

For the indirect cost of treatment the source of financing is taken in account as well that whether the households is paying for their treatment of illness from household income or from savings/loans/sales of assets. Table 6.8 shows the percentage of population that reported ill and their source of financing their treatment.

Table 6.7: Percentage of population Reported ill by Source of financing for their Treatment

Source of Financing	Urban	Rural	Total
Household Income			
Male	84.7	84.1	84.4
Female	84.3	83.4	83.8
Total	84.5	83.8	84.1
Saving/Loans/sales of Assets			
Male	15.3	15.9	15.6
Female	15.7	16.7	16.2
Total	15.5	16.2	15.8

Source: Computed from PPHS 2010

In the table above it is observed that 84% household pay from household income and almost 16% pay from their future income/ assets (savings/loans/sales of assets). A slight difference is also being observed between urban and rural populations, where rural populations pay more from their future income/assets (savings/loans/sales of assets).

The indirect cost of treatment of diarrhea is shown in Table 6.9, where 80% of the total expenditure is coming directly from the household income whereas 20% is from savings/loans/sales of asset. It shows that 20% of the households are paying the cost of treatment by foregoing their future income. The rural population has to forego their future income more than the urban population and it can also be observed that more is being spend for males than for their female counterparts.

Table 6.8: Percentage of population ill with Diarrhea by Source of financing for their Treatment

Source of Financing	Urban	Rural	Total
Household Income			
Male	90.0	77.6	79.4
Female	80.0	83.3	82.6
Total	84.0	80.4	81.0
Saving/Loans/sales of Assets*			
Male	10.0	22.4	20.6
Female	20.0	16.7	17.4
Total	16.0	19.6	19.0

** Significant at 5%*

Source: Computed from PPHS 2010

Indirect cost for the treatment of water borne diseases is shown in Table 6.10. Almost 77% are paying from the household income whereas almost 22% are foregoing their future income to pay for the treatment.

Table 6.9: Percentage of population ill with water borne diseases by Source of financing for their Treatment

Source of Financing	Urban	Rural	Total
Household Income			
Male	75.4	76.7	76.3
Female	83.0	77.7	78.8
Total	78.6	77.2	77.5
Saving/Loan/sales of Assets*			
Male	23.1	22.7	22.8
Female	17.0	21.8	20.8
Total	20.5	22.3	21.8

** Significant at 5%*

Source: Computed from PPHS 2010

As far as the future income is concerned rural population has to let go of it more than urban population, which might be due to the fact that rural population have lower monthly incomes than urban population.

6.3 Conclusions

This chapter evaluated the economic cost of illness through direct and indirect cost of illness. For majority of population reported ill (total ill), ill with diarrhea and ill with water borne diseases it is estimated that they spend around Rs.7001+ annually for treatment of their illnesses. Even the mean expenditures calculated for these illnesses are quite high majorly due to the fact that it is calculated over the span of a year, multiple episodes of diarrhea can happen and majority of the illness reported are chronic in nature thus requiring longer treatment periods and specialist doctor consultation. Generally for ill population and ill with water borne diseases the health expenditure is reporting to be slightly higher than rural population, despite the fact that according to PPHS 2010 data rural population reported with higher morbidity rates than urban population. Whereas, the rural population reported ill with diarrhea is bearing more expenditure on treatment than urban population which shows close relevance with high reporting of diarrheal morbidity in rural areas as well as poor availability/conditions of WATSAN facilities in those areas. In direct cost of treatment no specific preferences across genders are observed.

For indirect cost of treatment, number of days lost to get back to normal activity and source of financing is taken in to account. In accordance to the chronic nature of the illnesses reported, multiple episodes of diarrhea and nature of water borne diseases majority of the population with these illnesses are losing 31+ days annually. In all the illnesses it is observed that rural population tend to lose more days than urban population mainly due to the fact that living conditions are better in urban areas and also the improved availability and accessibility of health facilities. As far as the gender is concerned females are losing more days than their male counterparts, as morbidity rates are also higher in females. Population reported ill with diarrhea are aged 0-6 years so here it is assumed that the lost days of activity are of mothers as usually they give up their routine activities to take care of the sick child and it is observed that females residing in rural areas tend to lose more than females residing in urban areas.

Source of financing is taken as indirect cost of treatment as the population has to forgo their future income in form of savings, loan and sales of assets. Approximately 20% of the population has to let go their future income to pay for their treatment and generally rural population has to let go of it more than urban population, which might be due to the fact that rural population has lower monthly incomes than urban population. It is observed that more is being spent in form of savings, loans and sales of assets on rural male children than their female counterparts. Water borne diseases are reported to have the highest economic cost both direct and indirect cost as highest mean expenditure is calculated, highest number of lost activities days and also 22% of the population is paying from future income.

CHAPTER SEVEN

FINDINGS AND CONCLUSIONS

This chapter summarizes the study aimed to measure the impact of WATSAN facilities on health and the related direct and indirect economic cost. Main findings are discussed in this chapter.

7.1 Major Findings

7.1.1 Characteristics of Sampled Population:

The data used in this study is taken from Pakistan Panel of Household Survey 2010 that consisted of 4142 households with 2800 rural and 1342 urban households. The data contains in-depth information on health and WATSAN facilities.

The sample consists of 8693 individuals who reported ill during 12 months preceding the survey. About 28% of the population reported ill, for males and females this proportion was approximated 27% and 29% respectively. It was observed that age groups 0-14 years had the highest levels of illness followed by age group of 60+ years (27%). It was found that higher rates of population reported ill in rural households as compared to urban households. The highest rates of illness were seen in Punjab, approximately 32% suggesting a very high morbidity prevalence rate. The second highest morbidity was reported in province of Balochistan approximately 31% followed by Sindh and KP, which seemed to have the same morbidity prevalence rate (25% approximately).

The total sample population in PPHS 2010 with water borne diseases is 526 individuals. The water borne morbidity rates remained almost the same through different age groups, though in age group 0-6 years males were reported slightly higher than females. Whereas in other age groups of 7-14 years and 15-59 years females were reported marginally higher with water borne diseases than males. An expected pattern was observed as rural population reported more with water borne diseases than the urban population. In region of residence differentials females were reported to be more ill with water borne diseases than males in rural areas whereas in urban areas the trend was reversed for the two sexes. Not much difference was observed across age groups. In Punjab females were reported slightly less than males with water borne diseases and in Balochistan there were hardly any females reported where as in Sindh and KP females were observed to have reported more with water borne diseases than males. Highest share of water borne diseases were seen in KP, Punjab followed by Sindh and Balochistan.

Diarrhea was seen in children ages 0-6 years with 415 cases that were almost equally distributed in six ages. It showed 26% of the children with diarrhea were under 1 year and 26% had completed their first birthday. Children aged 0 and 1 years were reported with diarrhea more than other children and as the age increases the reporting of diarrhea decreases. For both male and female children diarrhea morbidity rate peaked at age 0 and 1 though at age 0 the rate was substantially higher for males than for females and vice versa for age 1. From ages 0 to 6 years it was observed that male children reported higher with diarrhea cases than female children except for the age of 1 year. Diarrheal morbidity prevalence rates reported higher in rural areas than in urban areas. The highest rates of diarrhea were observed in Sindh followed by Balochistan, KP and Punjab.

7.1.2 Effects of WATSAN facilities on Health

The relation of WATSAN facilities with total ill population in bivariate analysis came out to be insignificant whereas in multivariate analysis the relationship was positive. In housing environmental characteristics source of drinking water, type of toilet facility and type of drainage facility were taken into account. Source of drinking water had a positive and strong association with probability of falling ill, where piped water source was taken as reference category and population with other sources were 1.03 times more likely to fall ill. The probability of people living in households having other system (no flush system) were less likely to fall ill than people living in households with flush system (reference category). In drainage facility, covered drainage system was taken as reference category and it was observed that people living in households with open drainage system were 1.25 times more likely to fall ill and the one with no drainage facility were 1.86 times more likely to fall ill.

Regarding water borne diseases it was observed that households which had piped water as source of drinking water were taken as reference category and the households with other unsafe sources were 0.87 times more likely to have water borne diseases. It was seen that the households with other facility (no flush system) had 1.09 times more probability of fall ill with water borne diseases than the households with flush system (considered as reference category). The drainage system of the households was divided into covered drainage system, open drain and no drain system. Covered drainage system was taken as benchmark category and the individuals residing in households with open drain and no drain system had 1.76 and 1.07 times more probability to fall ill with water borne diseases than the individuals residing in households with covered drainage system.

In reference to diarrheal morbidity piped water was taken as reference category and it showed that households with other unsafe source of drinking water were 0.88 times less likely to fall ill. The pattern of risk according to toilet facilities was as expected. Children living in houses having proper flush system were less likely to be sick due to diarrhea than children with no such facilities. In terms of controlling diarrheal morbidity, sanitation and drainage facilities seemed to be more important than water supply. Children living in households with open drainage system and no system were 1.58 and 1.99 times more likely than children living in households with covered drainage system (reference category) to get ill with diarrhea.

7.1.3 Differentials of Health (total ill, water borne diseases and diarrhea) by Socio-Economic and Demographic Factors

The population reported ill was analyzed across all age groups and gender. Males were the benchmark category for gender and females were 1.98 times more likely to fall ill than males. Results of population reported ill with region of residence collaborated with bivariate analysis as urban was taken as the reference category where the probability of rural population falling ill was 1.83 times more. According to the results of place of residence Punjab was taken as reference category and all the other three provinces had high probability of people falling ill than Punjab. It was observed that as the education of the head of the household increases the probability of population falling ill decreases. It was estimated that nonworking population was1.61 times more likely to fall ill as compared to working people. Similar trends of decreasing illness probability in the higher income groups were observed.

Population reported with water borne diseases were seen across age groups, gender, place and region of residence, education of head of the household, working status and annual household income. Results showed that females and rural population reported more with water borne diseases, while the prevalence rates were highest in Punjab compared to rest of the provinces. As expected from previous results as the education level increases the incidence of disease decreases and it was the case with working status, non-working people were more probable to fall ill with water borne diseases than working people. While the annual income of households showed mixed results.

Diarrhea morbidity in children under six years of age showed that the child's age to be strongly associated with diarrhea, by region of residence the probability of diarrhea was found to be more in rural areas. Mother's education showed a negative effect on diarrhea, children of those mothers with primary, secondary and higher were less likely to fall ill with diarrhea than the children of illiterate mothers. Same was found for income groups, higher the annual income, less were the chances to fall ill with diarrhea.

7.1.4 Economic Cost of Illness

The economic cost of illness was estimated through direct and indirect cost. For majority of population reported ill it was estimated that they spend around Rs.7001+ annually for treatment of their illnesses. The expenditure incurred by population reported ill for their treatment was around Rs.9000. This direct cost of treatment for diarrhea and water borne diseases was estimated to be Rs.10,000 and Rs.19,000 respectively. For indirect cost of illness 59 mean days were lost by population reported ill (total ill), which translated into lost of Rs.6089 of their annual income. Moreover, due to diarrhea annual income lost Rs.1548 (15.8 mean days lost) and population reported with waterborne diseases (13 mean days lost) lost Rs.1393 of their annual income. In the source of financing for the selected diseases it showed that almost 20% of the population has to forgo their future income in form of savings, loan and sales of assets. Apart from total ill population, diarrhea reported to had the highest economic cost both direct and indirect cost as more days of activity were lost, expenditure was Rs.7000+ and also the future income had been forgone due to it.

7.2 Examining Hypotheses

After concluding the findings we can now accept or reject our hypotheses

- Housing water supply and sanitation facilities have an effect on the health of the individuals living in that household- **Accepted**
- The demographic factors significantly influence the WATSAN related diseases- **Accepted**
- The regional factors have a noticeable effect on WATSAN related diseases- **Accepted**

7.3 Conclusions

Health varies with different socioeconomic, demographic and environmental characteristics. The study analyzed the association of different socioeconomic and environmental factors on health. a detailed analysis was done on the effects of housing WATSAN facilities on health through bivariate analysis. The association was measured through three indicators: total population reported ill; population reported ill with water borne diseases; and children reported ill with diarrhea. For further insight into these factors a multivariate analysis was done using logistic regression.

One of the objectives of the study was to examine the association of various socioeconomic and demographic factors on health. Result showed that that these factors had a very strong association on health of the individuals measured through total ill population, population reported ill with water borne diseases and diarrhea. From the above findings it can be concluded that Pakistan's socioeconomic and demographic factors strongly affect health.

Another objective was to measure affects of WATSAN facilities on health. For the population reported ill (total ill), in the bivariate analysis no association with WATSAN facilities was observed. While in the multivariate analysis the probability of falling ill increased in populations living in households having no piped water source and no drainage system. Whereas the population reported ill with water borne diseases and diarrhea showed significant association for both bivariate and multivariate analysis where the likelihood of falling ill with these diseases increase significantly in the houses lacking both the proper toilet facility and covered drainage system. As for the unsafe source of drinking water, it showed no relation in increasing the likelihood of falling ill with diarrhea and water borne diseases. Thus the above finding shows that water borne diseases and diarrhea have more significant association with sanitation facilities rather than with source of drinking water.

7.4 Limitations

One of the major limitations of the current study is that the hygiene practice is not taken into account at both personal level and storage practices. The tap to mouth route of water intake involves the storage and water boiling practices which can turn safe water to unsafe water and vice versa, so they have significant effect on health but inclusion of these aspects are beyond the scope of the this study. Also the sanitation related non-water borne diseases are not covered. Time cost is an aspect of economic cost of illness but it is not dealt with in the current study due to data limitations.

7.5 Scope for Future Research

Based on the findings of the current study and the shortcomings of the existing literature few recommendations are made for future research:

- The current study found that water borne diseases and diarrhea have more significant association with sanitation facilities rather than with source of drinking water this can be because personal hygiene was not taken into account. Personal hygiene have significant effect on health which involves hand-washing practices, the storage and water boiling practices that should be taken in account in future researches.
- To further dig into the economic costs of diseases it is recommended that time costs should be considered in future studies. Conduct in-depth studies to review existing national WSH policies/initiatives, including enforcement and engagement programs.
- Studies should be carried out to evaluate, identify, develop and track leading indicators of WSH performance, which would help formulate more effective WSH initiatives.

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Appendices

Table:2 A Sanitation technologies with Description and exposure Pathways

Technology	Description	Exposure Pathways
Dry Toilet	A dry toilet operates without water. It may be a raised pedestal that the user can sit on, or a squat pan that the user squats over. In both cases, urine, faeces and anal cleansing materials and/or water are deposited in the toilet. Sanitizing additives and bulking materials may be applied to the faeces deposited in the toilet.	The user may sit on or squat over the dry toilet. Their individual habits relate to different exposure pathways, due to contact by the user and soiling of surfaces by earlier users. • Sitting on a pedestal may lead to direct contact but does not by itself create a greater exposure to excreta than squatting over a slab. • Poorly kept pedestals and squatting slabs become foci for disease transmission upon touching by hands with later contact with the mouth by soiled hands or stepping on soiled areas. • Soiled areas may transmit hookworm to subsequent individuals if they use the facility bare footed. Rough toilet floors are difficult to clean and faecal remaining may enhance the likelihood of contact. • Since there is no water seal for the dry toilet, flies and mosquitoes are able to access and breed in it. Besides being a nuisance, the flies and mosquitoes can act as mechanical vectors for the transmission of diseases. *Aedes* mosquitoes transmitting dengue may also breed in open compartments/containers for ablution water. • If the slab or toilet floor is not stable or well built, it may collapse or crack, exposing the user to greater levels of health hazards. Vulnerable groups such as the disabled, visually impaired, children and the aged are frequently in direct contact with different surfaces and are thereby more exposed. The aged may also fall more frequently during toilet visits and children often have more frequent hand-mouth contact. Soiled feet and shoes can carry faecal material to the home environment where further contamination and transmission may occur.
Pour Flush Toilet	A Pour-Flush toilet is a regular pedestal or squatting toilet where the user pours water in, after use. Normally 2-3 liters are sufficient. If freshwater is	The health risks relate to individual behavior and cleanliness of the toilet similar to other user interface alternatives. Vulnerable groups such as the aged and children are always at higher risk from contact with soiled surfaces. The water-seal is an effective barrier against mosquitoes and flies entering the toilet room. If water for flushing and anal cleansing is kept in open containers in

	not available, grey-water can alternatively be used for flushing. A U-bend below the pedestal or pan functions as a water seal to prevent insects and smells from exiting through the toilet.	the toilet room, the risk for mosquito breeding, like *Aedes* mosquitoes (transmitting dengue) is enhanced. If contaminated water like grey-water is used for flushing its quality determines if there is an additional risk due to accidental contact and ingestion.
Open Defecation/ open Latrine	Open defecation is ***not*** part of any sanitation system. However, certain habits of open defecation may relate to a reduced risk, or to reduced direct and indirect exposure through different pathways. Open defecation is practiced by billions of people mainly in developing countries. It is therefore brought up for comparative reasons. "Flying latrines" (wrap and throw) are when excreta are deposited in a bag, or wrapped in paper or similar and are thrown away or dropped at locations away from the home. "Open latrine" where the excreta are not covered should also be considered as open defecation. This often occurs at designated areas, usually in bushes/forest, at river/stream shores, beaches and on non-economic wastelands. Open spaces in uncompleted buildings located within residential areas are also sometimes	Open defecation is the most significant environmental factor in the transmission of excreta related diseases. Various transmission and exposure pathways are associated with this. The likelihood of direct contact is the prime one, but also i) contamination of drinking water sources ii) crops and soil and iii) breeding sites of disease transmitting vectors are of concern. The degree of exposure however varies considerably for different groups as well as with population density and seasons. The likelihood of exposure is always greater in densely populated areas, where children are the most vulnerable and have a higher frequency of contact with contaminated soils than adults. The impact on surface water directly and through storm water drains will occur due to open defecation including "flying latrines" in urban areas. A higher exposure to pathogens through drinking water may also occur in the rainy season compared to the dry season. Open latrines remain the single most important risk factor for trachoma disease

	used as 'open' latrines. 'Rotational defecation' is sometimes practiced, where community members move from previously used and highly faecally contaminated areas to less contaminated ones to fallow and allow for the decomposition of excreta.	
Bucket Latrine	A bucket latrine consists of a pedestal or seat drop hole with a bucket or pan placed in a chamber underneath. The user defecates into the bucket and when the bucket is full it is manually removed and emptied. The bucket may be placed inside a box or a chamber. The bucket chamber has a rear door that facilitates access and emptying when the bucket is full. The buckets are normally small (25 L – 30 L), and require frequent emptying, collection, and disposal to avoid overflows. Decomposition will normally be minimal (if not secondary storage occurs) and the content should be considered as fresh faecal material with associated risks. Secondary treatment will be needed.	The major exposure pathways, associated with the bucket latrines are related to the use and maintenance of the latrine as well as the collection and transportation of the excreta. Pathogens destruction is considered minor in the buckets. Without regular emptying, the bucket can overflow and expose users to pathogens. If the bucket is not stable, it can tip over and spill its contents, further exposing the user and community members to a high risk. Illegal emptying in gutters may occur. Bucket latrines may also provide breeding grounds for flies that can transport infectious materials from the toilet chamber into the home environment.
Pit Latrine	A single pit is a shaft, dug into the earth, which is either lined with reinforcing	A high groundwater table pit latrine will pollute groundwater (mainly with viruses and bacteria). Nitrate is also a major contaminant. The local geo- hydrological conditions (high

	materials (e.g. bricks) or left unlined. Lining prevents it from collapsing and provides support for the superstructure. Depending on its design and frequency of use, pit latrines can be used for up to 30 years though many are used for fewer than 5 years before they are full and must be emptied or covered.	groundwater table, fractured rocks or soil material with a high porosity) facilitate the percolation of pathogenic organisms, nitrate and dumped organic chemicals to the groundwater. These local geo-hydrological conditions and seasonality (rains or dry conditions) will be determinants for the extent of groundwater contamination. In the event of floods, pit latrines may also serve as sources of surface water contamination. Wet pit latrines may also become profuse breeding sites for *Culex quinquefasciatus,* which in some areas are vectors of bancroftian filariasis. Houseflies *can* act as mechanical vectors for the transmission of diarrheal causing organisms and breed in wet and unvented pit latrines

Source: Thor Axel Stenström, Razak Seidu, Nelson Ekane, and Christian Zurbrügg 2011.

Table 4A: Population reported Ill

Age Groups	**N**	**%**
0-6	1471	17.0
7-14	1600	18.5
15-59	5055	60.0
60+	567	6.6
Sex		
Male	4426	51.0
Female	4267	49.0
Region		
Urban	2436	28.1
Rural	6257	72.0
Province		
Punjab	3880	44.6
Sindh	2469	28.4
KP	1239	14.3
Baluchistan	1105	12.7
Working Status		
Working	2312	75.3
Not Working	759	24.6
Missing in Working Status (Ages 0-14)	3071	
Total Sample	**8693**	

Source: Computed from PPHS 2010

Table 4B: Population reported ill with Water Borne Diseases

Age Groups	**N**	**%**
0-6	70	14.0
7-14	85	16.0
15-59	347	66.0
60+	28	4.0
Sex		
Male	268	51.0
Female	257	49.0
Region		
Urban	129	24.6
Rural	396	75.4
Province		
Punjab	244	46.5
Sindh	160	30.5
KP	106	20.2
Baluchistan	15	2.9
Working Status		
Working	287	77.6
Not Working	83	22.4
Missing in Working Status (Ages 0-14)	156	
Total Sample	**526**	

Source: Computed from PPHS 2010

Table 4C: Children reported Ill with Diarrhea

Age Groups	**N**	**%**
0	108	26.0
1	108	26.0
2	76	18.2
3	61	14.8
4	35	8.5
5	21	5.1
6	6	1.5
Sex		
Male	229	55.1
Female	186	44.9

Region		
Urban	74	17.8
Rural	341	82.2
Province		
Punjab	85	20.5
Sindh	245	59.0
KPK	41	9.9
Baluchistan	44	10.6
Mother's Education		
Illiterate	337	81.3
Primary	33	8.0
Secondary & Matric	29	6.9
College & Higher	16	3.9
Total Sample	**415**	

Source: Computed from PPHS 2010

Table 4 D: Children (0-6 age group) reported with Diarrhea by sex, place of residence and Mother's Education

Mothers Education	URBAN			RURAL			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
No education	7.9	7.1	7.5	11.3	9.7	10.5	9.6	8.4	9.0
Primary	5.2	1.9	3.6	13.0	12.3	12.7	9.1	7.1	8.2
Sec & Matric	6.0	4.3	5.2	11.7	13.5	12.6	8.9	8.9	8.9
College & higher	6.0	1.9	3.9	10.3	13.3	11.6	8.1	7.6	7.8
Total	**7.2**	**5.7**	**6.5**	**11.4**	**10.2**	**10.8**	**9.3**	**7.9**	**8.7**

Source: Computed from PPHS 2010

Table 5 A: Percentage Distribution of Diseases Covered

Serial no	Diseases	Percentage Distribution
1	Injury	2.5
2	Respiratory Problem	3.9
3	TB	2.1
4	Intestinal Problem	1.8
5	Fever	39.7
6	Heart Problem /BP	10.2
7	Mental illness	1.1
8	Cataract/Other sight	1
9	Reproductive Health	3.7
10	Jaundice/Hepatitis	4.2
11	Measles	0.3
12	Renal/Kidney Problem	3.6
13	Diabetes	3.1
14	Others	20.4
15	Permanent Disability	1.7
16	Total	100

Source: Computed from PPHS 2010

Table5 B: Children (0-6 age group) reported with Fever by sex, place of residence and Source of Water Supply

	Male	Female	Total
Piped/Motor Pump			
Urban	7.3	7.5	7.4
Rural	13.7	16.6	15.1
Total	10.8	12.7	11.7
Others			
Urban	7.0	14.7	11.1
Rural	10.4	13.5	11.9
Total	9.8	13.7	11.8

Source: Computed from PPHS 2010

Table 5 C: Children (0-6 age group) reported with Fever by sex, place of residence and Toilet Facility

	Male	Female	Total
Flush System			
Urban	7.3	10.4	8.8
Rural	12.4	15.4	13.8
Total	10.3	13.3	11.7
Others			
Urban	6.5	9.6	8.2
Rural	10.7	13.8	12.2
Total	10.3	13.4	11.8

Source: Computed from PPHS 2010

Table 5 D: Children (0-6 age group) reported with Fever by sex, place of residence and drainage and sewage facility

	Male	Female	Total
Covered Drainage System			
Urban	6.9	7.9	7.4
Rural	8.4	8.1	8.3
Total	7.5	8.0	7.7
Open Drain			
Urban	6.2	7.6	6.9
Rural	11.0	15.6	13.3
Total	8.7	11.7	10.1
No System			
Urban	9.4	17.3	13.2
Rural	11.8	14.6	13.2
Total	11.5	14.9	13.2

Source: Computed from PPHS 2010

Table 5E: Population Reported ill with Fever by Toilet Facility

Age Groups	Flush System	Others	Total
0-5	16.4	16.9	16.6
6-14	12.5	14.1	13.2
15-60	9.0	10.6	9.6
61+	9.2	10.2	9.6
All	10.7	12.3	11.4

Source: Computed from PPHS 2010

Table 5F: Population Reported ill with Fever by Source of Water Supply

Age Groups	Piped/Motor Pump	Others	Total
0-5	18.3	15.5	16.6
6-14	15.5	11.4	13.2
15-60	10.3	9.0	9.6
61+	10.8	8.7	9.6
All	12.3	10.5	11.4

Source: Computed from PPHS 2010

Table 5G: Population Reported ill with Fever by Drainage Facility

Age Groups	Covered Drainage System	Open Drain	No System	Total
0-5	25.6	13.3	16.7	16.6
6-14	19.3	11.5	12.8	13.2
15-60	17.8	8.2	8.7	9.6
61+	19.3	9.2	8.3	9.6
All	19.1	9.6	10.8	11.4

Source: Computed from PPHS 2010

Table 5 H: Shows Logistic Regression Analysis of Population reported Ill with Fever

Estimates of determinants of fever by using Binary Logistic Regression			
Variable	**Category**	**Coefficients**	**Odds Ratio**
Age Groups			
	0-6[Rc]	-	-
	7-14	-.157	.855
	15-59	-.495	.610
	60+	-.438	.645
Sex			
	Male[Rc]	-	-
	Female	.094	1.099
Type of Residence*			
	Urban[Rc]	-	-
	Rural	-.462*	.630
Province*			
	Punjab[Rc]	-	-
	Sindh	-.224*	.799
	KP	.314*	1.369
	Baluchistan	-.976*	.377
Education of Head of the Household			
	Illiterate[Rc]	-	-
	Primary	-.047	.954
	Secondary & Matric	.021	1.021
	College & Higher	-.200	.818
Employment Status*			
	Employed[Rc]	-	-
	Unemployed	.367*	1.444
Source of Drinking Water			
	Piped/Motor Pump[Rc]	-	-
	Others	.015	1.015
Toilet Facility*			
	Flush System[Rc]	-	-
	Others	-.531*	.588
Drainage System*			
	Covered Drain System[Rc]	-	-
	Open Drain System	.396*	1.486
	No System	1.072*	2.920
***Significant at 5%, **Significant at 10%**			
R^C Stands for Reference Category			

Source: Computed from PPHS 2010